RTI INTERNATIONAL | Memorandum

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Subject: Baseline Operating Costs for Existing HMIWI
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I. Background

The U.S. Environmental Protection Agency (EPA), under sections 111 and 129 of the Clean Air Act (CAA), is required to regulate emissions of nine pollutants from hospital/medical/infectious waste incinerators (HMIWI): hydrogen chloride (HCl), carbon monoxide (CO), lead (Pb), cadmium (Cd), mercury (Hg), particulate matter (PM), dioxins/furans (CDD/CDF), nitrogen oxides (NO_X), and sulfur dioxide (SO_2). The regulation for the HMIWI category was promulgated on September 15, 1997 and subsequently remanded by the U.S. Court of Appeals for the D.C. Circuit on March 2, 1999. To respond to concerns raised by the Court regarding the methodology originally used to develop the 1997 regulation, EPA is re-developing the HMIWI regulation. In addition to developing compliance options to support that re-development, EPA is also exploring alternatives to compliance. The purpose of this memorandum is to show how the baseline operating costs for currently operating HMIWI compare to the primary alternative to compliance with the re-developed regulation, which is autoclaving and landfilling the waste.

II. Model Costs

This section presents the costs estimated for a series of model HMIWI for (1) the combustors currently being used to incinerate hospital/medical/infectious waste; (2) the emission controls currently being used to comply with the 1997 HMIWI regulation; (3) the monitoring, testing, recordkeeping, and reporting activities currently being used to demonstrate compliance with the 1997 regulation; and (4) the primary alternative to compliance with the re-developed regulation (i.e., autoclaving/landfilling). The model HMIWI include large, medium, small non-rural, and small rural units. Table 1 shows the basis for the development of the parameters for the model HMIWI (e.g., incinerator charge rate, stack gas flow rate, incinerator operating hours, and concentrations) were developed. Table 2 presents a summary of the model costs for combustors, emission controls, and the autoclave/landfill alternative.

A. Combustors

Combustor costs are presented for each model size in Table 3 and were estimated based on algorithms provided in the *Model Plant Description and Control Cost Report for HMIWI*.[1] The combustor capital costs from these algorithms were updated to 2007 dollars using the Chemical Engineering Plant Cost Index (CEPCI) and range from approximately $102,000 to $955,000.

The combustor annual costs were estimated in units of dollars per year ($/yr) and $/flow. The $/flow costs were calculated by dividing the $/yr control cost estimate for each model HMIWI by the gas flow rate for that model. The $/flow costs were used to calculate unit-specific control costs for each HMIWI, as discussed in section III of this memorandum. The combustor annual costs were updated to 2007 dollars using current estimates for unit costs and labor rates and range from approximately $54,800/yr to $366,000/yr. Updated unit costs for electricity, natural gas, and dust disposal were obtained from online sources.[2-4] A unit cost for water was obtained from the latest version of EPA's Air Compliance Advisor.[5] Current operating labor rates were estimated based on occupational employment statistics available online from the U.S. Bureau of Labor Statistics for several industries that use HMIWI, specifically the May 2007 mean hourly wage estimates for Stationary Engineers and Boiler Operators in the following sectors: General Medical and Surgical Hospitals; Waste Treatment and Disposal; Pharmaceutical and Medicine Manufacturing; and Colleges, Universities, and Professional Schools.[6] To determine an average operating labor rate for all HMIWI, a weighted average was taken of the aforementioned mean hourly wage estimates using the fraction of HMIWI located in each of those sectors.

B. Emission Controls

Emission control technologies that are currently being used to comply with the 1997 HMIWI regulation include packed-bed scrubbers, venturi scrubbers, fabric filters, dry scrubbers, electrostatic precipitators (ESPs), carbon adsorbers, selective noncatalytic reduction (SNCR), and activated carbon injection (ACI). This section presents the model costs that were estimated for these control measures.

As with the combustor costs, the emission control annual costs were estimated in units of $/yr and $/flow, with the $/flow costs used to calculate unit-specific control costs for each HMIWI, as discussed in section III.

1. Packed-bed scrubbers. Packed-bed scrubbers are used to reduce emissions of acid gases such as HCl from both medium and large HMIWI and also provide limited control of PM, metals, and SO_2 (if present at high enough concentrations). Model packed-bed scrubber costs are presented for the two model sizes in Table 4 and were estimated based on algorithms in the *Model Plant Description and Control Cost Report* for HMIWI and a memo update.[1,7] The packed-bed scrubber capital costs from these algorithms were updated to 2007 dollars using the CEPCI and range from approximately $328,000 to $453,000 for the medium and large models.

The packed-bed scrubber annual costs were updated to 2007 dollars using current estimates for unit costs and labor rates and range from approximately $65,700/yr to $104,000/yr (yr) for the medium and large models. The updated unit costs for electricity and caustic were

obtained from online sources.[2,8] Unit costs for water and sewage disposal were obtained from the latest version of EPA's Air Compliance Advisor.[5] Current operating labor rates were estimated based on the aforementioned occupational employment statistics available online from the U.S. Bureau of Labor Statistics.[6]

2. Venturi scrubbers. Venturi and other types of wet scrubbers (e.g., rotary atomizers) are used to reduce emissions of PM (and associated particulate metals) from large, medium, and small HMIWI and also provide some control of acid gases such as HCl and SO_2 (if present at high enough concentrations). For large HMIWI, these wet scrubbers are installed either alone (after the HMIWI) or after a dry scrubber/fabric filter, and the large model costs in this cost analysis are presented both ways. For the other model sizes, the wet scrubbers are installed alone. For the purposes of this cost analysis, venturi scrubbers were used to stand in for the other types of particulate wet scrubbers. Model venturi scrubber costs are presented for large, medium, and small HMIWI in Table 5 and were estimated based on algorithms in the *Model Plant Description and Control Cost Report* for HMIWI and a memo update.[1,7] The venturi scrubber capital costs from these algorithms were updated to 2007 dollars using the CEPCI and range from approximately $344,000 to $625,000 for the three models.

The venturi scrubber annual costs were updated to 2007 dollars using current estimates for unit costs and labor rates and range from approximately $78,400/yr to $192,000/yr for the three models. The updated unit costs for electricity and caustic were obtained from online sources.[2,8] Unit costs for water and sewage disposal were obtained from the latest version of EPA's Air Compliance Advisor.[5] Current operating labor rates were estimated based on the aforementioned occupational employment statistics available online from the U.S. Bureau of Labor Statistics.[6]

3. Fabric filters. Fabric filters are used to improve the PM (and associated particulate metals) emission control at two large HMIWI. Model fabric filter costs are presented for that model size in Table 6 and were estimated based on algorithms in the *Model Plant Description and Control Cost Report* for HMIWI.[1] The fabric filter capital costs from these algorithms were updated to 2007 dollars using the CEPCI and total approximately $1.02 million for the large model.

The fabric filter annual costs were updated to 2007 dollars using current estimates for unit costs and labor rates and total approximately $268,000/yr for the large model. Updated unit costs for electricity, compressed air, and dust disposal were obtained from online sources.[2,3,9] A unit cost for water was obtained from the latest version of EPA's Air Compliance Advisor.[5] Current operating labor rates were estimated based on the aforementioned occupational employment statistics available online from the U.S. Bureau of Labor Statistics.[6]

4. Dry scrubbers. Dry scrubbers are used in concert with fabric filters to reduce emissions of PM, as well as emissions of acid gases such as HCl. The predominant type of dry system used at HMIWI is a dry sorbent injection system followed by a fabric filter (DIFF). DIFF have been installed on both medium and large HMIWI. Model costs are presented for these two model sizes in Table 7 and were estimated based on algorithms in the *Model Plant Description and Control Cost Report* for HMIWI and a memo update.[1,10] The DIFF capital costs from these

algorithms were updated to 2007 dollars using the CEPCI and range from approximately $1.07 million to $1.36 million for the medium and large models.

The DIFF annual costs were updated to 2007 dollars using current estimates for unit costs and labor rates and range from approximately $206,000/yr to $347,000/yr for the medium and large models. Updated unit costs for electricity, lime, compressed air, and dust disposal were obtained from online sources.[2,3,9,11] A unit cost for water was obtained from the latest version of EPA's Air Compliance Advisor.[5] Current operating labor rates were estimated based on the aforementioned occupational employment statistics available online from the U.S. Bureau of Labor Statistics.[6]

5. Electrostatic precipitators. ESP's are used in concert with wet scrubbers to reduce emissions of PM (and associated particulate metals) at two large HMIWI. A dry ESP has been installed at one HMIWI, and a wet ESP at the other. Dry and wet ESP costs are presented for large model HMIWI in Table 8 and were estimated based on algorithms in the *OAQPS Control Cost Manual*.[12] The ESP capital costs from these algorithms were updated to 2007 dollars using the CEPCI and Vatavuk Air Pollution Control Cost Index (VAPCCI) and equal approximately $1.07 million for the dry ESP and $607,000 for the wet ESP.

The ESP annual costs were updated to 2007 dollars using current estimates for unit costs and labor rates and equal approximately $220,000/yr for the dry ESP and $158,000/yr for the wet ESP. Updated unit costs for electricity and dust disposal (for dry and wet ESPs) were obtained from online sources.[2,3] Unit costs for water and sewage disposal (for wet ESPs) were obtained from the latest version of EPA's Air Compliance Advisor.[5] Current operating labor rates were estimated based on the aforementioned occupational employment statistics available online from the U.S. Bureau of Labor Statistics.[6]

6. Carbon adsorbers. A carbon bed adsorber is used for Hg control at one large HMIWI (at East Carolina University). Carbon adsorber costs are presented for this specific HMIWI in Table 9 and were adapted from algorithms in the *OAQPS Control Cost Manual*.[13] For the purposes of this cost analysis, only the annual operating costs were estimated, which total approximately $6,800/yr for this specific HMIWI. (Because costs were estimated for a specific HMIWI, no $/flow estimates were developed.) In estimating the annual cost of the carbon for the carbon bed, the amount of carbon was assumed to be equivalent to that used in the ACI calculation in the section below. It was also assumed that the carbon is not regenerated (unlike more typical carbon adsorption units used to control organic emissions). Updated unit costs for virgin carbon and for spent carbon disposal were obtained from online sources.[3,14-16] Current operating labor rates were estimated based on the occupational employment statistics available online from the U.S. Bureau of Labor Statistics.[6]

7. Selective noncatalytic reduction. SNCR systems are used for NO_X emission control at two large HMIWI. NO_X reductions of 45 percent or higher are estimated for HMIWI using SNCR systems.[17] The costs for an SNCR system are presented for large model HMIWI in Table 10 and were estimated based on algorithms in the *OAQPS Control Cost Manual*.[18] The SNCR capital costs from these algorithms were updated to 2007 dollars using the CEPCI and total approximately $586,000 for the large model.

The SNCR annual costs were updated to 2007 dollars using current estimates for unit costs and labor rates and total approximately $67,900/yr for the large model. The unit cost for a 50 percent urea solution ($0.85/gallon [gal]) was also taken from the *OAQPS Control Cost Manual*.[18] Two other unit costs for urea were found online, but one cost (up to $0.46/gal) was based on delivery of dry urea (with the urea solution later mixed onsite), while the other cost ($0.60/gal) was over 5 years old.[19,20] To be conservative, the higher unit cost from the *OAQPS Control Cost Manual* was used. An updated unit cost for electricity was obtained from an online source.[2] A unit cost for water was obtained from the latest version of EPA's Air Compliance Advisor.[5] The average heating value of 8,500 British thermal units per pound (Btu/lb) of medical waste, used in the annual electricity cost equation, was obtained from the *Process Description Report* for HMIWI.[21]

The annual electricity cost for SNCR systems is also dependent on the NO_X concentration at the inlet to the SNCR system, which was estimated to be 0.28 lb/million Btu (MM Btu), based on the average of the NO_X concentration data for currently operating HMIWI. The NO_X concentration for each HMIWI was estimated (as shown in the following equation) using baseline emissions estimates developed in a separate memorandum:[22]

NO_X concentration (lb/MM Btu) = NO_X baseline emissions (lb/yr) / [operating hours per year (hr/yr) x incinerator charge rate (lb waste/hr) x heating value (8,500 Btu/lb waste)] x 10^6 Btu/MM Btu

8. Activated carbon injection system. Injecting activated carbon before the fabric filter or other particulate control device is used to improve the removal efficiency of both Hg and CDD/CDF at medium and large HMIWI. Activated carbon injection costs are presented for these two model sizes in Table 11 and were estimated based on algorithms in the *Model Plant Description and Control Cost Report* for HMIWI.[1] Capital costs for the ACI system were updated to 2007 dollars using the CEPCI and range from approximately $7,400 to $12,000 for the medium and large models.

Annual costs for the ACI system were updated to 2007 dollars using current estimates for unit costs and labor rates and range from approximately $12,500/yr to $56,300/yr for the medium and large models. Updated unit costs for activated carbon and dust disposal were obtained from online sources.[3,14-16] Current operating labor rates were estimated based on the occupational employment statistics available online from the U.S. Bureau of Labor Statistics.[6]

The factor of 0.00127 in the annual cost equation for dust disposal is based on an ACI rate capable of producing a carbon concentration of 338 milligrams per dry standard cubic meter (mg/dscm), which is expected to achieve reductions of 90 percent for Hg and 98 percent for CDD/CDF relative to inlet levels.[1]

C. Monitoring

1. Inspections. Under the 1997 HMIWI regulation, existing small rural HMIWI are required to conduct annual equipment inspections to compensate for the lack of annual emissions testing at those sources. The inspections include the incinerator, control device (if any), and monitoring equipment.

Information on equipment inspections was gathered for the 1997 regulation.[23] Four companies (one incinerator dealer, one maintenance contractor, and two incinerator manufacturers) were contacted for information on the types of activities normally conducted during an equipment inspection; the companies provided inspection cost estimates ranging from $350 to $800.[23] These costs were averaged and updated to 2007 dollars using the CEPCI to develop the inspection cost for small rural HMIWI ($900). (See Table 12.)

2. Parameter monitors. Monitoring of operating parameters is used to indicate whether air pollution control equipment and practices are functioning properly to minimize air pollution. The 1997 HMIWI regulation includes parameter monitoring requirements for good combustion, wet scrubbers, dry scrubbers with fabric filters, and wet/dry scrubber combinations. Where applicable, the model costs associated with these parameter monitoring requirements are presented in Table 13.

The monitoring costs presented in this memorandum include the costs to monitor the parameters, plus any ancillary equipment costs (e.g., computer, data logger/computer interface, logging and reporting software, and printer) and other costs. (Some of the other costs include planning, selecting the type of equipment, providing support facilities, installing and checking the equipment, conducting performance specification tests, preparing a quality assurance/quality control [QA/QC plan], and recordkeeping and reporting.)

The 1997 regulation requires HMIWI to monitor the following parameters:

- All HMIWI: monitor charge rate and secondary chamber temperature, to demonstrate good combustion practices
- HMIWI equipped with wet scrubbers: monitor flue gas temperature, pressure drop across the wet scrubber (or the horsepower or amperage to the wet scrubber), scrubber liquor flow rate, and scrubber liquor pH
- HMIWI equipped with DIFF: monitor fabric filter inlet temperature, and HCl sorbent (i.e., lime) flow rate
- HMIWI equipped with ACI: monitor Hg and CDD/CDF sorbent (i.e., activated carbon) flow rate

Consequently, the monitoring costs developed for the 1997 regulation included costs for the following:[24]

- All HMIWI: costs for weight scale and thermocouple wire
- HMIWI equipped with wet scrubbers: costs for thermocouple wire, signal wire, pressure transducer, liquid flow transducers, and controller element and transmitter for pH meter
- HMIWI equipped with DIFF: costs for thermocouple wire and labor to monitor and record lime flow
- HMIWI equipped with ACI: labor costs to monitor and record activated carbon flow

The parameter monitoring costs estimated for the 1997 regulation were updated to 2007 dollars using the CEPCI and latest labor rates and rounded to the nearest $100. Good combustion monitoring costs were estimated to be $6,000 for the small rural model. Wet scrubber monitoring costs were estimated to range from $7,700/yr to $11,000/yr for the small, medium, and large models. DIFF monitoring costs were estimated to range from $8,300/yr to $14,900/yr for the medium and large models. FF monitoring costs ($10,100/yr for the large model) were estimated the same as those for DIFF, but do not include the cost to monitor HCl sorbent flow rate. Wet/dry scrubber combinations include a combination of the costs for wet scrubbers and DIFF. DIFF/WS monitoring costs were estimated to be $16,000/yr for the large model. For the purposes of this cost analysis, the monitoring costs for the large HMIWI equipped with DI-ESP/WS, WS/WESP, and CA/WS were assumed to be similar to the monitoring cost for DIFF/WS, except that the WS/WESP and CA/WS monitoring costs ($11,200/yr for the large model) would not include the cost to monitor HCl sorbent flow rate. ACI monitoring costs were estimated to range from $1,600/yr to $4,800/yr for the medium and large models.

Two large HMIWI currently use SNCR systems and would be expected to monitor ammonia or urea injection rate. Costs to purchase and install an ammonia injection rate sensor with data acquisition system and data reduction were estimated by EPA in August 2008.[25] These SNCR monitoring costs were adapted to the cost format in Table 11 and rounded to the nearest $100. The SNCR monitoring cost for the large model was estimated to be $3,100/yr.

D. Stack Testing

Under the 1997 HMIWI regulation, HMIWI are required to:

- Small rural HMIWI: Demonstrate ongoing compliance with the emission limit for opacity by conducting annual opacity stack tests.
- All other HMIWI: Demonstrate ongoing compliance with the emission limits for HCl, CO, PM, and opacity by conducting annual stack tests for those pollutants.

Annual stack test costs developed for each EPA test method for the 1997 regulation were updated to 2007 dollars using the CEPCI, adjusted as necessary to conform to the range of more recent, typical test costs, and rounded to the nearest $1,000 (except for the less expensive opacity test, which was rounded to the nearest $100).[24,26,27] The updated and adjusted stack test costs are presented in Table 14 for all model HMIWI. Annual stack test costs were estimated at $12,000 for EPA Method 5 (PM); $2,500 for EPA Method 9 (opacity); and $7,000 each for EPA Methods 10 (CO) and 26 (HCl).

E. Recordkeeping and Reporting Costs

The 1997 HMIWI regulation imposes the following recordkeeping and reporting burden on HMIWI:

- Annual update of operating information—1 person-hour
- Review of operating information with each operator (assume 2 operators)—16 person-hours

- Annual report of CMS operating parameters—32 person-hours
- Annual report of no exceedances—8 person-hours per pollutant (1 pollutant small rural; 4 pollutants all other HMIWI)
- Annual report of performance test results—8 person-hours (small rural); 40 person-hours (all other HMIWI)
- Records of startup, shutdown, and malfunction (weekly)—1.5 person-hours
- Records of persons completing review of operating information (assume 2 operators)—2 person-hours
- Records of operating parameters (weekly)—0.5 person-hours (small rural); 1.5 person-hours (all other HMIWI)
- Records of CMS operation and maintenance (daily)—0.025 person-hours
- Time to train personnel (EPA Methods 9 and 22)—40 person-hours

Some of these burden items apply to all HMIWI, while others apply to only certain HMIWI (e.g., small rural units). The burden estimate for reporting CMS operating parameters (32 person-hours) was determined by dividing the cost to certify CMS ($1,400/yr) by the composite hourly labor rate ($43.60/hr). The cost to certify CMS was based on an estimate for the 1997 regulation.[24] That cost estimate was updated to 2007 dollars using the CEPCI. The composite hourly labor rate was determined (as shown in the following bullets) based on occupational employment statistics available online from the U.S. Bureau of Labor Statistics, which were adjusted upwards by 60 percent to include overhead and profit.[6]

- Technical labor rate (natural resources, construction, and maintenance) = (total compensation of $23.47/hr) x (overhead and profit rate of 1.6) = $37.55/hr
- Management labor rate (management, professional, and related) = (total compensation of $49.23/hr) x (overhead and profit rate of 1.6) = $78.76/hr
- Clerical labor rate (sales and office) = (total compensation of $13.19/hr) x (overhead and profit rate of 1.6) = $21.10/hr
- Composite hourly labor rate = (technical labor rate) + (0.05 x management labor rate) + (0.1 x clerical labor rate) = $43.60/hr

The management and clerical burden for each HMIWI were estimated at 5 and 10 percent of the technical burden, respectively. The recordkeeping and reporting costs for each HMIWI were estimated by multiplying the technical, management, and clerical burden estimates by their respective labor rates and summing the costs. The results are presented in Table 15.

F. Autoclave/Landfill Alternative to Compliance

The primary alternative to the compliance options listed above is onsite autoclaving, followed by landfilling the waste. The costs for this alternative are presented for each model HMIWI in Table 16 and were estimated using cost estimates provided by an autoclave vendor and an online source.[28,29]

Cost estimates from the vendor included capital costs for the sterilizer and compactor; operational costs for chamber liners, labor, capital expense, maintenance, steam, and electricity;

and hauling costs; the vendor also provided costs for a biological indicators test (including test kit).[28] Inspection costs and permit fees were obtained from an online source.[29]

The hauling costs from the vendor were revised to extract landfill costs. National average landfill tip fees from the 2005 Tip Fee Survey prepared by the National Solid Wastes Management Association (NSWMA) were then used to estimate model landfill costs.[3] The total annual autoclave/landfill costs in Table 16 are presented in $/lb of waste and in $/yr. Calculation of the costs in $/yr assumes each model HMIWI operates at two-thirds of its capacity. The $/yr costs range from $9,100/yr to $205,000/yr.

III. Nationwide Costs

The size of the combustor (large, medium, small, small rural) and the types of emission controls currently employed at each HMIWI were used to determine the baseline operating costs. See Table 17 for the size category assigned to each HMIWI (consistent with the HMIWI size definitions in the 1997 regulation) and the list of emission controls currently employed at each HMIWI. The model costs associated with combustor operation and emission controls were assigned to the 57 HMIWI, based on which size category (large, medium, small non-rural, small rural) the HMIWI belonged. For example, large model costs for a combustor, DIFF, and ACI systems would be applied to a large HMIWI using a DIFF and ACI system to comply with the 1997 regulation. Combustor and emission control costs were applied on a unit-specific basis by using model $/flow values, which were multiplied by unit-specific flow rates to determine $/yr. Note: Indirect annual costs (e.g., capital recovery costs) for combustors and emission controls were not included in the assigned model costs; in a comparison of baseline operating costs to autoclave/landfill costs, the indirect annual costs for combustors and emission controls already in place would be incurred regardless of whether that equipment is still used. In addition to combustor and emission control costs, monitoring costs associated with DIFF and ACI systems were also applied. Table 17 shows the combustor, emission control, and monitoring cost estimates applied to each HMIWI and presents nationwide totals. Combustor costs were estimated to be approximately $16 million/yr (including $15 million/yr for the large units; $1.2 million/yr for the medium units; $220,000/yr for the small units; and $92,000/yr for the small rural units). Control costs were estimated to be approximately $10 million/yr (including $9.5 million/yr for the large units; $710,000/yr for the medium units; and $65,000/yr for the small units). There are no control costs for the small rural units, which employ only good combustion. Monitoring costs were estimated to be approximately $530,000/yr (including $440,000/yr for the large units; $84,000/yr for the medium units; $11,000/yr for the small units; and $8,400/yr for the small rural units).

Stack testing costs were also assigned to individual HMIWI, based on their testing requirements under the 1997 regulation. For example, costs for PM, CO, HCl, and opacity tests were applied to all of the large, medium, and small HMIWI, which are required to test for those pollutants on an annual basis. The total cost for multiple stack tests such as these was adjusted by two-thirds to account for travel, accommodations, test methods/sampling trains, etc. that are common to the various stack tests.[30] (Opacity tests are the exception since that test method cannot be combined with any others.) Because small rural HMIWI are only required to test for opacity on an annual basis, only the costs for opacity tests were applied to those units. Table 17 presents the testing costs assigned to all 57 HMIWI (approximately $710,000/yr for the large units;

$340,000/yr for the medium units; $40,000/yr for the small units; and $5,000/yr for the small rural units, for a nationwide total of $1.1 million/yr).

Recordkeeping and reporting costs were assigned based on which HMIWI would be required to conduct those activities under the 1997 regulation. For example, small rural HMIWI were assigned lower costs for submitting annual reports and keeping records of operating parameters compared to all other units because the requirements for small rural HMIWI under the 1997 regulation are less stringent (fewer pollutants to test, fewer parameters to monitor). Table 17 presents the recordkeeping and reporting costs assigned to all 57 HMIWI (approximately $550,000/yr for the large units; $260,000/yr for the medium units; $30,000/yr for the small units; and $23,000/yr for the small rural units, for a nationwide total of $860,000/yr).

Including the costs of emission controls, monitoring, testing, and recordkeeping/reporting, the total nationwide costs at baseline were estimated at approximately $29 million/yr (including $26 million/yr for the large units; $2.6 million/yr for the medium units; $370,000/yr for the small units; and $130,000/yr for the small rural units).

Costs for the primary alternative to compliance (i.e., autoclaving and landfilling the waste) were also assigned to each HMIWI, so that the costs for this alternative could be compared to the total baseline operating costs for each HMIWI. Regional average landfill tip fees from NSWMA's 2005 Tip Fee Survey were used in estimating the nationwide autoclave/landfill costs.[3] For example, the regional average tip fee for the Mid-Atlantic region was used in estimating the autoclave/landfill costs for HMIWI in Maryland, Pennsylvania, and West Virginia. An autoclave/landfill cost (in $/yr) was calculated for each HMIWI by taking the applicable model autoclave cost (in $/lb of waste) and regional average tip fee (in $/ton of waste), converting them into compatible units, and multiplying them by the annual operating hours and charge rate for the HMIWI (assuming each HMIWI operates at two-thirds of its capacity). See Table 17 for a comparison of autoclave/landfill costs with baseline operating costs for each HMIWI and nationwide. As shown in Table 17, autoclave/landfill costs are approximately $11 million/yr (including $10 million/yr for large units; $540,000/yr for medium units; $40,000/yr for small units; and $18,000/yr for small rural units). The nationwide autoclave/landfill costs are lower than the baseline operating costs by nearly 65 percent nationwide (lower by about 60 percent for large, 80 percent for medium, 90 percent for small, and 85 percent for small rural units).

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Table 1. Basis for Model HMIWI Parameters

FACID	UNITID	Facility name	Unit number	City	State	Category	New/ existing	APCD code	APCD type	APCD description	Maximum charge rate (lb/hr)
1	1	Bristol-Myers Squibb Co.		Wallingford	CT	L	E	FF	Dry	Secondary chamber (1800F) and baghouse	1,000
5	5	Merck & Company, Inc.		Rahway	NJ	L	E	DIFF	Dry	Secondary chamber (1500F, 1 sec), partial quench, dry acid gas scrubber with dry lime injection, and baghouse	799
15	15--1	Curtis Bay Energy	Unit 1	Baltimore	MD	L	E	DIFF	Dry	Secondary chamber, dry scrubber, and baghouse	7,083
15	15--2	Curtis Bay Energy	Unit 2	Baltimore	MD	L	E	DIFF	Dry	Secondary chamber, dry scrubber, and baghouse	7,083
36	36--1	Merck & Company, Inc.	Unit 2	West Point (Upper Gwynedd Township)	PA	L	E	DIFF	Dry	Secondary/tertiary chamber (2000F, 2 sec), water quench followed by sodium bicarbonate injection system with dry reaction chamber and pulse-jet baghouse	2,000
36	36--2	Merck & Company, Inc.	Unit 5	West Point (Upper Gwynedd Township)	PA	L	E	DIFF	Dry	Secondary chamber (1800F, 2.2 sec), water quench followed by sodium bicarbonate injection system and pulse-jet baghouse	3,045
40	40	Charleston Area Medical Center, General Hospital		Charleston	WV	L	E	DIFF	Dry	Secondary chamber (1800F, 2 sec), dry injection/baghouse scrubber system with activated carbon	1,000
42	42	Stericycle, Inc.		Apopka	FL	L	E	DIFF	Dry	Secondary chamber (1800, 1 sec), dry scrubbing system with quench chamber, passive absorber, lime and carbon injection, and baghouse.	1,900
51	51	Lakeland Regional Medical Center		Lakeland	FL	L	E	DIFF	Dry	Secondary chamber (1800F, 1 sec), lime injection system, and baghouse	750
60	60--1	BMWNC, Inc.	Unit 1	Matthews	NC	L	E	DIFF	Dry	Secondary chamber (1641F), dry scrubber with lime and activated carbon injection, and baghouse	1,500
84	84	Mayo Clinic, Waste Management Facility		Rochester	MN	L	E	DIFF	Dry	Secondary chamber (1800F, 1 sec) and baghouse with lime and carbon injection	2,000
87	87	MedCentral Health System, Mansfield Hospital		Mansfield	OH	L	E	DIFF	Dry	Secondary chamber (1800F, 2 sec) and baghouse with lime and carbon injection system	600
109	109	Healthcare Environmental Services Inc.		Fargo	ND	L	E	DIFF	Dry	Secondary chamber (1800F) and dry scrubber/baghouse system with lime and carbon injection	1,686
120	120--1	Municipality of Chambers County, Resource Recovery Center	Unit 1	Anahuac	TX	L	N	DIFF	Dry	Secondary chamber, baghouse with virgin lime injection, urea injection, and activated carbon injection	4,167
120	120--2	Municipality of Chambers County, Resource Recovery Center	Unit 2	Anahuac	TX	L	N	DIFF	Dry	Secondary chamber, baghouse with virgin lime injection, urea injection, and activated carbon injection	4,167
29	29	Hamot Medical Center		Erie	PA	L	E	DIFF/WS	Dry/wet	Secondary chamber (2000F, 2 sec), lime injection system, powdered activated carbon injection system, baghouse, and vertical upflow two-stage multi-microventuri scrubber system	1,060
55	55	St. Joseph's Hospital		Tampa	FL	L	E	DIFF/WS	Dry/wet	Secondary chamber (1800F, 1 sec), lime injection, baghouse, and venturi scrubber	1,500
110	110	Stericycle, Inc.		North Salt Lake	UT	L	E	DI-ESP/WS	Dry/wet	Secondary chamber (1834F), carbon injection system, ESP, dry scrubber, and wet scrubber	1,935
125	125	East Carolina University, Health Sciences Campus, HSC Utility Plant		Greenville	NC	L	N	CA/WS	Dry/wet	Secondary chamber (1985F), rotary atomizing wet scrubber (with NaOH scrubbing medium), carbon bed adsorber, HEPA filtering system, and heat recovery system	1,000
20	20--1	Fort Detrick	Unit 5	Fort Detrick	MD	L	E	WS	Wet	Secondary chamber and rotary atomizing wet scrubber	1,000
20	20--2	Fort Detrick	Unit 6	Fort Detrick	MD	L	E	WS	Wet	Secondary chamber and rotary atomizing wet scrubber	1,000
43	43	Boca Raton Community Hospital		Boca Raton	FL	L	E	WS	Wet	Secondary chamber (1800F, 1 sec) and rotary atomizing wet scrubber system with caustic soda injection	730
44	44	Bethesda Memorial Hospital		Boynton Beach	FL	L	E	WS	Wet	Secondary chamber (1800F, 2 sec) and rotary atomizing scrubber with mist eliminator	1,000

Table 1. Basis for Model HMIWI Parameters

FACID	UNITID	Facility name	Unit number	City	State	Category	New/ existing	APCD code	APCD type	APCD description	Maximum charge rate (lb/hr)
46	46	Holy Cross Hospital		Fort Lauderdale	FL	L	E	WS	Wet	Secondary chamber (1800F, 1 sec) and venturi scrubber with packed bed absorption unit using dilute NaOH	1,300
48	48	Memorial Regional Hospital		Hollywood	FL	L	E	WS/WESP	Wet	Secondary chamber (1800F, 1 sec), packed column gas scrubber, and wet ESP	1,800
54	54	Bayfront Medical Center		St. Petersburg	FL	L	E	WS	Wet	Secondary chamber (1800F, 1 sec) and flux force/condensation collision scrubber system using dilute NaOH	1,500
59	59--1	Stericycle, Inc.	Unit 1	Haw River	NC	L	E	WS	Wet	Secondary chamber (1800F, 1 sec), rapid gas quench system, wet scrubber system consisting of a packed bed absorber and venturi scrubber, and demister.	1,911
59	59--2	Stericycle, Inc.	Unit 2	Haw River	NC	L	E	WS	Wet	Secondary chamber (1800F, 1 sec), rapid gas quench system, wet scrubber system consisting of a packed bed absorber and venturi scrubber, and demister.	1,911
65	65--1	Stericycle, Inc.	Unit 1	Clinton	IL	L	E	WS	Wet	Secondary chamber (1800F), venturi scrubber, and condensing absorber	1,500
65	65--2	Stericycle, Inc.	Unit 2	Clinton	IL	L	E	WS	Wet	Secondary chamber (1800F), venturi scrubber, and condensing absorber	1,500
71	71	Loyola University Medical Center		Maywood	IL	L	E	WS	Wet	Two secondary chambers (1600F), twin rotary atomizer scrubber using 50% caustic solution, and two demister pads	1,650
77	77	Parkview Hospital		Fort Wayne	IN	L	E	WS	Wet	Secondary chamber and wet scrubber	1,200
94	94	Stericycle, Inc.		Warren	OH	L	E	WS	Wet	Secondary chamber (1800F, 2 sec), wet scrubber	1,400
98	98--1	University of Texas Medical Branch		Galveston	TX	L	E	WS	Wet	Secondary chamber, packed tower, and venturi scrubber with activated carbon injection	1,500
106	106	Stericycle, Inc.		Kansas City	KS	L	E	WS	Wet	Secondary chamber (1800F, 2 sec), wet scrubber	1,500
130	130	Department of Veterans Affairs Medical Center		Miami	FL	L	E	WS	Wet	Secondary chamber (1800F, 1 sec), venturi scrubber, and packed tower absorber	1,000
						Avge L					**1,500**
						Avge L, dry					
						Avge L, wet					
38	38	Wilkes-Barre General Hospital		Wilkes-Barre	PA	M	N	DIFF	Dry	Secondary/tertiary chambers (1800F, 2.85 sec) and dry scrubber/baghouse with lime and activated carbon injection	400
63	63	St. Jude Children's Research Hospital		Memphis	TN	M	E	DIFF	Dry	Secondary chamber (1528F) and baghouse with sodium bicarbonate and carbon injection	500
95	95	St. Joseph's Hospital		Marshfield	WI	M	E	DIFF	Dry	Secondary chamber (1800F), quench tower, and baghouse with lime/carbon injection	500
13	13	University of Maryland at Baltimore, Environmental Health and Safety Facility		Baltimore	MD	M	E	WS	Wet	Secondary chamber (1832F) and venturi caustic scrubber with packed-bed scrubber	500
16	16	Johns Hopkins Medical Institute, Department of Health, Safety, and Environment		Baltimore	MD	M	E	WS	Wet	Secondary chamber (1800F) and venturi wet scrubber followed by saturation chamber and mist eliminator	320
18	18	Franklin Square Hospital Center		Baltimore	MD	M	E	WS	Wet	Secondary chamber (1800F) and venturi scrubber followed by quench chamber and mist eliminator	500
21	21	Washington County Hospital		Hagerstown	MD	M	E	WS	Wet	Secondary chamber and venturi caustic scrubber	500
25	25	Holy Spirit Hospital		Camp Hill	PA	M	E	WS	Wet	Secondary chamber (1800F) and venturi scrubber with prequench and NaOH injection	500
30	30	Riddle Memorial Hospital		Media	PA	M	E	WS	Wet	Secondary chamber (1800F, 2 sec), caustic packed tower scrubber, and high pressure venturi, with activated carbon injection	500
34	34	Pennsylvania State University, Animal Diagnostic Lab Incinerator		State College	PA	M	E	WS	Wet	Secondary chamber (1900F) and rotary atomizing wet scrubber with demister	500
41	41	Thomas Memorial Hospital		South Charleston	WV	M	E	WS	Wet	Secondary chamber (1800F) and venturi packed tower wet scrubber with caustic injection	470
47	47	Malcolm Randall Veterans Affairs Medical Center		Gainesville	FL	M	E	WS	Wet	Secondary chamber (1800F, 1 sec) and wet scrubber with caustic soda injection	495
81	81	South Bend Medical Foundation		South Bend	IN	M	E	WS	Wet	Secondary chamber and wet scrubber	470

Table 1. Basis for Model HMIWI Parameters

FACID	UNITID	Facility name	Unit number	City	State	Category	New/ existing	APCD code	APCD type	APCD description	Maximum charge rate (lb/hr)
82	82	Good Samaritan Hospital		Vincennes	IN	M	E	WS	Wet	Secondary chamber and multi-chamber spray scrubber	500
88	88	Medina General Hospital		Medina	OH	M	E	WS	Wet	Secondary chamber (1800F, 1 sec) and wet scrubber	300
108	108--1	Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases	Unit 1	Hamilton	MT	M	E	WS	Wet	Secondary chamber and wet scrubber	500
111	111	Wyoming Medical Center		Casper	WY	M	E	WS	Wet	Secondary chamber and wet scrubber	400
						Avge M					**500**
						Avge M, dry					
						Avge M, wet					
86	86	Fairfield Medical Center		Lancaster	OH	S	E	WS	Wet	Secondary chamber (1800F, 1 sec) and wet scrubber	95
129	129	Centers for Disease Control and Prevention--Clifton, Building 18	Unit 3	Atlanta	GA	S	N	WS	Wet	Secondary chamber (1800F, 1.68 sec) and rotary atomizing wet scrubber	120
						Avge S					**108**
115	115	Kona Community Hospital		Kealakekua	HI	SR	E	CC	Comb ctrl	Secondary chamber (1900F, 2 sec), no APCD	200
116	116	Yukon-Kuskokwim Delta Regional Hospital		Bethel	AK	SR	E	CC	Comb ctrl	Secondary chamber, no APCD	50
						Avge SR					**125**

Notes:
1. Assumed values are highlighted in yellow.
2. For dry APCD, 95% HCl control assumed based on average % HCl control (96.59%) for several of the HMIWI in database equipped with dry APCD, and 99% PM control assumed based on % Pb and Cd control (99.6% and 99.2%) for a recently shutdown HMIWI (Northwest Hospital Center) equipped with a dry APCD.
3. For wet APCD, 99% HCl control assumed based on % HCl control (99.29%) for an HMIWI in database equipped with a wet APCD, and 85% PM control assumed based on % Pb and Cd control (87.2% and 88.4%) for a recently shutdown HMIWI (Northwest Hospital Center) equipped with a dry APCD.

Table 1. Basis for Model HMIWI Parameters

FACID	UNITID	Facility name	Unit number	Stack gas flow rate (dscfm)	Stack gas temperature (°F)	Operating hours (hr/yr)	HCl (ppmvd)	HCl % reduction	HCl unc. (ppmvd)	PM (gr/dscf)	PM % reduction	PM unc. (gr/dscf)	NO_X (lb/yr)	NO_X (lb/hr)	NO_X (lb/lb waste)
1	1	Bristol-Myers Squibb Co.		1,648	217	2,072	65.7			0.00180	99.00%	0.180	2,273	1.10	0.0011
5	5	Merck & Company, Inc.		7,346	246	4,321	0.780			0.00330	99.00%	0.330	19,121	4.43	0.0055
15	15--1	Curtis Bay Energy	Unit 1	27,698	296	8,736	85.2	93.19%	1,251	0.00823	99.00%	0.823	226,518	25.93	0.0037
15	15--2	Curtis Bay Energy	Unit 2	30,578	303	8,736	76.9	92.27%	994	0.00407	99.00%	0.407	237,734	27.21	0.0038
36	36--1	Merck & Company, Inc.	Unit 2	5,235	358	865	4.22			0.00156	99.00%	0.156	2,090	2.42	0.0012
36	36--2	Merck & Company, Inc.	Unit 5	8,119	304	5,753	3.75			0.00255	99.00%	0.255	21,826	3.79	0.0012
40	40	Charleston Area Medical Center, General Hospital		4,323	312	1,248	26.6			0.00106	99.00%	0.106	2,452	1.96	0.0020
42	42	Stericycle, Inc.		7,008	327	7,951	27.1			0.00203	99.00%	0.203	39,974	5.03	0.0026
51	51	Lakeland Regional Medical Center		3,323	212	6,247	2.68			0.00254	99.00%	0.254	9,015	1.44	0.0019
60	60--1	BMWNC, Inc.	Unit 1	6,763	343	7,456	38.8	96.24%	1,031	0.00504	99.00%	0.504	24,601	3.30	0.0022
84	84	Mayo Clinic, Waste Management Facility		6,516	294	6,240	15.2	96.93%	497	0.0137	99.00%	1.367	35,973	5.76	0.0029
87	87	MedCentral Health System, Mansfield Hospital		2,351	260	3,120	24.8			0.00357	99.00%	0.357	4,418	1.42	0.0024
109	109	Healthcare Environmental Services Inc.		4,478	302	1,872	72.5			0.00611	99.00%	0.611	8,612	4.60	0.0027
120	120--1	Municipality of Chambers County, Resource Recovery Center	Unit 1	10,031	296	7,896	11.0	98.76%	888	0.00702	99.00%	0.702	28,677	3.63	0.0009
120	120--2	Municipality of Chambers County, Resource Recovery Center	Unit 2	9,028	291	7,896	5.30	99.11%	594	0.00947	99.00%	0.947	31,733	4.02	0.0010
29	29	Hamot Medical Center		3,701	122	2,080	16.6			0.00174	99.00%	0.174	6,563	3.16	0.0030
55	55	St. Joseph's Hospital		3,347	400	8,008	12.5			0.00111	99.00%	0.111	14,483	1.81	0.0012
110	110	Stericycle, Inc.		6,291	126	7,309	3.93			0.00449	99.00%	0.449	67,691	9.26	0.0048
125	125	East Carolina University, Health Sciences Campus, HSC Utility Plant		3,124	125	625	1.58	99.996%	43,053	0.00323	99.00%	0.323	845	1.35	0.0014
20	20--1	Fort Detrick	Unit 5	2,424	87	1,300	0.190			0.00721	85.00%	0.048	3,068	2.36	0.0024
20	20--2	Fort Detrick	Unit 6	2,308	92	1,300	0.353			0.00775	85.00%	0.052	3,068	2.36	0.0024
43	43	Boca Raton Community Hospital		2,078	91	8,736	0.986			0.0104	85.00%	0.069	15,052	1.72	0.0024
44	44	Bethesda Memorial Hospital		4,537	106	3,024	0.608			0.00960	85.00%	0.064	8,102	2.68	0.0027

Table 1. Basis for Model HMIWI Parameters

FACID	UNITID	Facility name	Unit number	Stack gas flow rate (dscfm)	Stack gas temperature (°F)	Operating hours (hr/yr)	HCl (ppmvd)	HCl % reduction	HCl unc. (ppmvd)	PM (gr/dscf)	PM % reduction	PM unc. (gr/dscf)	NO_X (lb/yr)	NO_X (lb/hr)	NO_X (lb/lb waste)
46	46	Holy Cross Hospital		3,378	124	2,964	1.18			0.0103	85.00%	0.069	4,403	1.49	0.0011
48	48	Memorial Regional Hospital		4,568	143	4,992	1.02			0.00973	85.00%	0.065	20,301	4.07	0.0023
54	54	Bayfront Medical Center		2,898	133	3,352	0.947			0.00543	85.00%	0.036	8,694	2.59	0.0017
59	59--1	Stericycle, Inc.	Unit 1	4,002	135	8,400	4.24			0.00714	85.00%	0.048	37,888	4.51	0.0024
59	59--2	Stericycle, Inc.	Unit 2	3,917	138	8,400	3.88			0.0102	85.00%	0.068	37,888	4.51	0.0024
65	65--1	Stericycle, Inc.	Unit 1	3,304	143	7,665	1.12			0.00921	85.00%	0.061	27,136	3.54	0.0024
65	65--2	Stericycle, Inc.	Unit 2	3,125	141	7,558	1.43			0.00878	85.00%	0.059	26,757	3.54	0.0024
71	71	Loyola University Medical Center		3,526	156	4,800	2.22			0.0105	85.00%	0.070	11,087	2.31	0.0014
77	77	Parkview Hospital		2,766	114	8,395	2.68	99.29%	380	0.0109	85.00%	0.073	23,777	2.83	0.0024
94	94	Stericycle, Inc.		2,737	138	7,904	0.661			0.00617	85.00%	0.041	26,118	3.30	0.0024
98	98--1	University of Texas Medical Branch		4,534	111	5,328	2.12			0.0147	85.00%	0.098	12,637	2.37	0.0016
106	106	Stericycle, Inc.		3,590	152	8,760	0.567			0.00828	85.00%	0.055	31,014	3.54	0.0024
130	130	Department of Veterans Affairs Medical Center		6,422	155	4,160	8.32	99.00%	832	0.0111	85.00%	0.074	13,396	3.22	0.0032
				3,959	**154**	**5,997**	**3.82**	**98.76%**	**888**	**0.007**		**0.108**			
					291		**24.83**	**96.59%**		**0.004**					
					127		**1.12**	**99.15%**		**0.010**					
38	38	Wilkes-Barre General Hospital		2,063	274	4,472	8.95	95.00%	179	0.00399	99.00%	0.399	4,222	0.94	0.0024
63	63	St. Jude Children's Research Hospital		2,333	276	1,050	27.5	95.00%	551	0.00505	99.00%	0.505	1,648	1.57	0.0031
95	95	St. Joseph's Hospital		1,634	223	1,404	5.27	95.00%	105	0.00294	99.00%	0.294	1,657	1.18	0.0024
13	13	University of Maryland at Baltimore, Environmental Health and Safety Facility		1,972	189	1,440	0.708	99.00%	71	0.0126	85.00%	0.084	1,652	1.15	0.0023
16	16	Johns Hopkins Medical Institute, Department of Health, Safety, and Environment		1,890	179	1,350	1.39	99.00%	139	0.0294	85.00%	0.196	1,328	0.98	0.0031
18	18	Franklin Square Hospital Center		2,999	54	5,408	1.48	99.00%	148	0.0256	85.00%	0.170	10,116	1.87	0.0037
21	21	Washington County Hospital		1,834	112	2,496	6.26	99.00%	626	0.0197	85.00%	0.131	2,946	1.18	0.0024
25	25	Holy Spirit Hospital		1,702	99	3,944	0.736	99.00%	74	0.0164	85.00%	0.110	4,654	1.18	0.0024
30	30	Riddle Memorial Hospital		1,730	239	2,920	2.10	99.00%	210	0.0124	85.00%	0.083	3,398	1.16	0.0023
34	34	Pennsylvania State University, Animal Diagnostic Lab Incinerator		2,117	175	1,022	1.27	99.00%	127	0.0239	85.00%	0.159	1,206	1.18	0.0024
41	41	Thomas Memorial Hospital		1,526	146	2,080	2.62	99.00%	262	0.0261	85.00%	0.174	1,870	0.90	0.0019
47	47	Malcolm Randall Veterans Affairs Medical Center		1,645	115	1,664	4.69	99.00%	469	0.0173	85.00%	0.115	2,670	1.60	0.0032
81	81	South Bend Medical Foundation		2,325	121	2,028	12.3	99.00%	1,230	0.01159	85.00%	0.077	460	0.23	0.0005

Table 1. Basis for Model HMIWI Parameters

FACID	UNITID	Facility name	Unit number	Stack gas flow rate (dscfm)	Stack gas temperature (°F)	Operating hours (hr/yr)	HCl (ppmvd)	HCl % reduction	HCl unc. (ppmvd)	PM (gr/dscf)	PM % reduction	PM unc. (gr/dscf)	NO_X (lb/yr)	NO_X (lb/hr)	NO_X (lb/lb waste)
82	82	Good Samaritan Hospital		1,352	128	2,574	1.58	99.00%	158	0.0137	85.00%	0.091	3,038	1.18	0.0024
88	88	Medina General Hospital		1,153	100	3,016	3.29	99.00%	329	0.0267	85.00%	0.178	2,136	0.71	0.0024
108	108--1	Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases	Unit 1	1,790	112	1,248	0.455	99.00%	46	0.0216	85.00%	0.144	1,884	1.51	0.0030
111	111	Wyoming Medical Center		1,505	130	989	1.17	99.00%	117	0.00336	85.00%	0.022	1,343	1.36	0.0034
				1,790	**130**	**2,028**	**2.10**		**158**	**0.016**		**0.144**			
					258		**8.95**			**0.004**					
					136		**5.48**			**0.018**					
86	86	Fairfield Medical Center		1,095	97	5,018	1.03	99.00%	103	0.0137	85.00%	0.091	1,125	0.22	0.0024
129	129	Centers for Disease Control and Prevention--Clifton, Building 18	Unit 3	715	163	2,920	1.30	99.00%	130	0.00760	85.00%	0.051	827	0.28	0.0024
				905	**130**	**3,969**	**1.16**		**116**	**0.011**		**0.071**			
115	115	Kona Community Hospital		684	1,787	1,430	135		135	0.0128		0.0128	675	0.47	0.0024
116	116	Yukon-Kuskokwim Delta Regional Hospital		559	1,457	1,560	298		298	0.0162		0.0162	163	0.10	0.0021
				621	**1,622**	**1,495**	**216**		**216**	**0.015**		**0.015**			

Notes:
1. Assumed values are highlighted in yellow.
2. For dry APCD, 95% HCl control assumed based on average % HCl control (96.5
99% PM control assumed based on % Pb and Cd control (99.6% and 99.2%) for a r
3. For wet APCD, 99% HCl control assumed based on % HCl control (99.29%) for a
85% PM control assumed based on % Pb and Cd control (87.2% and 88.4%) for a r

Table 1. Basis for Model HMIWI Parameters

FACID	UNITID	Facility name	Unit number	NO_X (lb/MMBtu)
1	1	Bristol-Myers Squibb Co.		0.13
5	5	Merck & Company, Inc.		0.65
15	15--1	Curtis Bay Energy	Unit 1	0.43
15	15--2	Curtis Bay Energy	Unit 2	0.45
36	36--1	Merck & Company, Inc.	Unit 2	0.14
36	36--2	Merck & Company, Inc.	Unit 5	0.15
40	40	Charleston Area Medical Center, General Hospital		0.23
42	42	Stericycle, Inc.		0.31
51	51	Lakeland Regional Medical Center		0.23
60	60--1	BMWNC, Inc.	Unit 1	0.26
84	84	Mayo Clinic, Waste Management Facility		0.34
87	87	MedCentral Health System, Mansfield Hospital		0.28
109	109	Healthcare Environmental Services Inc.		0.32
120	120--1	Municipality of Chambers County, Resource Recovery Center	Unit 1	0.10
120	120--2	Municipality of Chambers County, Resource Recovery Center	Unit 2	0.11
29	29	Hamot Medical Center		0.35
55	55	St. Joseph's Hospital		0.14
110	110	Stericycle, Inc.		0.56
125	125	East Carolina University, Health Sciences Campus, HSC Utility Plant		0.16
20	20--1	Fort Detrick	Unit 5	0.28
20	20--2	Fort Detrick	Unit 6	0.28
43	43	Boca Raton Community Hospital		0.28
44	44	Bethesda Memorial Hospital		0.32

Table 1. Basis for Model HMIWI Parameters

FACID	UNITID	Facility name	Unit number	NO_X (lb/MMBtu)
46	46	Holy Cross Hospital		0.13
48	48	Memorial Regional Hospital		0.27
54	54	Bayfront Medical Center		0.20
59	59--1	Stericycle, Inc.	Unit 1	0.28
59	59--2	Stericycle, Inc.	Unit 2	0.28
65	65--1	Stericycle, Inc.	Unit 1	0.28
65	65--2	Stericycle, Inc.	Unit 2	0.28
71	71	Loyola University Medical Center		0.16
77	77	Parkview Hospital		0.28
94	94	Stericycle, Inc.		0.28
98	98--1	University of Texas Medical Branch		0.19
106	106	Stericycle, Inc.		0.28
130	130	Department of Veterans Affairs Medical Center		0.38
				0.28
38	38	Wilkes-Barre General Hospital		0.28
63	63	St. Jude Children's Research Hospital		0.37
95	95	St. Joseph's Hospital		0.28
13	13	University of Maryland at Baltimore, Environmental Health and Safety Facility		0.27
16	16	Johns Hopkins Medical Institute, Department of Health, Safety, and Environment		0.36
18	18	Franklin Square Hospital Center		0.44
21	21	Washington County Hospital		0.28
25	25	Holy Spirit Hospital		0.28
30	30	Riddle Memorial Hospital		0.27
34	34	Pennsylvania State University, Animal Diagnostic Lab Incinerator		0.28
41	41	Thomas Memorial Hospital		0.23
47	47	Malcolm Randall Veterans Affairs Medical Center		0.38
81	81	South Bend Medical Foundation		0.06

Table 1. Basis for Model HMIWI Parameters

FACID	UNITID	Facility name	Unit number	NO_X (lb/MMBtu)
82	82	Good Samaritan Hospital		0.28
88	88	Medina General Hospital		0.28
108	108--1	Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases	Unit 1	0.36
111	111	Wyoming Medical Center		0.40
				0.28
86	86	Fairfield Medical Center		0.28
129	129	Centers for Disease Control and Prevention--Clifton, Building 18	Unit 3	0.28
				0.28
115	115	Kona Community Hospital		0.28
116	116	Yukon-Kuskokwim Delta Regional Hospital		0.25
				0.26

Notes:
1. Assumed values are highlighted in yellow.
2. For dry APCD, 95% HCl control assumed based on average % HCl control (96.5
99% PM control assumed based on % Pb and Cd control (99.6% and 99.2%) for a r
3. For wet APCD, 99% HCl control assumed based on % HCl control (99.29%) for a
85% PM control assumed based on % Pb and Cd control (87.2% and 88.4%) for a r

Table 2. Summary of HMIWI Combustor and Control Costs

Control option	Pollutants controlled	Large	Medium	Small	Small rural
A. Total Capital Investment, $					
1. Combustor	PM, CO, CDD/CDF	$954,948	$212,177	$102,229	$113,121
2. Packed-bed scrubber	HCl, SO_2	$452,658	$327,726	--	--
3. Venturi scrubber	HCl, Pb, Cd, Hg, PM, CDD/CDF, SO_2	$625,073	$625,073	$424,205	$343,858
4. Fabric filter	Pb, Cd, Hg, PM, CDD/CDF	$1,017,892	--	--	--
5. Dry injection fabric filter	HCl, Pb, Cd, Hg, PM, CDD/CDF, SO_2	$1,363,508	$1,074,716	--	--
6. Electrostatic precipitator (dry)	Pb, Cd, Hg, PM, CDD/CDF	$1,067,363	--	--	--
7. Electrostatic precipitator (wet)	Pb, Cd, Hg, PM, CDD/CDF	$607,438	--	--	--
8. Selective noncatalytic reduction	NO_X	$585,709	--	--	--
9. Activated carbon injection system	Hg, CDD/CDF	$11,989	$7,425	--	--
B. Annual Costs, $/yr					
1. Combustor	PM, CO, CDD/CDF	$366,304	$88,751	$118,935	$54,832
2. Packed-bed scrubber	HCl, SO_2	$104,101	$65,687	--	--
3. Venturi scrubber	HCl, Pb, Cd, Hg, PM, CDD/CDF, SO_2	$192,484	$159,654	$83,893	$78,366
4. Fabric filter	Pb, Cd, Hg, PM, CDD/CDF	$267,793	--	--	--
5. Dry injection fabric filter	HCl, Pb, Cd, Hg, PM, CDD/CDF, SO_2	$347,053	$206,105	--	--
6. Electrostatic precipitator (dry)	Pb, Cd, Hg, PM, CDD/CDF	$220,178	--	--	--
7. Electrostatic precipitator (wet)	Pb, Cd, Hg, PM, CDD/CDF	$157,544	--	--	--
8. Carbon adsorber	Hg, CDD/CDF	$6,754	--	--	--
9. Selective noncatalytic reduction	NO_X	$67,918	--	--	--
10. Activated carbon injection system	Hg, CDD/CDF	$56,313	$12,522	--	--
11. Autoclave/landfill	Alternative to compliance	$205,273	$27,758	$19,497	$9,139

Note:
Annual costs for carbon adsorber do not include indirect annual costs (e.g., capital recovery costs).

Table 3. Combustor Costs

Parameters/Costs	Equation	Large	Medium	Small	Small rural
A. Parameters					
1. Incinerator capacity, lb/hr (C)		1,500	500	100	125
2. Annual operating hours, hr/yr (H)		6,000	2,000	4,000	1,500
a. Preheat	= 0.5 hr/d x H/24	125	42	83	31
b. Burning	= H - (preheat + burndown + cooldown)	5,375	1,625	3,250	1,219
c. Burndown	= 2 hr/d x H/24	500	167	333	125
d. Cooldown	= 2 hr/d x H/24 (for medium/small)	0	167	333	125
3. Exhaust gas flow rate, dscfm (Q)		4,000	1,800	900	600
5. Operating labor rate, $/hr (LR)		$24	$24	$24	$24
6. Electricity cost, $/kWh (EC)		$0.06	$0.06	$0.06	$0.06
7. Natural gas cost, $/1,000 ft^3 (NGC)		$7.97	$7.97	$7.97	$7.97
8. Burner capacities, Btu/hr					
a. Primary chamber (PC)	= (129.1 x C) + 170,273	363,923	234,823	183,183	186,411
b. Secondary chamber (SC)	= (1,290 x C) + 297,036	2,232,036	942,036	426,036	458,286
9. Burner utilization rate, %					
a. PC burner-preheat		100%	100%	100%	100%
b. PC burner-burning		100%	100%	100%	100%
c. PC burner-burndown		0%	0%	0%	0%
d. SC burner-preheat		50%	50%	50%	50%
e. SC burner-burning		75%	75%	75%	75%
f. SC burner-burndown		90%	90%	90%	90%
10. Burner utilization, Btu/yr					
a. PC burner-preheat	= PC burner capacity x PC burner utilization rate x preheat hr/yr	45,490,375	9,784,292	15,265,250	5,825,328
b. PC burner-burning	= PC burner capacity x PC burner utilization rate x burning hr/yr	1,956,086,125	381,587,375	595,344,750	227,187,797
c. PC burner-burndown	= PC burner capacity x PC burner utilization rate x burndown hr/yr	0	0	0	0
d. SC burner-preheat	= SC burner capacity x SC burner utilization rate x preheat hr/yr	139,502,250	19,625,750	17,751,500	7,160,719
e. SC burner-burning	= SC burner capacity x SC burner utilization rate x burning hr/yr	8,997,895,125	1,148,106,375	1,038,462,750	418,902,047
f. SC burner-burndown	= SC burner capacity x SC burner utilization rate x burndown hr/yr	1,004,416,200	141,305,400	127,810,800	51,557,175
11. Heating value (natural gas), Btu/ft^3 (HV)		1,020	1,020	1,020	1,020
12. Ash disposal cost, $/ton (ADC)		$34.29	$34.29	$34.29	$34.29
13. Water cost, $/1,000 gal (WC)		$0.20	$0.20	$0.20	$0.20
14. Cost index					
a. 2007		525.4	525.4	525.4	525.4
b. 1989		357.5	357.5	357.5	357.5
15. Refractory thickness, in. (RT)		4.5	4.5	4.5	4.5
16. Insulation thickness, in. (IT)		2	2	2	2
17. PC volume, ft^3 (PCV)	= (0.304 x C) + 26.05	482	178	56	64
18. PC internal diameter, ft (PCD)	= $(4 \times PCV / (\pi \times 1.5))^{1/3}$	7.42	5.33	3.63	3.79
19. PC internal length, ft (PCL)	= PCL/PCD ratio (1.5) x PCD	11.14	7.99	5.45	5.68
20. PC refractory volume, ft^3	= $PCL \times \pi/4 \times ((RT \times 2/12 \times PCD)^2 - PCD^2) + \pi/2 \times PCD^2 \times RT/12$	134.78	70.38	33.49	36.32
21. PC insulation volume, ft^3	= $PCL \times (\pi/4 \times (((((RT+ IT) \times 2)/12) + PCD)^2 - ((RT \times 2/12) + PCD)^2)) + 2 \times \pi/4 \times (PCD + RT/12)^2 \times (IT/12)$	64.56	34.63	17.18	18.54
22. SC volume, ft^3 (SCV)	= Q/0.9 x (SC temp + 460)/528 x (resid time) x (1 min/60 sec)	317.06	142.68	71.34	47.56
23. SC internal diameter, ft (SCD)	= $(SCV \times 2/\pi)^{1/3}$	5.87	4.50	3.57	3.12

Table 3. Combustor Costs

Parameters/Costs	Equation	Large	Medium	Small	Small rural
24. SC internal length, ft (SCL)	= SCL/SCD ratio (2) x SCD	11.73	8.99	7.14	6.23
25. SC refractory volume, ft^3	=SCL x (π/4 x ((RT x 2/12 + SCD)^2- SCD^2)) + π/2 x SCD^2 x RT/12	106.53	63.48	40.64	31.36
26. SC insulation volume, ft^3	= SCL x (π/4 x (((((RT+ IT) x 2)/12) + SCD)^2 - ((RT x 2/12) + SCD)^2)) + 2 x π/4 x (SCD + RT/12)^2 x (IT/12)	51.86	31.68	20.82	16.36
27. Unit refractory cost, $/$ft^3$	= $127/$ft^3$ x (525.4/357.5)	$187	$187	$187	$187
28. Unit insulation cost, $/$ft^3$	= $43/$ft^3$ x (525.4/357.5)	$63	$63	$63	$63
29. Capital recovery factors (CRF)	= [i x (1 + i)^a] / [(1 + i)^a - 1], where i = interest rate, a = equipment life				
a. Refractory CRF, 8-yr life, 7% interest		0.16747	0.16747	0.16747	0.16747
b. Equipment CRF, 20-yr life, 7% interest		0.09439	0.09439	0.09439	0.09439
B. Total Capital Investment, $					
1. Purchased equipment cost (PEC)					
a. Large model	= (174.2 x C + 177,740) x (525.4/357.5)	$645,235			
b. Medium/small models	= 5,817 x C$^{0.4537}$ x (525.4/357.5)		$143,363	$69,074	$76,433
2. Installation cost (IC)	= 0.48 x PEC	$309,713	$68,814	$33,155	$36,688
3. Total cost	= PEC + IC	$954,948	$212,177	$102,229	$113,121
C. Direct Annual Costs, $/yr					
1. Operating labor	= ((0.5 x burning hr/yr) + (1 hr/d ash removal x H/24 hr/d [for medium/small])) x LR	$64,500	$21,500	$43,000	$16,125
2. Supervisory labor	= 0.15 x (operating labor)	$9,675	$3,225	$6,450	$2,419
3. Maintenance labor	= (0.5 hr/8-hr shift) x H x (LR x 1.1)	$9,900	$3,300	$6,600	$2,475
4. Maintenance materials	= 0.02 x TCI	$12,905	$2,867	$1,381	$1,529
5. Electricity	= (0.746 kW/hp) x hp x H x EC	$8,250	$618	$494	$203
6. Auxiliary fuel	= burner utilization / HV x NGC	$94,885	$13,287	$14,023	$5,553
7. Ash disposal	= 0.09 x C x (1 ton / 2,000 lb) x (burning hr/yr) x ADC	$12,441	$1,254	$501	$235
8. Water	= (water consumption (1 gpm)) x (60 min/hr) x (burning hr/yr) x WC	$71	$12	$24	$9
9. Refractory replacement					
a. PC refractory	= CRF x [PC refractory volume (ft^3) x unit refractory cost ($/$ft^3$) + PC insulation volume (ft^3) x unit insulation cost (ft^3)]	$4,896	$2,566	$1,229	$1,332
b. SC refractory	= CRF x [SC refractory volume (ft^3) x unit refractory cost ($/$ft^3$) + SC insulation volume (ft^3) x unit insulation cost (ft^3)]	$3,879	$2,320	$1,491	$1,153
D. Indirect Annual Costs, $/yr					
1. Overhead	= 0.6 x (labor + maintenance materials)	$58,188	$18,535	$34,459	$13,528
2. Property taxes, insurance, and administration	= 0.04 x TCI	$25,809	$5,735	$2,763	$3,057
3. Capital recovery	= CRF x TCI	$60,906	$13,532	$6,520	$7,215
E. Total Annual Cost					
1. $/yr	= Direct Annual Costs + Indirect Annual Costs	$366,304	$88,751	$118,935	$54,832
2. $/dscfm	= ($/yr) / Q	$91.58	$49.31	$132.15	$91.39

Table 3. Combustor Costs

Parameters/Costs	Equation	Large	Medium	Small	Small rural

Notes:
Costs assume continuous operation for large model, intermittent operation for medium and small models.
Large model: hp = (0.0130 x C) + 10.42
Medium/small models: hp = (0.0101 x C) + 1.677

Sources:
1. Cost equation: Model Plant Description and Cost Report (II-A-112).
2. Operating labor rate: Bureau of Labor Statistics, Occupational Employment Statistics, May 2007 National Industry-Specific Occupational Employment and Wage Estimates.
3. Electricity cost: Energy Information Administration. Average Retail Price of Electricity: 2006.
4. Natural gas cost: Energy Information Administration. Natural Gas Prices: December 2007.
5. Ash disposal cost: NSWMA's 2005 Tip Fee Survey.
6. Water cost: Air Compliance Advisor, version 7.5.

Table 4. Packed Bed Scrubber Costs

Parameters/Costs	Equation	Large	Medium
A. Parameters			
1. Incinerator capacity, lb/hr (C)		1,500	500
2. Temperature out of FF into quench, F (T1)		300	300
3. Temperature out of PB to ID fan, F (T2)		130	130
4. Annual operating hours, hr/yr (H)		6,000	2,000
5. Exhaust gas flow rate, dscfm (Qd)		4,000	1,800
6. Assumed moisture content in gas entering quench, % (M)		10	10
7. Exhaust gas flow rate, scfm (Qw)	= (Qd) / (1- M/100)	4,444	2,000
8. Water added in quench, scfm (Qh)	= ((7.010 x (T1 - 77) - 6.958 x (T2 - 77)) x 0.9 + (8.154 x (T1 - 77) - 8.064 x (T2 - 77)) x 0.1) x (lb-mole/385 scf) x Qw / (1,160 Btu/lb) / (18 lb/lb-mole) x (0.7302 ft^3-atm/lb-mol-R) x 528 R / 1 atm	259	116
9. Actual flow out of PB, acfm (Qa)	= (Qw + Qh) x (460 + T2)/(528)	5,256	2,365
10. HCl concentration, ppmvd (HCl)		25	9
11. Operating labor rate, $/hr (LR)		$24	$24
12. Electricity cost, $/kWh (EC)		$0.06	$0.06
13. Caustic cost, $/ton (CC)		$357	$357
14. Sewage disposal cost, $/1,000 gal (SDC)		$3.80	$3.80
15. Water cost, $/1,000 gal (WC)		$0.20	$0.20
16. Assumed pressure drop through control system, inches of water (ΔP)		15	15
17. Surface area-to-volume ratio for 1" dia. Ceramic Raschig rings, ft^2/ft^3 (SAV)		58	58
18. Minimum packing wetting rate, ft^2/hr (WR)		1	1
19. Water density, lb/ft^3 (Wd)		62.4	62.4
20. Water circulation flow rate, lb/hr-ft^2 (Gs)	= SAV x Wd x WR	4,705	4,705
21. Estimated column cross-sectional area from separate analysis, ft^2 (A)		19.2	8.6
22. Water circulation rate, gpm (GPM)	= Gs x A x (1 hr/60 min) x (1 gal/8.33 lb)	181	81
23. Water head, ft of water (Head)		60	60
24. Wastewater (blowdown) flow, gpm (B)	= (HCl/1000000) x (Qd) x (lb-mole/385 ft^3) x (1 lb-mole NaCl/1 lb-mole HCl) x (58.2 lb NaCl/lb-mole NaCl) x (1 lb wastewater/0.1 lb NaCl) x (1 gal/8.33 lb)	0.018	0.003
25. Capital recovery factor, 15-yr equipment life, 7% interest (CRF)	= $[i \times (1 + i)^a] / [(1 + i)^a - 1]$, where i = interest rate, a = equipment life	0.10979	0.10979
26. Chemical Engineering plant cost index			
a. 2007		525.4	525.4
b. 1989		357.5	357.5
B. Total Capital Investment, $	= (27.6 x Qd + 109,603) x (525.4/357.5) x (1.4 retrofit factor)	$452,658	$327,726
C. Direct Annual Costs, $/yr			
1. Operating labor	= (if Qa < 20,000, then 0, otherwise 0.5 hr/shift) x H x LR	$0	$0
2. Supervisory labor	= 0.15 x (operating labor)	$0	$0
3. Maintenance labor	= (0.5 hr/8-hr shift) x H x (LR x 1.1)	$9,900	$3,300
4. Maintenance materials	= 0.02 x TCI	$9,053	$6,555
5. Electricity	= (0.000181 x Qa x ΔP x H x EC) + (0.000289 x GPM x Head x H x EC)	$5,172	$775
6. Caustic	= HCl x (3.117E-9) x Q x H x CC	$667	$36
7. Sewage disposal	= B x (gal/8.33 lb) x (60 min/hr) x H x SDC	$25	$1

Table 4. Packed Bed Scrubber Costs

Parameters/Costs	Equation	Large	Medium
8. Makeup water	= (B + Qh x (lbmole/385 scf) x (18 lb/lbmole) x (gal/8.33 lb)) x (60 min/hr) x H x WC	$106	$16
D. Indirect Annual Costs, $/yr			
1. Overhead	= 0.6 x (labor + maintenance materials)	$11,372	$5,913
2. Property taxes, insurance, and administration	= 0.04 x TCI	$18,106	$13,109
3. Capital recovery	= CRF x TCI	$49,699	$35,983
E. Total Annual Cost			
1. $/yr	= Direct Annual Costs + Indirect Annual Costs	$104,101	$65,687
2. $/dscfm	= ($/yr) / Q	$26.03	$36.49

Sources:

1. Cost equations: Model Plant Description and Cost Report (II-A-112); and Wet Scrubber Cost Memorandum (IV-B-30).
2. Operating labor rate: Bureau of Labor Statistics, Occupational Employment Statistics, May 2007 National Industry-Specific Occupational Employment and Wage Estimates.
3. Electricity cost: Energy Information Administration. Average Retail Price of Electricity: 2006.
4. Caustic cost: Purchasing.com. Caustic soda price hike is on the horizon. August 29, 2007.
5. Sewage disposal cost, water cost: Air Compliance Advisor, version 7.5.

Table 5. Venturi Scrubber Costs

Parameters/Costs	Equation	Large (after HMIWI)	Large- (after DIFF)	Medium	Small
A. Parameters					
1. Incinerator capacity, lb/hr (C)		1,500	1,500	500	100
2. Annual operating hours, hr/yr (H)		6,000	6,000	2,000	4,000
3. Exhaust gas flow rate, dscfm (Q)		4,000	4,000	1,800	900
4. HCl concentration, ppmvd (HCl)		890	20	160	120
5. Operating labor rate, $/hr (LR)		$24	$24	$24	$24
6. Electricity cost, $/kWh (EC)		$0.06	$0.06	$0.06	$0.06
7. Caustic cost, $/ton (CC)		$357	$357	$357	$357
8. Sewage disposal cost, $/1,000 gal (SDC)		$3.80	$3.80	$3.80	$3.80
9. Water cost, $/1,000 gal (WC)		$0.20	$0.20	$0.20	$0.20
10. Capital recovery factor, 20-yr equipment life, 7% interest (CRF)	= [i x $(1 + i)^a$] / [$(1 + i)^a$ - 1], where i = interest rate, a = equipment life	0.10979	0.09439	0.09439	0.09439
17. Cost index					
a. 2007		525.4	525.4	525.4	525.4
b. 1995		381.1	381.1	381.1	381.1
B. Total Capital Investment, $	= (145.7 x C + 234,848) x (525.4/381.1)	$625,073	$625,073	$424,205	$343,858
C. Direct Annual Costs, $/yr					
1. Operating labor	= (0.4 hr/8-hr shift) x H x LR	$7,200	$7,200	$2,400	$4,800
2. Supervisory labor	= 0.15 x (operating labor)	$1,080	$1,080	$360	$720
3. Maintenance labor	= (0.3 hr/8-hr shift) x H x (LR x 1.1)	$5,940	$5,940	$1,980	$3,960
4. Maintenance materials	= 0.02 x TCI	$12,501	$12,501	$8,484	$6,877
5. Electricity	= (0.746 kW/hp) x fan hp (0.02316 x Q + 4.554) x H x EC	$26,798	$26,798	$4,250	$4,669
6. Caustic	= (HCl) x (3.117E-9) x Q x H x CC	$23,737	$533	$640	$480
7. Sewage disposal	= [blowdown rate (0.000747 x Q), gpm] x (60 min/hr) x H x SDC	$4,088	$4,088	$613	$613
8. Makeup water	= [makeup water flow rate (0.00512 x Q), gpm] x (60 min/hr) x H x WC	$1,475	$1,475	$221	$221
D. Indirect Annual Costs, $/yr					
1. Overhead	= 0.6 x (labor + maintenance materials)	$16,033	$16,033	$7,934	$9,814
2. Property taxes, insurance, and administration	= 0.04 x TCI	$25,003	$25,003	$16,968	$13,754
3. Capital recovery	= CRF x TCI	$68,630	$59,002	$40,042	$32,458
E. Total Annual Cost, $/yr	= Direct Annual Costs + Indirect Annual Costs	$192,484	$159,654	$83,893	$78,366

Sources:

1. Cost equations: Model Plant Description and Cost Report (II-A-112); and Wet Scrubber Cost Memorandum (IV-B-30).
2. Operating labor rate: Bureau of Labor Statistics, Occupational Employment Statistics, May 2007 National Industry-Specific Occupational Employment and Wage Estimates.
3. Electricity cost: Energy Information Administration. Average Retail Price of Electricity: 2006.
4. Caustic cost: Purchasing.com. Caustic soda price hike is on the horizon. August 29, 2007.
5. Sewage disposal cost, water cost: Air Compliance Advisor, version 7.5.

Table 6. Fabric Filter Costs

Parameters/Costs	Equation	Large
A. Parameters		
1. Incinerator capacity, lb/hr (C)		1,500
2. Annual operating hours, hr/yr (H)		6,000
3. Exhaust gas flow rate, dscfm (Q)		4,000
4. PM concentration, gr/dscf (PM)		0.10
5. Water vapor in gas from incinerator (10% by weight)		
a. lb/min	= Q / (385 ft^3/lb-mol) x (29 lb/lb-mol) x moisture content (0.10)	30.1
b. scfm	= (lb/min) / (18 lb/lb-mol) x (385 ft^3/lb-mol)	644
6. Enthalpy change in quench (1800°F to 300°F)		
a. Dry gas from incinerator, Btu/lb air	= [7.010 x (300°F - 77°F) - 7.554 x (1800°F - 77°F)] / (29 lb/lb-mol)	395
b. Water vapor from incinerator, Btu/lb water vapor	= [8.154 x (300°F - 77°F) - 9.215 x (1800°F - 77°F)] / (18 lb/lb-mol)	781
c. Total gas stream, Btu/yr	= [(Btu/lb air) x Q / (385 ft3/lb-mol) x (29 lb/lb-mol) x (60 min/hr) x H] + [(Btu/lb water vapor) x Q x (0.00753 lb water vapor/ft3) x (60 min/hr) x H]	5.13E+10
d. Cooling water		
i. Heat of vaporization at 77°F, Btu/lb		1,050
ii. Sensible heat for vapor, Btu/lb		85
iii. Total, Btu/lb water		1,135
7. Cooling water evaporated, lb/yr		
a. lb/yr	= [enthalpy change (total gas stream, Btu/yr)] / [enthalpy change (cooling water, Btu/lb)]	4.52E+07
b. scfm	= [cooling water evaporated (lb/yr)] / (18 lb/lb-mol) x (385 ft3/lb-mol) / (H * 60 min/hr)	2,686
8. Actual gas flow into fabric filter, acfm (AQ)	= [Q + (water vapor in gas from incinerator, scfm) + (water vapor added in quench, i.e., cooling water evaporated, scfm)] x [(300°F + 460°F)/528°R]	10,551
9. Operating labor rate, $/hr (LR)		$24
10. Electricity cost, $/kWh (EC)		$0.06
11. Water cost, $/1,000 gal (WC)		$0.20
12. Compressed air cost, $/1,000 ft^3 (CAC)		$0.24
13. Dust disposal cost, $/ton (DDC)		$34.29
14. Capital recovery factors	= $[i \times (1 + i)^a] / [(1 + i)^a - 1]$, where i = interest rate, a = equipment life	
a. Bag CRF, 2-yr life, 7% interest		0.55309
b. Cage CRF, 4-yr life, 7% interest		0.29523
c. Equipment CRF, 20-yr life, 7% interest		0.09439
15. Cost index		
a. 2007		525.4
b. 1989		357.5

Table 6. Fabric Filter Costs

Parameters/Costs	Equation	Large
B. Total Capital Investment, $	= (47.0 x Q + 306,720) x (1.4 retrofit cost factor) x (525.4/357.5)	$1,017,892
C. Direct Annual Operating Costs, $/yr		
1. Electricity	= (0.746 kW/hp) x hp (0.0072 x Q + 3.20) x H x EC	$8,823
3. Evaporative cooler water	= (0.1007 x Q + 23.1506) gal/min x (60 min/hr) x H x WC	$30,668
4. Operating labor	= (1 hr/shift) x (1 shift/8 hr) x H x LR	$18,000
5. Supervisory labor	= 0.15 x (operating labor)	$2,700
6. Maintenance labor	= (0.5 hr/shift) x (1 shift/8 hr) x H x (LR x 1.1)	$9,900
7. Maintenance materials	= 0.02 x TCI	$20,358
8. Compressed air	= AQ x (2 ft^3 air/1,000 ft^3 filtered) x (60 min/hr) x H x CAC	$1,823
9. Dust disposal	= (PM gr/dscf x Q x 60 min/hr x 1 lb/7,000 gr) x (1 ton/2,000 lb) x H x DDC	$353
10. Bag replacement		
a. Bag cost	= AQ x ($2.5/$ft^2$) x (525.4/317.4) x (1.08 taxes and freight ratio)/(3.5 ft/min G/C ratio)	$13,473
b. Bag replacement labor cost	= AQ x (0.15 hr/bag)/(18 ft^2 bag area)/(3.5 ft/min G/C ratio) x LR	$603
c. Bag replacement cost	= Bag CRF x [(total bag cost) + (bag replacement labor cost)]	$7,785
11. Cage replacement		
a. Number of bags	= AQ/(3.5 ft/min G/C ratio)/(18 ft^2 bag area)	$167
b. Cage replacement labor cost	= bag replacement labor cost	$603
c. Cage replacement cost	= Cage CRF x [single-cage cost (4.941+ 0.163 x 18 ft^2 bag area) x (number of bags) x (525.4/317.4) + (cage replacement labor cost)]	$823
D. Indirect Annual Costs, $/yr		
1. Overhead	= 0.6 x (labor + maintenance materials)	$30,575
2. Property taxes, insurance, and administration	= 0.04 x TCI	$40,716
3. Capital recovery	= Equipment CRF x (TCI - bag replacement cost - cage replacement cost)	$95,269
E. Total Annual Cost		
1. $/yr	= Direct Annual Costs + Indirect Annual Costs	$267,793
2. $/dscfm	= ($/yr) / Q	$66.95

Sources:

1. Cost equations: Model Plant Description and Cost Report (II-A-112); and Dry Injection Fabric Filter Cost Memorandum (IV-B-32).
2. Operating labor rate: Bureau of Labor Statistics, Occupational Employment Statistics, May 2007 National Industry-Specific Occupational Employment and Wage Estimates.
3. Electricity cost: Energy Information Administration. Average Retail Price of Electricity: 2006.
4. Water cost: Air Compliance Advisor, version 7.5.
5. Compressed air cost: P2Pays.org. Energy Tips – Compressed Air. Compressed Air Tip Sheet #1. August 2004.
6. Dust disposal cost: NSWMA's 2005 Tip Fee Survey

Table 7. Dry Injection Fabric Filter Costs

Parameters/Costs	Equation	Large	Medium
A. Parameters			
1. Incinerator capacity, lb/hr (C)		1,500	500
2. Annual operating hours, hr/yr (H)		6,000	2,000
3. Exhaust gas flow rate, dscfm (Q)		4,000	1,800
4. HCl concentration, ppmvd (HCl)		890	160
5. PM concentration, gr/dscf (PM)		0.10	0.15
6. Water vapor in gas from incinerator (10% by weight)			
a. lb/min	= Q / (385 ft^3/lb-mol) x (29 lb/lb-mol) x moisture content (0.10)	30.1	13.6
b. scfm	= (lb/min) / (18 lb/lb-mol) x (385 ft^3/lb-mol)	644	290
7. Enthalpy change in quench (1800°F to 300°F)			
a. Dry gas from incinerator, Btu/lb air	= [7.010 x (300°F - 77°F) - 7.554 x (1800°F - 77°F)] / (29 lb/lb-mol)	395	395
b. Water vapor from incinerator, Btu/lb water vapor	= [8.154 x (300°F - 77°F) - 9.215 x (1800°F - 77°F)] / (18 lb/lb-mol)	781	781
c. Total gas stream, Btu/yr	= [(Btu/lb air) x Q / (385 ft^3/lb-mol) x (29 lb/lb-mol) x (60 min/hr) x H] + [(Btu/lb water vapor) x Q x (0.00753 lb water vapor/ft^3) x (60 min/hr) x H]	5.13E+10	7.70E+09
d. Cooling water			
i. Heat of vaporization at 77°F, Btu/lb		1,050	1,050
ii. Sensible heat for vapor, Btu/lb		85	85
iii. Total, Btu/lb water		1,135	1,135
8. Cooling water evaporated, lb/yr			
a. lb/yr	= [enthalpy change (total gas stream, Btu/yr)] / [enthalpy change (cooling water, Btu/lb)]	4.52E+07	6.78E+06
b. scfm	= [cooling water evaporated (lb/yr)] / (18 lb/lb-mol) x (385 ft^3/lb-mol) / (H * 60 min/hr)	2,686	1,209
9. Actual gas flow into fabric filter, acfm (AQ)	= [Q + (water vapor in gas from incinerator, scfm) + (water vapor added in quench, i.e., cooling water evaporated, scfm)] x [(300°F + 460°F)/528°R]	10,551	4,748
10. Operating labor rate, $/hr (LR)		$24	$24
11. Electricity cost, $/kWh (EC)		$0.06	$0.06
12. Lime cost, $/ton (LC)		$95	$95
13. Water cost, $/1,000 gal (WC)		$0.20	$0.20
14. Compressed air cost, $/1,000 ft^3 (CAC)		$0.24	$0.24
15. Dust disposal cost, $/ton (DDC)		$34.29	$34.29
16. Capital recovery factors (CRF)	= [i x $(1 + i)^a$] / [$(1 + i)^a$ - 1], where i = interest rate, a = equipment life		
a. Bag CRF, 2-yr life, 7% interest		0.55309	0.55309
b. Cage CRF, 4-yr life, 7% interest		0.29523	0.29523
c. Equipment CRF, 20-yr life, 7% interest		0.09439	0.09439
17. Cost index			
a. 2007		525.4	525.4
b. 1989		357.5	357.5
B. Total Capital Investment, $	= (63.8 x Q + 407,498) x (1.4 retrofit cost factor) x (525.4/357.5)	$1,363,508	$1,074,716

Table 7. Dry Injection Fabric Filter Costs

Parameters/Costs	Equation	Large	Medium
C. Direct Annual Operating Costs, $/yr			
1. Electricity	= (0.746 kW/hp) x hp (0.0079 x Q + 3.51) x H x EC	$9,681	$1,630
2. Makeup lime	= (2.4E-7 lb/dscf x HCl x Q) x (1 ton/2,000 lb) x (60 min/hr) x H x LC	$14,610	$394
3. Evaporative cooler water	= (0.1007 x Q + 23.1506) gal/min x (60 min/hr) x H x WC	$30,668	$4,906
4. Operating labor	= (1 hr/shift) x (1 shift/8 hr) x H x LR	$18,000	$6,000
5. Supervisory labor	= 0.15 x (operating labor)	$2,700	$900
6. Maintenance labor	= (0.5 hr/shift) x (1 shift/8 hr) x H x (LR x 1.1)	$9,900	$3,300
7. Maintenance materials	= 0.02 x TCI	$27,270	$21,494
8. Compressed air	= AQ x (2 ft^3 air/1,000 ft^3 filtered) x (60 min/hr) x H x CAC	$1,823	$273
9. Dust disposal	= [(PM gr/dscf x Q x 60 min/hr x 1 lb/7,000 gr) + (HCl x Q x 60 min/hr x 2.86E-7 lb/dscf)] x (1 ton/2,000 lb) x H x DDC	$6,637	$249
10. Bag replacement			
a. Bag cost	= AQ x ($2.5/$ft^2$) x (525.4/317.4) x (1.08 taxes and freight ratio)/(3.5 ft/min G/C ratio)	$13,473	$6,063
b. Bag replacement labor cost	= AQ x (0.15 hr/bag)/(18 ft^2 bag area)/(3.5 ft/min G/C ratio) x LR	$603	$271
c. Bag replacement cost	= Bag CRF x [(total bag cost) + (bag replacement labor cost)]	$7,785	$3,503
11. Cage replacement			
a. Number of bags	= AQ/(3.5 ft/min G/C ratio)/(18 ft^2 bag area)	167	75
b. Cage replacement labor cost	= bag replacement labor cost	$603	$271
c. Cage replacement cost	= Cage CRF x [single-cage cost (4.941+ 0.163 x 18 ft^2 bag area) x (number of bags) x (525.4/317.4) + (cage replacement labor cost)]	$823	$370
D. Indirect Annual Costs, $/yr			
1. Overhead	= 0.6 x (labor + maintenance materials)	$34,722	$19,017
2. Property taxes, insurance, and administration	= 0.04 x TCI	$54,540	$42,989
3. Capital recovery	= Equipment CRF x (TCI - bag replacement cost - cage replacement cost)	$127,893	$101,080
E. Total Annual Cost			
1. $/yr	= Direct Annual Costs + Indirect Annual Costs	$347,053	$206,105
2. $/dscfm	= ($/yr) / Q	$86.76	$114.50

Sources:

1. Cost equations: Model Plant Description and Cost Report (II-A-112); and Dry Injection Fabric Filter Cost Memorandum (IV-B-32).
2. Operating labor rate: Bureau of Labor Statistics, Occupational Employment Statistics, May 2007 National Industry-Specific Occupational Employment and Wage Estimates.
3. Electricity cost: Energy Information Administration. Average Retail Price of Electricity: 2006.
4. Lime cost: U.S. Geological Survey. Mineral Commodity Summaries 2008. Hydrated Lime Average Value, 2007.
5. Water cost: Air Compliance Advisor, version 7.5.
6. Compressed air cost: P2Pays.org. Energy Tips – Compressed Air. Compressed Air Tip Sheet #1. August 2004.
7. Dust disposal cost: NSWMA's 2005 Tip Fee Survey.

Table 8. ESP Costs

Parameters/Costs	Dry ESP Large (before WS)	Wet ESP Large (after WS)	Notes
A. Input Parameters			
1. Inlet stream flow rate, dscfm	4,000	4,000	
2. Inlet stream moisture content, %	10	10	
3. Inlet stream temperature, °F	300	130	
4. Water added in quench before wet scrubber, scfm	N/A	259	
5. Inlet stream flowrate, acfm	6,397	5,256	
6. Particulate type	fly ash	fly ash	
7. ESP type ('flat plate' =1; 'plate wire' = 2)	2	2	
8. ESP 'options' included? ('yes'=1; 'no'=0)	1	1	
9. Inlet particulate loading, gr/dscf	10.0	10.0	
10. Particulate mass median diameter, microns	15	15	
11. Most penetrating particle size, microns	2	2	
12. Particle rapping puff size, microns	5	5	
13. Particulate resistivity, ohm-cm	2.0E+07	2.0E+07	No severe back corona if <2.0E+11
14. Overall PM collection efficiency, fraction	0.990	0.990	
15. PM migration velocity, cm/s	9.4	9.4	From Table 6.2
16. Sneakage factor	0.07	0.05	From page 6-30
17. Rapping reentrainment factor	0.124	0.000	From page 6-31
18. Gas free space permittivity, F/m	8.8E-12	8.8E-12	
19. ESP pressure drop, in. w.c.	0.38	0.38	From Table 6.6
20. Material of construction (see list below)	1	1	
B. Design Parameters			
1. Overall penetration	0.010	0.010	
2. Specific collection area #1, ft^2/1000 acfm	248.9	248.9	
3. Gas viscosity, kg/m-s	2.3E-05	2.0E-05	
4. Electric field at sparking, V/m	3.1E+05	4.7E+05	
5. Average electric field, V/m	1.8E+05	2.7E+05	Need to multiply by 0.7 if back corona is severe
6. Loss factor	0.185	0.050	
7. Number of collecting sections in ESP	3	2	
8. Average section penetration	0.2154	0.1000	
9. Section collection penetration	0.0370	0.0526	If this value is negative, n must be increased
10. Particle size change factor (D), micron	0.2154	0.1000	
11. Particle size change factor (MMDrp), micron	2.577	0.000	
12. Section parameters table:			
Dry ESP		Wet ESP	
Section # MMDi SCAi	MMDi	SCAi	
1 15 17.57	15	5.80	
2 7.877 33.46	8.913	9.76	
3 5.517 47.78	0.000	0.00	
4 0.000 0.00	0.000	0.00	
5 0.000 0.00	0.000	0.00	
6 0.000 0.00	0.000	0.00	
13. Specific collection area #2, s/m	98.81	15.57	
14. ESCA #2, ft^2/1,000 acfm	501.96	79.07	
15. Total collector plate area, ft^2 (use max of SCA #1 and #2)	3,211	1,308	Equipment cost correlation valid for >10,000 ft^2
C. Cost Inputs			
1. Operating factor, hr/yr	6,000	6,000	
2. Operating labor rate, $/hr	24	24	
3. Operating labor factor, hr/shift	0.5	0.5	

Table 8. ESP Costs

Parameters/Costs		Dry ESP Large (before WS)	Wet ESP Large (after WS)	Notes
4. Operating labor factor lookup table:				
Plate Area, ft^2	Factor, hr/shift			
0	0.5			
10,000	1.0			
100,000	1.5			
1,000,000	2.0			
5. Electricity price, $/kWh		$0.06	$0.06	
6. Dust disposal, $/ton (assumed transportation cost included)		$34.29	$34.29	
7. Water use in wet ESP, gal/min-kacfm			5.00	
8. Water cost, $/1,000 gal			$0.20	
9. Wastewater treatment, $/1,000 gal			$3.80	
10. Annual interest rate, fraction)		0.07	0.07	
11. Control system life, yrs		20	20	
12. Capital recovery factor		0.0944	0.0944	
13. Taxes, insurance & admin. Factor		0.04	0.04	
14. Cost index				
a. VAPCCI, fourth quarter 1998		107.7	107.7	
b. CE plant cost index, Oct 1998		391.5	391.5	
c. CE plant cost index, 2007		525.4	525.4	
D. Total Capital Investment, $				
1. Equipment costs				
a. Basic ESP		$97,576	$55,531	
b. ESP 'standard options'		$43,909	$24,989	
c. Auxiliaries (ductwork, etc.)		$0	$0	
d. Total (base)		$141,485	$80,520	
e. Total (escalated)		$288,439	$164,151	
2. Purchased equipment cost		$340,358	$193,698	
3. Retrofit factor		1.4	1.4	
4. Total		$1,067,363	$607,438	
E. Direct Annual Costs, $/yr				
1. Operating labor		$9,000	$9,000	
2. Supervisory labor		$1,350	$1,350	
3. ESP coordinator labor		$3,000	$3,000	
4. Maintenance labor		$7,920	$7,920	
5. Maintenance materials		$3,404	$1,937	
6. Electricity (only for ESP, not fan)		$2,303	$938	
7. Water		$0	$1,892	
8. Dust disposal (only PM from incinerator, not carbon)		$34,952	$0	
9. Wastewater disposal		$0	$35,948	
F. Indirect Annual Costs, $/yr				
1. Overhead		$14,804	$13,924	
2. Taxes, insurance, administrative		$42,695	$24,298	
3 Capital recovery		$100,752	$57,338	
G. Total Annual Cost				
1. $/yr		$220,178	$157,544	
2. $/dscfm		$55.04	$39.39	

Note:

Table 8. ESP Costs

Parameters/Costs	Dry ESP Large (before WS)	Wet ESP Large (after WS)	Notes

Material of construction, enter one: carbon steel--'1'; 316 stainless steel--'1.3'; Carpenter 20 (CB-3)--'1.9'; Monel-400--'2.3'; Nickel-200--'3.2'; titanium--'4.5'.

Source:
OAQPS Control Cost Manual.

Table 9. Carbon Adsorber Operating Costs

Parameters/Costs	Equation	ECU
A. Parameters		
1. Incinerator capacity, lb/hr (C)		1,000
2. Annual operating hours, hr/yr (H)		625
3. Exhaust gas flow rate, dscfm (Q)		3,124
4. Mercury concentration (after control), mg/dscm		0.00164
5. Mercury control efficiency (assumed), %		90
6. Mercury concentration (calculated uncontrolled), mg/dscm (U)		0.0164
7. Mercury emissions (uncontrolled), mg/yr	= U x Q x (1 m^3/35.3145 ft^3) x (60 min/hr) x H	54,404
8. Carbon consumption, lb/yr (AC)	= (338 mg/dscm) x Q x (1 m^3/35.3145 ft^3) x (1 kg/1,000 g) x (l lb/453.593 kg) x (60 min/hr) x H	2,472
9. Operating labor rate, $/hr (LR)		$24
10. Carbon cost, $/lb (ACC)		$1.38
11. Spent carbon landfill disposal cost, $/ton (DDC)		$34.29
B. Direct Annual Costs, $/yr		
1. Operating labor	= (if Q < 10,000, then 0, otherwise 0.5 hr/shift) x H x LR	$0
2. Supervisory labor	= 0.15 x (operating labor)	$0
3. Maintenance labor	= (0.5 hr/8-hr shift) x H x (LR x 1.1)	$1,031
4. Maintenance materials	= maintenance labor	$1,031
5. Carbon	= (AC) x (ACC)	$3,411
6. Carbon disposal	= (AC) x (DCC) x (1 ton/2,000 lb)	$42
C. Indirect Annual Costs, $/yr		
1. Overhead	= 0.6 x (labor + maintenance materials)	$1,238
D. Total Annual Operating Cost, $/yr	= Direct Annual Costs + Indirect Annual Costs	$6,754

Note:
Assumed that the amount of carbon needed in a carbon bed would be equivalent to that used in ACI calculation. Also assumed the carbon is not regenerated.

Sources:
1. Mercury concentration after control: East Carolina University Test Report-January 2000.
2. Carbon consumption, mercury concentration (338 mg/dscm): Model Plant Description and Cost Report.
3. Cost equations: OAQPS Control Cost Manual.

Table 10. Selective Noncatalytic Reduction Costs

Parameters/Costs	Equation	Large
A. Parameters		
1. Incinerator capacity, lb/hr (C)		1,500
2. Annual operating hours, hr/yr (H)		6,000
3. Exhaust gas flow rate, dscfm (Q)		4,000
4. NO_X, lb/MMBtu		0.28
5. Heating value, Btu/lb (HV)		8,500
6. Urea solution cost, $/gal (U)		$0.85
7. Electricity cost, $/kWh (EC)		$0.06
8. Water cost, $/1,000 gal (WC)		$0.20
9. Capital recovery factor, 20-yr equipment life, 7% interest (CRF)	= $[i \times (1 + i)^a] / [(1 + i)^a - 1]$, where i = interest rate, a = equipment life	0.09439
10. Cost index		
a. 2007		525.4
b. 1998		390.6
B. Total Capital Investment, $ (TCI)		
1. Total Direct Capital Cost (DC)	= [$950/(MMBtu/hr)] x $[(C \times HV) / 10^6] \times [(2{,}375$ MMBtu/hr / $(C \times HV)]^{0.577} \times (0.66 + 0.85 \times 45\%$ NO_X removal efficiency) x (1.2 retrofit factor) x (525.4/390.6)	$416,033
2. Indirect Installation Costs, $ (IC)	= 0.2 x DC	$83,207
3. Other Capital Costs, $ (OC)	= [0.173 x (DC + IC)] + (119.3 gal x U)	$86,470
4. Total	= DC + IC + OC	$585,709
C. Direct Annual Costs, $/yr		
1. Maintenance	= 0.015 x TCI	$8,786
2. Reagent	= (0.36 gal/hr) x H x U	$1,836
3. Electricity	= kW $[0.47 \times NO_X \times (C \times HV) / 10^6] / 9.5 \times H \times EC$	$65
4. Water	= 1.62 gal/hr x H x WC	$1,944
D. Indirect Annual Costs, $/yr		
1. Capital recovery	= CRF x TCI	$55,287
E. Total Annual Cost		
1. $/yr	= Direct Annual Costs + Indirect Annual Costs	$67,918
2. $/dscfm	= ($/yr) / Q	$16.98

Sources:

1. Cost equations, urea solution cost: OAQPS Control Cost Manual. Section 4.2: NO_X Post-Combustion, Chapter 1: Selective Noncatalytic Reduction.
2. Heating value: Process Description Report (II-A-110).
3. Electricity cost: Energy Information Administration. Average Retail Price of Electricity: 2006.
4. Water cost: Air Compliance Advisor, version 7.5.
5. NO_X removal efficiency: Clean Air Technology Center. EPA Technical Bulletin: Nitrogen Oxides (NO_X)--Why and How They Are Controlled. 456/F-99-006R. November 1999.

Table 11. Activated Carbon Injection Costs

Parameters/Costs	Equation	Large	Medium
A. Parameters			
1. Incinerator capacity, lb/hr (C)		1,500	500
2. Annual operating hours, hr/yr (H)		6,000	2,000
3. Exhaust gas flow rate, dscfm (Q)		4,000	1,800
4. Operating labor rate, $/hr (LR)		$24	$24
5. Activated carbon cost, $/lb (ACC)		$1.38	$1.38
6. Dust disposal cost, $/ton (DDC)		$34.29	$34.29
7. Capital recovery factor, 20-yr equipment life, 7% interest (CRF)	= $[i \times (1 + i)^a] / [(1 + i)^a - 1]$, where i = interest rate, a = equipment life	0.09439	0.09439
8. Cost index			
a. 2007		525.4	525.4
b. 1990		361.3	361.3
B. Total Capital Investment, $	= $4{,}500 \times (Q/1{,}976)^{0.6}$ x (1.2 retrofit factor) x (525.4/361.3)	$11,989	$7,425
C. Direct Annual Costs, $/yr			
1. Operating labor	= (0.25 hr/8-hr shift) x H x LR	$4,500	$1,500
2. Supervisory labor	= 0.15 x (operating labor)	$675	$225
3. Maintenance	= 0.2 x TCI	$2,398	$1,485
4. Activated carbon	= 0.00127 x Q x H x ACC	$42,062	$6,309
5. Dust disposal	= 0.00127 x Q x (1 ton/2,000 lb) x H x DDC	$523	$78
D. Indirect Annual Costs, $/yr			
1. Overhead	= 0.6 x (labor + maintenance materials)	$4,544	$1,926
2. Property taxes, insurance, and administration	= 0.04 x TCI	$480	$297
3. Capital recovery	= CRF x TCI	$1,132	$701
E. Total Annual Cost			
1. $/yr	= Direct Annual Costs + Indirect Annual Costs	$56,313	$12,522
2. $/dscfm	= ($/yr) / Q	$14.08	$6.96

Note:
Factor of 1.27×10^{-3} for activated carbon is based on injecting carbon at a rate to achieve a carbon concentration of 338 mg/dscm (achieving reductions of 90% for Hg, 98% for CDD/CDF).

Sources:
1. Cost equations: Model Plant Description and Cost Report (II-A-112).
2. Operating labor rate: Bureau of Labor Statistics, Occupational Employment Statistics, May 2007 National Industry-Specific Occupational Employment and Wage Estimates.
3. Activated carbon cost: The Innovation Group. Chemical Profiles: Carbon, Activated. 2002. Assumed 20% price increase based on online information from Norit, an activated carbon vendor.
4. Dust disposal cost: NSWMA's 2005 Tip Fee Survey.

Table 12. Maintenance and Inspection Costs

Parameters	Equation	Values
A. Parameters		
1. Cost index		
a. 2007		525.4
d. 1992		358.2
B. Maintenance/Inspection Cost, $/yr (rounded)		
1. Company A	= $500 x (525.4/358.2)	$700
2. Company B	= $350 x (525.4/358.2)	$500
3. Company C	= $800 x (525.4/358.2)	$1,200
4. Company D	= $750 x (525.4/358.2)	$1,100
5. Average	= ∑ (Companies A-D) / 4	$900

Note:
Maintenance/inspection costs have been rounded to the nearest $100 to be consistent with level of rounding in original costs.

Source:
Maintenance/Inspection Programs Memorandum (II-B-88).

Table 13. Parameter Monitoring Costs

Parameters/Costs	Equation	Large							Medium	
		DIFF	FF	WS	DIFF/WS, DI-ESP/WS	CA/WS, WS/WESP	SNCR	ACI	DIFF	WS
A. Parameters										
1. Recording charge weight and hourly rate, min/hr	= (10 sec/load) x (1 min/60 sec) x (8 loads/hr)	1.3	1.3	1.3	1.3	1.3	1.3		1.3	1.3
2. Recording lime/carbon flow, min/4-hr period		5	5	5	5	5	5	5	5	5
3. Annual operating hours, hr/yr (H)		6,000	6,000	6,000	6,000	6,000	6,000	6,000	2,000	2,000
4. Cost index										
a. 2007		525.4	525.4	525.4	525.4	525.4	525.4	525.4	525.4	525.4
b. 1997		386.5	386.5	386.5	386.5	386.5	386.5	386.5	386.5	386.5
c. 1993		359.2	359.2	359.2	359.2	359.2	359.2	359.2	359.2	359.2
d. 1992		358.2	358.2	358.2	358.2	358.2	358.2	358.2	358.2	358.2
5. Operating labor wage rate, $/hr (LR)		$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00	$24.00
6. Capital recovery factor, 20-yr equipment life, 7% interest (CRF)	= $[i \times (1 + i)^a] / [(1 + i)^a - 1]$, where i = interest rate, a = equipment life	0.09439	0.09439	0.09439	0.09439	0.09439	0.09439	0.09439	0.09439	0.09439
C. Total Capital Investment, $ (TCI)										
1. Planning	= $500 x (525.4/386.5)	$700	$700	$700	$700	$700	$700		$700	$700
2. Select type of equipment	= $300 x (525.4/386.5)	$400	$400	$400	$400	$400	$400		$400	$400
3. Provide support facilities	= $1,000 x (525.4/386.5)	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400		$1,400	$1,400
4. Purchased equipment cost (PEC)										
a. Scale/parameter monitors	= $10,400 x (525.4/359.2) (good comb.)	$15,400	$15,400	$20,800	$20,900	$20,900	$4,900		$15,400	$20,800
	= $10,500 x (525.4/359.2) (DIFF, FF)									
	= $14,200 x (525.4/359.2) (WS)									
	= $14,300 x (525.4/359.2) (DIFF/WS, etc.)									
b. Taxes and freight	= 0.08 x scale/monitor cost	$1,200	$1,200	$1,700	$1,700	$1,700	$400		$1,200	$1,700
5. Install and check equipment	= $150 x (525.4/359.2) (good comb.)	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000		$1,000	$1,000
	= $650 x (525.4/359.2) (everything else)									
6. Perf. spec. tests (certif.)	= $500 x (525.4/386.5)	$700	$700	$700	$700	$700	$700		$700	$700
7. Prepare QA/QC plan	= $500 x (525.4/386.5)	$700	$700	$700	$700	$700	$700		$700	$700
8. Total capital cost	= Planning + selecting equipment + support facilities + PEC + installation + perf. spec. tests + QA/QC plan	$21,500	$21,500	$27,400	$27,500	$27,500	$10,200		$21,500	$27,400
D. Annual Costs, $/yr										
1. Operating labor										
a. Recording charge weight and hourly rate	= (Recording charge weight and hourly rate) x (1 hr/60 min) x H x LR	$3,200	$3,200	$3,200	$3,200	$3,200			$1,100	$1,100
b. Recording lime or carbon flow measurements	= (Recording flow/4-hr period) x (1 hr/60 min) x H x LR	$3,000			$3,000			$3,000	$1,000	
2. Maintenance materials	= 0.02 x TCI	$400	$400	$500	$600	$600	$200		$400	$500
3. Recordkeeping and reporting	= $1,000 x (525.4/386.5)	$1,400	$1,400	$1,400	$1,400	$1,400	$1,400		$1,400	$1,400
4. Overhead	= 0.6 x (labor + maintenance materials)	$4,000	$2,200	$2,200	$4,100	$2,300	$100	$1,800	$1,500	$1,000
5. Property taxes, insurance, and administration	= 0.04 x TCI	$900	$900	$1,100	$1,100	$1,100	$400		$900	$1,100
6. Capital recovery	= CRF x TCI	$2,000	$2,000	$2,600	$2,600	$2,600	$1,000		$2,000	$2,600
7. Total annual cost	=SUM(C29:C34)	$14,900	$10,100	$11,000	$16,000	$11,200	$3,100	$4,800	$8,300	$7,700

Note:
1. Monitoring costs have been rounded to the nearest $100 to be consistent with level of rounding in original costs.
2. Monitoring for DI-ESP/WS similar to DIFF/WS, so used same costs.
3. Monitoring for WS/WESP and CA/WS similar to FF/WS, so used same costs.

Sources:

Table 13. Parameter Monitoring Costs

Parameters/Costs	Equation	Large							Medium	
		DIFF	FF	WS	DIFF/WS, DI-ESP/WS	CA/WS, WS/WESP	SNCR	ACI	DIFF	WS

1. Testing and Monitoring Options and Costs Memo (IV-B-66).
2. E-mail and attachment from Peter Westlin, EPA, to Mary Johnson, EPA. August 19, 2008. Monitoring Options for SNCR on Medical Waste Incinerators.
3. E-mail from Dan Bivins, EPA, to Mary Johnson, EPA. September 27, 2006. Cost of CO CEMS.

Table 13. Parameter Monitoring Cos

Parameters/Costs	ACI	Small WS
A. Parameters		
1. Recording charge weight and hourly rate, min/hr		1.3
2. Recording lime/carbon flow, min/4-hr period	5	5
3. Annual operating hours, hr/yr (H)	2,000	4,000
4. Cost index		
a. 2007	525.4	525.4
b. 1997	386.5	386.5
c. 1993	359.2	359.2
d. 1992	358.2	358.2
5. Operating labor wage rate, $/hr (LR)	$24.00	$24.00
6. Capital recovery factor, 20-yr equipment life, 7% interest (CRF)	0.09439	0.09439
C. Total Capital Investment, $ (TCI)		
1. Planning		$700
2. Select type of equipment		$400
3. Provide support facilities		$1,400
4. Purchased equipment cost (PEC)		
a. Scale/parameter monitors		$20,800
b. Taxes and freight		$1,700
5. Install and check equipment		$1,000
6. Perf. spec. tests (certif.)		$700
7. Prepare QA/QC plan		$700
8. Total capital cost		$27,400
D. Annual Costs, $/yr		
1. Operating labor		
a. Recording charge weight and hourly rate		$2,100
b. Recording lime or carbon flow measurements	$1,000	
2. Maintenance materials		$500
3. Recordkeeping and reporting		$1,400
4. Overhead	$600	$1,600
5. Property taxes, insurance, and administration		$1,100
6. Capital recovery		$2,600
7. Total annual cost	$1,600	$9,300

Note:
1. Monitoring costs have been rounded to the nearest
2. Monitoring for DI-ESP/WS similar to DIFF/WS, so u
3. Monitoring for WS/WESP and CA/WS similar to FF/

Sources:

Table 13. Parameter Monitoring Cos

Parameters/Costs	ACI	Small WS
1. Testing and Monitoring Options and Costs Memo ('		

2. E-mail and attachment from Peter Westlin, EPA, to
3. E-mail from Dan Bivins, EPA, to Mary Johnson, EP

Table 13. Parameter Monitoring Cos

Parameters/Costs	Small rural Good comb.
A. Parameters	
1. Recording charge weight and hourly rate, min/hr	1.3
2. Recording lime/carbon flow, min/4-hr period	5
3. Annual operating hours, hr/yr (H)	1,500
4. Cost index	
a. 2007	525.4
b. 1997	386.5
c. 1993	359.2
d. 1992	358.2
5. Operating labor wage rate, $/hr (LR)	$24.00
6. Capital recovery factor, 20-yr equipment life, 7% interest (CRF)	0.09439
C. Total Capital Investment, $ (TCI)	
1. Planning	$700
2. Select type of equipment	$400
3. Provide support facilities	$1,400
4. Purchased equipment cost (PEC)	
a. Scale/parameter monitors	$15,200
b. Taxes and freight	$1,200
5. Install and check equipment	$200
6. Perf. spec. tests (certif.)	$700
7. Prepare QA/QC plan	$700
8. Total capital cost	$20,500
D. Annual Costs, $/yr	
1. Operating labor	
a. Recording charge weight and hourly rate	$800
b. Recording lime or carbon flow measurements	
2. Maintenance materials	$400
3. Recordkeeping and reporting	$1,400
4. Overhead	$700
5. Property taxes, insurance, and administration	$800
6. Capital recovery	$1,900
7. Total annual cost	$6,000

Note:
1. Monitoring costs have been rounded to the nearest
2. Monitoring for DI-ESP/WS similar to DIFF/WS, so u
3. Monitoring for WS/WESP and CA/WS similar to FF/

Sources:

Table 13. Parameter Monitoring Cos

Parameters/Costs	Small rural Good comb.
1. Testing and Monitoring Options and Costs Memo (I	

2. E-mail and attachment from Peter Westlin, EPA, to
3. E-mail from Dan Bivins, EPA, to Mary Johnson, EP

Table 14. Stack Testing Costs

Parameters		Values
A. Testing Costs, $		
1. Method 5 (PM)	= $8,000 x (525.4/358.2)	$12,000
2. Method 9 (opacity)	= $1,000 x (525.4/358.2) + $1,500	$2,500
3. Method 10 (CO)	= $4,000 x (525.4/358.2) + $1,000	$7,000
4. Method 26 (HCl)	= $5,000 x (525.4/358.2)	$7,000

Note:
1. Testing costs have been rounded to the nearest $1,000 (except for opacity) to be consistent with level of rounding in original costs; costs also adjusted based on additional information from EPA.
2. Multiple test costs adjusted by 2/3 in nationwide cost estimates to account for travel, accomodations, etc. common to all tests.

Sources:
1. Memorandum from R. Segall, EPA/EMB, to R. Copland, EPA/SDB. October 14, 1992. Medical Waste Incinerator Study: Emission Measurement and Continuous Monitoring. (II-B-89)
2. E-mail from Jason Dewees, EPA, to Mary Johnson, EPA. August 20, 2008. Monitoring Options for SNCR & Test Cost Questions.

Table 15. Recordkeeping and Reporting Costs

Burden item	(A) Person-hours per occurrence	(B) Number of occurrences per year	(C) Person-hours per respondent per year (C = A x B)	(D) Respondents per year	(E) Technical person-hours per year (E = C x D)	(F) Management person-hours per year (F = E x 0.05)	(G) Clerical person-hours per year (G = E x 0.1)	(H) Total person-hours per year (H = E + F + G)	(I) Cost, $	(J) Cost per respondent, $
A. Applications	N/A									
B. Surveys and Studies	N/A									
C. Reporting Requirements										
1. Read instructions	N/A									
2. Required activities										
a. Annual update of operating information	20	1	20	57	1,140	57	114	1,311	$49,706	$872
b. Review of operating information with each operator	8	2	16	57	912	46	91	1,049	$39,765	$698
3. Write report										
a. Annual report										
i. CMS emissions/operating parameters	32	1	32	57	1,824	91	182	2,098	$79,529	$1,395
ii. Report of no exceedances										
--Small rural HMIWI	8	1	8	2	16	1	2	18	$698	$349
--All other HMIWI	32	1	32	55	1,760	88	176	2,024	$76,739	$1,395
iii. Results of performance tests conducted during the year										
--Small rural HMIWI	8	1	8	2	16	1	2	18	$698	$349
--All other HMIWI	40	1	40	55	2,200	110	220	2,530	$95,923	$1,744
D. Recordkeeping Requirements										
1. Read instructions	N/A									
2. Plan activities	N/A									
3. Implement activities	N/A									
4. Develop record system	N/A									
5. Time to enter information										
a. Records of startup, shutdown, or malfunction	1.5	52	78	57	4,446	222	445	5,113	$193,852	$3,401
b. Records of persons completing review of operating information	2	2	4	57	228	11	23	262	$9,941	$174
c. Records of annual and any subsequent compliance tests	Incl. in 3C									
d. Records of process and control device operating parameters										
i. Small rural HMIWI	0.5	52	26	2	52	3	5	60	$2,267	$1,134
ii. All other HMIWI	1.5	52	78	55	4,290	215	429	4,934	$187,050	$3,401
e. Records of CMS operation and maintenance	0.025	365	9	57	520	26	52	598	$22,678	$398
6. Time to train personnel	40	1	40	57	2,280	114	228	2,622	$99,411	$1,744
7. Time for audits	N/A									
E. Total Labor Burden and Cost					19,684	984	1,968	22,637	$858,257	

Notes:
1. Estimate that 57 HMIWI are operating, including 2 small rural units and 55 other units (large, medium, small non-rural).
2. Industry costs are based on the following hourly rates: technical at $37.55, management at $78.76, and clerical at $21.10 (see table below). The composite hourly labor rate is ($37.55/hr) + (0.05 x $78.76/hr) + (0.1 x $21.10/hr) = $43.60/hr. Labor rates were increased by 60% to account for overhead.
3. Inspection cost already accounted for under monitoring costs.
4. Assume 20 hours to update the operating information each year.
5. Assume 8 hours to review the operating information with each operator.
6. Review of operating information assumes 2 operators per facility. Also assume there is no operator turnover at the affected facilities.
7. Person-hours per occurrence for annual report of CMS operating parameters are based on the reporting and recordkeeping costs for CMS ($1,400) divided by the composite hourly rate ($43.60/hr).
8. Assume 8 person-hours per report per pollutant to report no excess emissions. For small rural HMIWI, testing and monitoring focus on stack opacity. For the remaining HMIWI, testing and monitoring focus primarily on three pollutants (PM, CO, and HCl) and stack opacity.
9. Assume all respondents in compliance and report no exceedances.
10. For small rural HMIWI, assume 8 hours to review report of annual stack opacity compliance test. For the remaining HMIWI, assume 40 hours to review report of annual PM, CO, HCl, and stack opacity compliance tests.
11. These records are kept on a weekly basis.
12. Assume 2 operators per facility and no operator turnover at the affected facilities, but no facilities will need to complete initial operator training requirements (only annual refresher training).
13. For small rural HMIWI, assume 0.5 hours per week to record process and control device operating parameters and to record any exceedances of these parameters. For the remaining HMIWI, assume 1.5 hours per week to record operating parameters and parameter exceedances.
14. Person-hours per occurrence for CMS operation and maintenance (O&M) are based on the O&M cost for CMS divided by the composite hourly labor rate and the operating days per year, determined for each existing HMIWI, and then averaged.
15. Time to train personnel based on the time per year to train one person to perform the Method 9 and Method 22 tests. The labor requirements to train the personnel were estimated to be 8 hours per day for 5 days per year.
16. The average recurrent burden and cost in the first 3 years after promulgation for the sources with recurrent burden are equal to the person-hours added down each column for technical, management, and clerical and the sum of the cost column.

Sources:
1. Bureau of Labor Statistics, Occupational Employment Statistics, May 2007 National Industry-Specific Occupational Employment and Wage Estimates.
2. Testing and Monitoring Options and Costs Memo (IV-B-66).

Labor Rates:

Parameter	General Medical & Surgical Hospitals	Waste Treatment & Disposal	Colleges, Universities, & Professional Schools	Pharmaceutical & Medicine Manufacturing	Total	Loaded
% of industry (excluding U.S. military/gov. research facilities)	58.49%	26.42%	7.55%	7.55%	100.00%	
Technical - Stationary Engineers & Boiler Operators	$23.80	$23.31	$22.01	$22.94	$23.47	$37.55
Management - Engineering Managers	$45.95	$55.00	$47.07	$56.56	$49.23	$78.76
Clerical - Office Clerks, General	$13.16	$12.75	$12.53	$15.63	$13.19	$21.10
Composite labor rate						$43.60

Table 16. Autoclave/Landfill Costs

Parameters/Costs	Equation	Large	Medium	Small	Small rural
A. Parameters					
1. Incinerator capacity, lb/hr (C)		1,500	500	100	125
2. Annual operating hours, hr/yr (H)		6,000	2,000	4,000	1,500
3. Landfill tip fee (national average), $/ton		$34.29	$34.29	$34.29	$34.29
B. Total Capital Investment, $		$1,000,000	$450,000	$350,000	$350,000
C. Annual Costs, $/lb					
1. Autoclave		$0.02	$0.02	$0.06	$0.06
2. Biological indicators test	= [($7/test kit) x (12 tests/yr) + (0.5 hr/test) x (12 tests/yr) x ($20/hr)]/ (312 d/yr) / (50,000 lb waste/d)	$0.000013	$0.000013	$0.000013	$0.000013
3. Inspections	= 2 hr/inspection x 1 inspection/yr x ($20/hr) / (312 d/yr) / (50,000 lb waste/d)	$0.000003	$0.000003	$0.000003	$0.000003
4. Permit fee	= ($500/yr) / (312 hr/yr) / (50,000 lb waste/d)	$0.00003	$0.00003	$0.00003	$0.00003
6. Total					
a. Without landfill tip fee	= Autoclave + biological indicators test + inspections + permit fee	$0.02	$0.02	$0.06	$0.06
b. With landfill tip fee	= Autoclave + biological indicators test + inspections + permit fee + (landfill tip fee/2,000 lb/ton)	$0.03	$0.04	$0.07	$0.07
D. Annual Costs (with landfill tip fee), $/yr	= Total annual cost x (C x 0.67) x H	$205,273	$27,758	$19,497	$9,139

Notes:

1. Annual autoclave costs include operational costs (chamber liners, labor, capital expense, maintenance, steam, electricity) and hauling costs. Hauling costs from vendor were revised to extract landfill costs, which will be applied to each HMIWI on a regional basis in estimating nationwide costs. National average landfill tip fees used to estimate model costs.
2. The vendor's labor rate and operating time were used in costing the biological indicators test, inspections, and permit fee in order to be consistent with the approach used in the vendor's autoclave costs.

Sources:

1. Autoclave costs and biological indicators test (test kit): San-I-Pak, July 2008.
2. Biological indicators test (labor), inspections, and permit fee: Bay Area Dioxins Project, June 2003.

Table 17. Nationwide Comparison of Baseline Operating Costs and Autoclave/Landfill Costs

FACID	UNITID	Facility name	Unit number	City	State	Category	New/ existing	APCD code	APCD type	APCD description
1	1	Bristol-Myers Squibb Co.		Wallingford	CT	L	E	FF	Dry	Secondary chamber (1800F) and baghouse
5	5	Merck & Company, Inc.		Rahway	NJ	L	E	DIFF	Dry	Secondary chamber (1500F, 1 sec), partial quench, dry acid gas scrubber with dry lime injection, and baghouse
15	15--1	Curtis Bay Energy	Unit 1	Baltimore	MD	L	E	DIFF	Dry	Secondary chamber, dry scrubber, and baghouse
15	15--2	Curtis Bay Energy	Unit 2	Baltimore	MD	L	E	DIFF	Dry	Secondary chamber, dry scrubber, and baghouse
20	20--1	Fort Detrick	Unit 5	Fort Detrick	MD	L	E	WS	Wet	Secondary chamber and rotary atomizing wet scrubber
20	20--2	Fort Detrick	Unit 6	Fort Detrick	MD	L	E	WS	Wet	Secondary chamber and rotary atomizing wet scrubber
29	29	Hamot Medical Center		Erie	PA	L	E	DIFF/WS	Dry/wet	Secondary chamber (2000F, 2 sec), lime injection system, powdered activated carbon injection system, baghouse, and vertical upflow two-stage multi-microventuri scrubber system
36	36--1	Merck & Company, Inc.	Unit 2	West Point (Upper Gwynedd Township)	PA	L	E	DIFF	Dry	Secondary/tertiary chamber (2000F, 2 sec), water quench followed by sodium bicarbonate injection system with dry reaction chamber and pulse-jet baghouse
36	36--2	Merck & Company, Inc.	Unit 5	West Point (Upper Gwynedd Township)	PA	L	E	DIFF	Dry	Secondary chamber (1800F, 2.2 sec), water quench followed by sodium bicarbonate injection system and pulse-jet baghouse
40	40	Charleston Area Medical Center, General Hospital		Charleston	WV	L	E	DIFF	Dry	Secondary chamber (1800F, 2 sec), dry injection/baghouse scrubber system with activated carbon
42	42	Stericycle, Inc.		Apopka	FL	L	E	DIFF	Dry	Secondary chamber (1800, 1 sec), dry scrubbing system with quench chamber, passive absorber, lime and carbon injection, and baghouse.
43	43	Boca Raton Community Hospital		Boca Raton	FL	L	E	WS	Wet	Secondary chamber (1800F, 1 sec) and rotary atomizing wet scrubber system with caustic soda injection
44	44	Bethesda Memorial Hospital		Boynton Beach	FL	L	E	WS	Wet	Secondary chamber (1800F, 2 sec) and rotary atomizing scrubber with mist eliminator
46	46	Holy Cross Hospital		Fort Lauderdale	FL	L	E	WS	Wet	Secondary chamber (1800F, 1 sec) and venturi scrubber with packed bed absorption unit using dilute NaOH
48	48	Memorial Regional Hospital		Hollywood	FL	L	E	WS/WESP	Wet	Secondary chamber (1800F, 1 sec), packed column gas scrubber, and wet ESP
51	51	Lakeland Regional Medical Center		Lakeland	FL	L	E	DIFF	Dry	Secondary chamber (1800F, 1 sec), lime injection system, and baghouse
54	54	Bayfront Medical Center		St. Petersburg	FL	L	E	WS	Wet	Secondary chamber (1800F, 1 sec) and flux force/condensation collision scrubber system using dilute NaOH
55	55	St. Joseph's Hospital		Tampa	FL	L	E	DIFF/WS	Dry	Secondary chamber (1800F, 1 sec), lime injection, baghouse, and venturi scrubber
59	59--1	Stericycle, Inc.	Unit 1	Haw River	NC	L	E	WS	Wet	Secondary chamber (1800F, 1 sec), rapid gas quench system, wet scrubber system consisting of a packed bed absorber and venturi scrubber, and demister.
59	59--2	Stericycle, Inc.	Unit 2	Haw River	NC	L	E	WS	Wet	Secondary chamber (1800F, 1 sec), rapid gas quench system, wet scrubber system consisting of a packed bed absorber and venturi scrubber, and demister.
60	60--1	BMWNC, Inc.	Unit 1	Matthews	NC	L	E	DIFF	Dry	Secondary chamber (1641F), dry scrubber with lime and activated carbon injection, and baghouse
65	65--1	Stericycle, Inc.	Unit 1	Clinton	IL	L	E	WS	Wet	Secondary chamber (1800F), venturi scrubber, and condensing absorber
65	65--2	Stericycle, Inc.	Unit 2	Clinton	IL	L	E	WS	Wet	Secondary chamber (1800F), venturi scrubber, and condensing absorber
71	71	Loyola University Medical Center		Maywood	IL	L	E	WS	Wet	Two secondary chambers (1600F), twin rotary atomizer scrubber using 50% caustic solution, and two demister pads
77	77	Parkview Hospital		Fort Wayne	IN	L	E	WS	Wet	Secondary chamber and wet scrubber
84	84	Mayo Clinic, Waste Management Facility		Rochester	MN	L	E	DIFF	Dry	Secondary chamber (1800F, 1 sec) and baghouse with lime and carbon injection
87	87	MedCentral Health System, Mansfield Hospital		Mansfield	OH	L	E	DIFF	Dry	Secondary chamber (1800F, 2 sec) and baghouse with lime and carbon injection system
94	94	Stericycle, Inc.		Warren	OH	L	E	WS	Wet	Secondary chamber (1800F, 2 sec), wet scrubber
98	98--1	University of Texas Medical Branch		Galveston	TX	L	E	WS	Wet	Secondary chamber, packed tower, and venturi scrubber with activated carbon injection
106	106	Stericycle, Inc.		Kansas City	KS	L	E	WS	Wet	Secondary chamber (1800F, 2 sec), wet scrubber
109	109	Healthcare Environmental Services Inc.		Fargo	ND	L	E	DIFF	Dry	Secondary chamber (1800F) and dry scrubber/baghouse system with lime and carbon injection

Table 17. Nationwide Comparison of Baseline Operating Costs and Autoclave/Landfill Costs

FACID	UNITID	Facility name	Unit number	City	State	Category	New/ existing	APCD code	APCD type	APCD description
110	110	Stericycle, Inc.		North Salt Lake	UT	L	E	DI-ESP/WS	Dry/wet	Secondary chamber (1834F), carbon injection system, ESP, dry scrubber, and wet gas absorber
120	120--1	Municipality of Chambers County, Resource Recovery Center	Unit 1	Anahuac	TX	L	N	DIFF	Dry	Secondary chamber, baghouse with virgin lime injection, urea injection, and activated carbon injection
120	120--2	Municipality of Chambers County, Resource Recovery Center	Unit 2	Anahuac	TX	L	N	DIFF	Dry	Secondary chamber, baghouse with virgin lime injection, urea injection, and activated carbon injection
125	125	East Carolina University, Health Sciences Campus, HSC Utility Plant		Greenville	NC	L	N	CA/WS	Dry/wet	Secondary chamber (1985F), rotary atomizing wet scrubber (with NaOH scrubbing medium), carbon bed adsorber, HEPA filtering system, and heat recovery system
130	130	Department of Veterans Affairs Medical Center		Miami	FL	L	E	WS	Wet	Secondary chamber (1800F, 1 sec), venturi scrubber, and packed tower absorber
13	13	University of Maryland at Baltimore, Environmental Health and Safety Facility		Baltimore	MD	M	E	WS	Wet	Secondary chamber (1832F) and venturi caustic scrubber with packed-bed scrubber
16	16	Johns Hopkins Medical Institute, Department of Health, Safety, and Environment		Baltimore	MD	M	E	WS	Wet	Secondary chamber (1800F) and venturi wet scrubber followed by saturation chamber and mist eliminator
18	18	Franklin Square Hospital Center		Baltimore	MD	M	E	WS	Wet	Secondary chamber (1800F) and venturi scrubber followed by quench chamber and mist eliminator
21	21	Washington County Hospital		Hagerstown	MD	M	E	WS	Wet	Secondary chamber and venturi caustic scrubber
25	25	Holy Spirit Hospital		Camp Hill	PA	M	E	WS	Wet	Secondary chamber (1800F) and venturi scrubber with prequench and NaOH injection
30	30	Riddle Memorial Hospital		Media	PA	M	E	WS	Wet	Secondary chamber (1800F, 2 sec), caustic packed tower scrubber, and high pressure venturi, with activated carbon injection
34	34	Pennsylvania State University, Animal Diagnostic Lab Incinerator		State College	PA	M	E	WS	Wet	Secondary chamber (1900F) and rotary atomizing wet scrubber with demister
38	38	Wilkes-Barre General Hospital		Wilkes-Barre	PA	M	N	DIFF	Dry	Secondary/tertiary chambers (1800F, 2.85 sec) and dry scrubber/baghouse with lime and activated carbon injection
41	41	Thomas Memorial Hospital		South Charleston	WV	M	E	WS	Wet	Secondary chamber (1800F) and venturi packed tower wet scrubber with caustic injection
47	47	Malcolm Randall Veterans Affairs Medical Center		Gainesville	FL	M	E	WS	Wet	Secondary chamber (1800F, 1 sec) and wet scrubber with caustic soda injection
63	63	St. Jude Children's Research Hospital		Memphis	TN	M	E	DIFF	Dry	Secondary chamber (1528F) and baghouse with sodium bicarbonate and carbon injection
81	81	South Bend Medical Foundation		South Bend	IN	M	E	WS	Wet	Secondary chamber and wet scrubber
82	82	Good Samaritan Hospital		Vincennes	IN	M	E	WS	Wet	Secondary chamber and multi-chamber spray scrubber
88	88	Medina General Hospital		Medina	OH	M	E	WS	Wet	Secondary chamber (1800F, 1 sec) and wet scrubber
95	95	St. Joseph's Hospital		Marshfield	WI	M	E	DIFF	Dry	Secondary chamber (1800F), quench tower, and baghouse with lime/carbon injection
108	108--1	Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases	Unit 1	Hamilton	MT	M	E	WS	Wet	Secondary chamber and wet scrubber
111	111	Wyoming Medical Center		Casper	WY	M	E	WS	Wet	Secondary chamber and wet scrubber
86	86	Fairfield Medical Center		Lancaster	OH	S	E	WS	Wet	Secondary chamber (1800F, 1 sec) and wet scrubber
129	129	Centers for Disease Control and Prevention--Clifton, Building 18	Unit 3	Atlanta	GA	S	N	WS	Wet	Secondary chamber (1800F, 1.68 sec) and rotary atomizing wet scrubber
115	115	Kona Community Hospital		Kealakekua	HI	SR	E	CC	Comb ctrl	Secondary chamber (1900F, 2 sec), no APCD
116	116	Yukon-Kuskokwim Delta Regional Hospital		Bethel	AK	SR	E	CC	Comb ctrl	Secondary chamber, no APCD
Total large										
Total medium										
Total small										
Total small rural										
Total nationwide										

Note:
Included CO CEMS cost for one unit. CO CEMS annual cost = $26,300 ($25,000 x 525.4/499.6). Source is e-mail from Dan Bivins, EPA, to Mary Johnson, EPA. September 27, 2006.

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	Maximum charge rate (lb/hr)	Stack gas flow rate (dscfm)	Stack gas temperature (°F)	Operating hours (hr/yr)	Autoclave ($/lb)	Landfill tip fee region	Landfill tip fee ($/ton)	Autoclave/ landfill cost	Incinerator operation	DIFF
1	1	Bristol-Myers Squibb Co.		1,000	1,648	217	2,072	$0.02	Northeast	$70.53	**$72,413**	**$115,222**	
5	5	Merck & Company, Inc.		799	7,346	246	4,321	$0.02	Mid-Atlantic	$46.29	**$92,623**	**$513,461**	$329,586
15	15--1	Curtis Bay Energy	Unit 1	7,083	27,698	296	8,736	$0.02	Mid-Atlantic	$46.29	**$1,660,043**	**$1,936,035**	$1,242,723
15	15--2	Curtis Bay Energy	Unit 2	7,083	30,578	303	8,736	$0.02	Mid-Atlantic	$46.29	**$1,660,043**	**$2,137,348**	$1,371,945
20	20--1	Fort Detrick	Unit 5	1,000	2,424	87	1,300	$0.02	Mid-Atlantic	$46.29	**$34,876**	**$169,431**	
20	20--2	Fort Detrick	Unit 6	1,000	2,308	92	1,300	$0.02	Mid-Atlantic	$46.29	**$34,876**	**$161,338**	
29	29	Hamot Medical Center		1,060	3,701	122	2,080	$0.02	Mid-Atlantic	$46.29	**$59,151**	**$258,679**	$166,044
36	36--1	Merck & Company, Inc.	Unit 2	2,000	5,235	358	865	$0.02	Mid-Atlantic	$46.29	**$46,413**	**$365,920**	$234,881
36	36--2	Merck & Company, Inc.	Unit 5	3,045	8,119	304	5,753	$0.02	Mid-Atlantic	$46.29	**$469,971**	**$567,529**	$364,292
40	40	Charleston Area Medical Center, General Hospital		1,000	4,323	312	1,248	$0.02	Mid-Atlantic	$46.29	**$33,481**	**$302,185**	$193,970
42	42	Stericycle, Inc.		1,900	7,008	327	7,951	$0.02	South	$30.97	**$327,757**	**$489,813**	$314,407
43	43	Boca Raton Community Hospital		730	2,078	91	8,736	$0.02	South	$30.97	**$138,361**	**$145,213**	
44	44	Bethesda Memorial Hospital		1,000	4,537	106	3,024	$0.02	South	$30.97	**$65,608**	**$317,121**	
46	46	Holy Cross Hospital		1,300	3,378	124	2,964	$0.02	South	$30.97	**$83,599**	**$236,134**	
48	48	Memorial Regional Hospital		1,800	4,568	143	4,992	$0.02	South	$30.97	**$194,950**	**$319,272**	
51	51	Lakeland Regional Medical Center		750	3,323	212	6,247	$0.02	South	$30.97	**$101,651**	**$232,273**	$149,094
54	54	Bayfront Medical Center		1,500	2,898	133	3,352	$0.02	South	$30.97	**$109,087**	**$202,532**	
55	55	St. Joseph's Hospital		1,500	3,347	400	8,008	$0.02	South	$30.97	**$260,611**	**$233,951**	$150,171
59	59--1	Stericycle, Inc.	Unit 1	1,911	4,002	135	8,400	$0.02	South	$30.97	**$348,271**	**$279,697**	
59	59--2	Stericycle, Inc.	Unit 2	1,911	3,917	138	8,400	$0.02	South	$30.97	**$348,271**	**$273,796**	
60	60--1	BMWNC, Inc.	Unit 1	1,500	6,763	343	7,456	$0.02	South	$30.97	**$242,647**	**$472,707**	$303,426
65	65--1	Stericycle, Inc.	Unit 1	1,500	3,304	143	7,665	$0.02	Midwest	$34.96	**$264,808**	**$230,975**	
65	65--2	Stericycle, Inc.	Unit 2	1,500	3,125	141	7,558	$0.02	Midwest	$34.96	**$261,102**	**$218,409**	
71	71	Loyola University Medical Center		1,650	3,526	156	4,800	$0.02	Midwest	$34.96	**$182,418**	**$246,484**	
77	77	Parkview Hospital		1,200	2,766	114	8,395	$0.02	Midwest	$34.96	**$232,030**	**$193,349**	
84	84	Mayo Clinic, Waste Management Facility		2,000	6,516	294	6,240	$0.02	Midwest	$34.96	**$287,446**	**$455,427**	$292,335
87	87	MedCentral Health System, Mansfield Hospital		600	2,351	260	3,120	$0.02	Midwest	$34.96	**$43,117**	**$164,322**	$105,477
94	94	Stericycle, Inc.		1,400	2,737	138	7,904	$0.02	Midwest	$34.96	**$254,869**	**$191,286**	
98	98--1	University of Texas Medical Branch		1,500	4,534	111	5,328	$0.02	South Central	$24.06	**$154,893**	**$316,938**	
106	106	Stericycle, Inc.		1,500	3,590	152	8,760	$0.02	West Central	$24.13	**$254,975**	**$250,939**	
109	109	Healthcare Environmental Services Inc.		1,686	4,478	302	1,872	$0.02	West Central	$24.13	**$61,244**	**$313,003**	$200,914

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	Maximum charge rate (lb/hr)	Stack gas flow rate (dscfm)	Stack gas temperature (°F)	Operating hours (hr/yr)	Autoclave ($/lb)	Landfill tip fee region	Landfill tip fee ($/ton)	Autoclave/ landfill cost	Incinerator operation	DIFF
110	110	Stericycle, Inc.		1,935	6,291	126	7,309	$0.02	West Central	$24.13	**$274,436**	**$439,730**	
120	120--1	Municipality of Chambers County, Resource Recovery Center	Unit 1	4,167	10,031	296	7,896	$0.02	South Central	$24.06	**$637,686**	**$701,128**	$450,048
120	120--2	Municipality of Chambers County, Resource Recovery Center	Unit 2	4,167	9,028	291	7,896	$0.02	South Central	$24.06	**$637,686**	**$631,040**	$405,059
125	125	East Carolina University, Health Sciences Campus, HSC Utility Plant		1,000	3,124	125	625	$0.02	South	$30.97	**$13,555**	**$218,351**	
130	130	Department of Veterans Affairs Medical Center		1,000	6,422	155	4,160	$0.02	South	$30.97	**$90,255**	**$448,880**	
13	13	University of Maryland at Baltimore, Environmental Health and Safety Facility		500	1,972	189	1,440	$0.02	Mid-Atlantic	$46.29	**$22,880**	**$76,114**	
16	16	Johns Hopkins Medical Institute, Department of Health, Safety, and Environment		320	1,890	179	1,350	$0.02	Mid-Atlantic	$46.29	**$13,728**	**$72,942**	
18	18	Franklin Square Hospital Center		500	2,999	54	5,408	$0.02	Mid-Atlantic	$46.29	**$85,927**	**$115,785**	
21	21	Washington County Hospital		500	1,834	112	2,496	$0.02	Mid-Atlantic	$46.29	**$39,659**	**$70,780**	
25	25	Holy Spirit Hospital		500	1,702	99	3,944	$0.02	Mid-Atlantic	$46.29	**$62,666**	**$65,716**	
30	30	Riddle Memorial Hospital		500	1,730	239	2,920	$0.02	Mid-Atlantic	$46.29	**$46,396**	**$66,763**	
34	34	Pennsylvania State University, Animal Diagnostic Lab Incinerator		500	2,117	175	1,022	$0.02	Mid-Atlantic	$46.29	**$16,238**	**$81,723**	
38	38	Wilkes-Barre General Hospital		400	2,063	274	4,472	$0.02	Mid-Atlantic	$46.29	**$56,844**	**$79,640**	$78,761
41	41	Thomas Memorial Hospital		470	1,526	146	2,080	$0.02	Mid-Atlantic	$46.29	**$31,066**	**$58,916**	
47	47	Malcolm Randall Veterans Affairs Medical Center		495	1,645	115	1,664	$0.02	South	$30.97	**$21,947**	**$63,500**	
63	63	St. Jude Children's Research Hospital		500	2,333	276	1,050	$0.02	South	$30.97	**$13,989**	**$90,060**	$89,066
81	81	South Bend Medical Foundation		470	2,325	121	2,028	$0.02	Midwest	$34.96	**$26,672**	**$89,733**	
82	82	Good Samaritan Hospital		500	1,352	128	2,574	$0.02	Midwest	$34.96	**$36,013**	**$52,190**	
88	88	Medina General Hospital		300	1,153	100	3,016	$0.02	Midwest	$34.96	**$25,318**	**$44,524**	
95	95	St. Joseph's Hospital		500	1,634	223	1,404	$0.02	Midwest	$34.96	**$19,644**	**$63,076**	$62,380
108	108--1	Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases	Unit 1	500	1,790	112	1,248	$0.02	West Central	$24.13	**$15,197**	**$69,105**	
111	111	Wyoming Medical Center		400	1,505	130	989	$0.02	West Central	$24.13	**$9,635**	**$58,088**	
86	86	Fairfield Medical Center		95	1,095	97	5,018	$0.06	Midwest	$34.96	**$23,343**	**$133,457**	
129	129	Centers for Disease Control and Prevention--Clifton, Building 18	Unit 3	120	715	163	2,920	$0.06	South	$30.97	**$16,690**	**$87,093**	
115	115	Kona Community Hospital		200	684	1,787	1,430	$0.06	West	$37.74	**$14,271**	**$50,769**	
116	116	Yukon-Kuskokwim Delta Regional Hospital		50	559	1,457	1,560	$0.06	West	$37.74	**$3,892**	**$41,482**	
Total large											**$10,035,221**	**$14,749,915**	**$6,274,369**
Total medium											**$543,819**	**$1,218,657**	**$230,206**
Total small											**$40,033**	**$220,549**	**$0**
Total small rural											**$18,163**	**$92,251**	**$0**
Total nationwide											**$10,637,237**	**$16,166,150**	**$6,504,576**

Note:
Included CO CEMS cost for one unit. CO CEMS annual cost = $26,300 ($25,000 x 525.4/499.6). Source is e-mail from Dan Bivins, EPA, to Mary Johnson, EPA. September 27, 2006.

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	FF	ACI	Venturi scrubber	Packed-bed scrubber	Dry ESP	Wet ESP	Carbon bed adsorber	SNCR	Total control cost	Maintenance/ inspection
1	1	Bristol-Myers Squibb Co.		$60,438								**$60,438**	
5	5	Merck & Company, Inc.										**$329,586**	
15	15--1	Curtis Bay Energy	Unit 1									**$1,242,723**	
15	15--2	Curtis Bay Energy	Unit 2									**$1,371,945**	
20	20--1	Fort Detrick	Unit 5			$59,904						**$59,904**	
20	20--2	Fort Detrick	Unit 6			$57,043						**$57,043**	
29	29	Hamot Medical Center			$50,610	$69,991						**$286,645**	
36	36--1	Merck & Company, Inc.	Unit 2									**$234,881**	
36	36--2	Merck & Company, Inc.	Unit 5									**$364,292**	
40	40	Charleston Area Medical Center, General Hospital			$59,122							**$253,092**	
42	42	Stericycle, Inc.			$95,832							**$410,238**	
43	43	Boca Raton Community Hospital				$51,342						**$51,342**	
44	44	Bethesda Memorial Hospital				$112,122						**$112,122**	
46	46	Holy Cross Hospital				$83,488	$30,654					**$114,141**	
48	48	Memorial Regional Hospital					$41,446		$86,683			**$128,129**	
51	51	Lakeland Regional Medical Center										**$149,094**	
54	54	Bayfront Medical Center				$71,608						**$71,608**	
55	55	St. Joseph's Hospital				$63,300						**$213,471**	
59	59--1	Stericycle, Inc.	Unit 1			$98,890	$36,309					**$135,199**	
59	59--2	Stericycle, Inc.	Unit 2			$96,804	$35,543					**$132,346**	
60	60--1	BMWNC, Inc.	Unit 1		$92,485							**$395,911**	
65	65--1	Stericycle, Inc.	Unit 1			$81,664	$29,984					**$111,648**	
65	65--2	Stericycle, Inc.	Unit 2			$77,221	$28,353					**$105,574**	
71	71	Loyola University Medical Center				$87,147						**$87,147**	
77	77	Parkview Hospital				$68,361						**$68,361**	
84	84	Mayo Clinic, Waste Management Facility			$89,104							**$381,439**	
87	87	MedCentral Health System, Mansfield Hospital			$32,149							**$137,626**	
94	94	Stericycle, Inc.				$67,631						**$67,631**	
98	98--1	University of Texas Medical Branch			$62,009	$112,057	$41,143					**$215,209**	
106	106	Stericycle, Inc.				$88,722						**$88,722**	
109	109	Healthcare Environmental Services Inc.			$61,239							**$262,152**	

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	FF	ACI	Venturi scrubber	Packed-bed scrubber	Dry ESP	Wet ESP	Carbon bed adsorber	SNCR	Total control cost	Maintenance/ inspection
110	110	Stericycle, Inc.			$86,033		$57,083	$120,682				**$263,799**	
120	120--1	Municipality of Chambers County, Resource Recovery Center	Unit 1		$137,175						$31,675	**$618,898**	
120	120--2	Municipality of Chambers County, Resource Recovery Center	Unit 2		$123,463						$28,508	**$557,030**	
125	125	East Carolina University, Health Sciences Campus, HSC Utility Plant		$114,532		$59,079				$6,754		**$180,365**	
130	130	Department of Veterans Affairs Medical Center				$158,707	$58,271					**$216,978**	
13	13	University of Maryland at Baltimore, Environmental Health and Safety Facility				$29,448	$18,179					**$47,627**	
16	16	Johns Hopkins Medical Institute, Department of Health, Safety, and Environment				$28,221						**$28,221**	
18	18	Franklin Square Hospital Center				$44,796						**$44,796**	
21	21	Washington County Hospital				$27,384						**$27,384**	
25	25	Holy Spirit Hospital				$25,425						**$25,425**	
30	30	Riddle Memorial Hospital			$11,072	$25,830	$15,945					**$52,848**	
34	34	Pennsylvania State University, Animal Diagnostic Lab Incinerator				$31,618						**$31,618**	
38	38	Wilkes-Barre General Hospital			$13,208							**$91,969**	
41	41	Thomas Memorial Hospital				$22,794	$14,071					**$36,866**	
47	47	Malcolm Randall Veterans Affairs Medical Center				$24,568						**$24,568**	
63	63	St. Jude Children's Research Hospital			$14,936							**$104,002**	
81	81	South Bend Medical Foundation				$34,717						**$34,717**	
82	82	Good Samaritan Hospital				$20,192						**$20,192**	
88	88	Medina General Hospital				$17,226						**$17,226**	
95	95	St. Joseph's Hospital			$10,461							**$72,841**	
108	108--1	Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases	Unit 1			$26,736						**$26,736**	
111	111	Wyoming Medical Center				$22,474						**$22,474**	
86	86	Fairfield Medical Center				$39,135						**$39,135**	
129	129	Centers for Disease Control and Prevention--Clifton, Building 18	Unit 3			$25,539						**$25,539**	
115	115	Kona Community Hospital										**$0**	$900
116	116	Yukon-Kuskokwim Delta Regional Hospital										**$0**	$900
Total large				**$174,970**	**$889,221**	**$1,565,079**	**$358,786**	**$120,682**	**$86,683**	**$6,754**	**$60,183**	**$9,536,727**	**$0**
Total medium				**$0**	**$49,678**	**$381,430**	**$48,196**	**$0**	**$0**	**$0**	**$0**	**$709,510**	**$0**
Total small				**$0**	**$0**	**$64,674**	**$0**	**$0**	**$0**	**$0**	**$0**	**$64,674**	**$0**
Total small rural				**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$1,800**
Total nationwide				**$114,532**	**$938,899**	**$2,011,183**	**$406,981**	**$120,682**	**$86,683**	**$6,754**	**$60,183**	**$10,250,473**	**$1,800**

Note:
Included CO CEMS cost for one unit. CO CEMS annual cost = $26,300 ($25,000 x 525.4/499.6). Source is e-mail from Dan Bivins, EPA, to Mary Johnson, EPA. September 27, 2006.

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	Good combustion monitoring	DIFF monitoring	FF monitoring	ACI monitoring	WS monitoring	DIFF/WS monitoring	DI-ESP/WS monitoring	WS/WESP monitoring	CA/WS monitoring	SNCR monitoring
1	1	Bristol-Myers Squibb Co.				$7,200							
5	5	Merck & Company, Inc.			$12,000								
15	15--1	Curtis Bay Energy	Unit 1		$12,000								
15	15--2	Curtis Bay Energy	Unit 2		$12,000								
20	20--1	Fort Detrick	Unit 5					$7,300					
20	20--2	Fort Detrick	Unit 6					$7,300					
29	29	Hamot Medical Center					$4,800		$12,300				
36	36--1	Merck & Company, Inc.	Unit 2		$12,000								
36	36--2	Merck & Company, Inc.	Unit 5		$12,000								
40	40	Charleston Area Medical Center, General Hospital			$12,000		$4,800						
42	42	Stericycle, Inc.			$12,000		$4,800						
43	43	Boca Raton Community Hospital						$7,300					
44	44	Bethesda Memorial Hospital						$7,300					
46	46	Holy Cross Hospital						$7,300					
48	48	Memorial Regional Hospital									$7,500		
51	51	Lakeland Regional Medical Center			$12,000								
54	54	Bayfront Medical Center						$7,300					
55	55	St. Joseph's Hospital							$12,300				
59	59--1	Stericycle, Inc.	Unit 1					$7,300					
59	59--2	Stericycle, Inc.	Unit 2					$7,300					
60	60--1	BMWNC, Inc.	Unit 1		$12,000		$4,800						
65	65--1	Stericycle, Inc.	Unit 1					$7,300					
65	65--2	Stericycle, Inc.	Unit 2					$7,300					
71	71	Loyola University Medical Center						$7,300					
77	77	Parkview Hospital						$7,300					
84	84	Mayo Clinic, Waste Management Facility			$12,000		$4,800						
87	87	MedCentral Health System, Mansfield Hospital			$12,000		$4,800						
94	94	Stericycle, Inc.						$7,300					
98	98--1	University of Texas Medical Branch					$4,800	$7,300					
106	106	Stericycle, Inc.						$7,300					
109	109	Healthcare Environmental Services Inc.			$12,000		$4,800						

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	Good combustion monitoring	DIFF monitoring	FF monitoring	ACI monitoring	WS monitoring	DIFF/WS monitoring	DI-ESP/WS monitoring	WS/WESP monitoring	CA/WS monitoring	SNCR monitoring
110	110	Stericycle, Inc.					$4,800			$12,300			
120	120--1	Municipality of Chambers County, Resource Recovery Center	Unit 1		$12,000		$4,800						$1,700
120	120--2	Municipality of Chambers County, Resource Recovery Center	Unit 2		$12,000		$4,800						$1,700
125	125	East Carolina University, Health Sciences Campus, HSC Utility Plant				$3,440		$7,300				$7,500	
130	130	Department of Veterans Affairs Medical Center						$7,300					
13	13	University of Maryland at Baltimore, Environmental Health and Safety Facility						$4,000					
16	16	Johns Hopkins Medical Institute, Department of Health, Safety, and Environment						$4,000					
18	18	Franklin Square Hospital Center						$4,000					
21	21	Washington County Hospital						$4,000					
25	25	Holy Spirit Hospital						$4,000					
30	30	Riddle Memorial Hospital					$1,600	$4,000					
34	34	Pennsylvania State University, Animal Diagnostic Lab Incinerator						$4,000					
38	38	Wilkes-Barre General Hospital			$7,300		$1,600						
41	41	Thomas Memorial Hospital						$4,000					
47	47	Malcolm Randall Veterans Affairs Medical Center						$4,000					
63	63	St. Jude Children's Research Hospital			$7,300		$1,600						
81	81	South Bend Medical Foundation						$4,000					
82	82	Good Samaritan Hospital						$4,000					
88	88	Medina General Hospital						$4,000					
95	95	St. Joseph's Hospital			$7,300		$1,600						
108	108--1	Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases	Unit 1					$4,000					
111	111	Wyoming Medical Center						$4,000					
86	86	Fairfield Medical Center						$5,600					
129	129	Centers for Disease Control and Prevention--Clifton, Building 18	Unit 3					$5,600					
115	115	Kona Community Hospital		$3,300									
116	116	Yukon-Kuskokwim Delta Regional Hospital		$3,300									
Total large				**$0**	**$168,000**	**$10,640**	**$52,800**	**$124,100**	**$24,600**	**$12,300**	**$7,500**	**$7,500**	**$3,400**
Total medium				**$0**	**$21,900**	**$0**	**$6,400**	**$56,000**	**$0**	**$0**	**$0**	**$0**	**$0**
Total small				**$0**	**$0**	**$0**	**$0**	**$11,200**	**$0**	**$0**	**$0**	**$0**	**$0**
Total small rural				**$6,600**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Total nationwide				**$6,600**	**$189,900**	**$3,440**	**$59,200**	**$191,300**	**$24,600**	**$12,300**	**$7,500**	**$7,500**	**$3,400**

Note:
Included CO CEMS cost for one unit. CO CEMS annual cost = $26,300 ($25,000 x 525.4/499.6). Source is e-mail from Dan Bivins, EPA, to Mary Johnson, EPA. September 27, 2006.

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	CO CEMS	Total monitoring cost	PM	CO	HCl	Opacity	Total testing cost	Operating information	Compliance report	Records	Training personnel
1	1	Bristol-Myers Squibb Co.			**$7,200**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
5	5	Merck & Company, Inc.			**$12,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
15	15--1	Curtis Bay Energy	Unit 1		**$12,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
15	15--2	Curtis Bay Energy	Unit 2		**$12,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
20	20--1	Fort Detrick	Unit 5		**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
20	20--2	Fort Detrick	Unit 6		**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
29	29	Hamot Medical Center			**$17,100**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
36	36--1	Merck & Company, Inc.	Unit 2		**$12,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
36	36--2	Merck & Company, Inc.	Unit 5		**$12,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
40	40	Charleston Area Medical Center, General Hospital			**$16,800**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
42	42	Stericycle, Inc.			**$16,800**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
43	43	Boca Raton Community Hospital			**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
44	44	Bethesda Memorial Hospital			**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
46	46	Holy Cross Hospital			**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
48	48	Memorial Regional Hospital			**$7,500**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
51	51	Lakeland Regional Medical Center			**$12,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
54	54	Bayfront Medical Center			**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
55	55	St. Joseph's Hospital			**$12,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
59	59--1	Stericycle, Inc.	Unit 1		**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
59	59--2	Stericycle, Inc.	Unit 2		**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
60	60--1	BMWNC, Inc.	Unit 1		**$16,800**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
65	65--1	Stericycle, Inc.	Unit 1		**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
65	65--2	Stericycle, Inc.	Unit 2		**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
71	71	Loyola University Medical Center			**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
77	77	Parkview Hospital			**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
84	84	Mayo Clinic, Waste Management Facility			**$16,800**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
87	87	MedCentral Health System, Mansfield Hospital			**$16,800**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
94	94	Stericycle, Inc.			**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
98	98--1	University of Texas Medical Branch			**$12,100**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
106	106	Stericycle, Inc.			**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
109	109	Healthcare Environmental Services Inc.			**$16,800**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	CO CEMS	Total monitoring cost	PM	CO	HCl	Opacity	Total testing cost	Operating information	Compliance report	Records	Training personnel
110	110	Stericycle, Inc.			**$17,100**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
120	120--1	Municipality of Chambers County, Resource Recovery Center	Unit 1		**$18,500**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
120	120--2	Municipality of Chambers County, Resource Recovery Center	Unit 2		**$18,500**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
125	125	East Carolina University, Health Sciences Campus, HSC Utility Plant		$26,300	**$44,540**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
130	130	Department of Veterans Affairs Medical Center			**$7,300**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
13	13	University of Maryland at Baltimore, Environmental Health and Safety Facility			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
16	16	Johns Hopkins Medical Institute, Department of Health, Safety, and Environment			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
18	18	Franklin Square Hospital Center			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
21	21	Washington County Hospital			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
25	25	Holy Spirit Hospital			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
30	30	Riddle Memorial Hospital			**$5,600**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
34	34	Pennsylvania State University, Animal Diagnostic Lab Incinerator			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
38	38	Wilkes-Barre General Hospital			**$8,900**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
41	41	Thomas Memorial Hospital			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
47	47	Malcolm Randall Veterans Affairs Medical Center			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
63	63	St. Jude Children's Research Hospital			**$8,900**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
81	81	South Bend Medical Foundation			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
82	82	Good Samaritan Hospital			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
88	88	Medina General Hospital			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
95	95	St. Joseph's Hospital			**$8,900**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
108	108--1	Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases	Unit 1		**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
111	111	Wyoming Medical Center			**$4,000**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
86	86	Fairfield Medical Center			**$5,600**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
129	129	Centers for Disease Control and Prevention--Clifton, Building 18	Unit 3		**$5,600**	$12,000	$7,000	$7,000	$2,500	**$19,833**	$1,570	$4,535	$7,374	$1,744
115	115	Kona Community Hospital			**$4,200**				$2,500	**$2,500**	$1,570	$2,093	$6,209	$1,744
116	116	Yukon-Kuskokwim Delta Regional Hospital			**$4,200**				$2,500	**$2,500**	$1,570	$2,093	$6,209	$1,744
Total large				**$26,300**	**$437,140**	**$432,000**	**$252,000**	**$252,000**	**$90,000**	**$714,000**	**$56,507**	**$163,244**	**$265,468**	**$62,786**
Total medium				**$0**	**$84,300**	**$204,000**	**$119,000**	**$119,000**	**$42,500**	**$337,167**	**$26,684**	**$77,087**	**$125,360**	**$29,649**
Total small				**$0**	**$11,200**	**$24,000**	**$14,000**	**$14,000**	**$5,000**	**$39,667**	**$3,139**	**$9,069**	**$14,748**	**$3,488**
Total small rural				**$0**	**$8,400**	**$0**	**$0**	**$0**	**$5,000**	**$5,000**	**$3,139**	**$4,186**	**$12,418**	**$3,488**
Total nationwide				**$26,300**	**$533,840**	**$648,000**	**$378,000**	**$378,000**	**$140,000**	**$1,076,000**	**$89,470**	**$253,586**	**$417,993**	**$99,411**

Note:
Included CO CEMS cost for one unit. CO CEMS annual cost = $26,300 ($25,000 x 525.4/499.6). Source is e-mail from Dan Bivins, EPA, to Mary Johnson, EPA. September 27, 2006.

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	Total record-keeping and reporting cost	Total baseline operating cost
1	1	Bristol-Myers Squibb Co.		$15,222	$217,915
5	5	Merck & Company, Inc.		$15,222	$890,102
15	15--1	Curtis Bay Energy	Unit 1	$15,222	$3,225,814
15	15--2	Curtis Bay Energy	Unit 2	$15,222	$3,556,348
20	20--1	Fort Detrick	Unit 5	$15,222	$271,691
20	20--2	Fort Detrick	Unit 6	$15,222	$260,736
29	29	Hamot Medical Center		$15,222	$597,480
36	36--1	Merck & Company, Inc.	Unit 2	$15,222	$647,856
36	36--2	Merck & Company, Inc.	Unit 5	$15,222	$978,876
40	40	Charleston Area Medical Center, General Hospital		$15,222	$607,132
42	42	Stericycle, Inc.		$15,222	$951,907
43	43	Boca Raton Community Hospital		$15,222	$238,910
44	44	Bethesda Memorial Hospital		$15,222	$471,598
46	46	Holy Cross Hospital		$15,222	$392,631
48	48	Memorial Regional Hospital		$15,222	$489,957
51	51	Lakeland Regional Medical Center		$15,222	$428,422
54	54	Bayfront Medical Center		$15,222	$316,496
55	55	St. Joseph's Hospital		$15,222	$494,778
59	59--1	Stericycle, Inc.	Unit 1	$15,222	$457,252
59	59--2	Stericycle, Inc.	Unit 2	$15,222	$448,498
60	60--1	BMWNC, Inc.	Unit 1	$15,222	$920,474
65	65--1	Stericycle, Inc.	Unit 1	$15,222	$384,978
65	65--2	Stericycle, Inc.	Unit 2	$15,222	$366,338
71	71	Loyola University Medical Center		$15,222	$375,987
77	77	Parkview Hospital		$15,222	$304,065
84	84	Mayo Clinic, Waste Management Facility		$15,222	$888,722
87	87	MedCentral Health System, Mansfield Hospital		$15,222	$353,803
94	94	Stericycle, Inc.		$15,222	$301,274
98	98--1	University of Texas Medical Branch		$15,222	$579,302
106	106	Stericycle, Inc.		$15,222	$382,017
109	109	Healthcare Environmental Services Inc.		$15,222	$627,011

Table 17. Nationwide Comparison of Baseline Operatin

FACID	UNITID	Facility name	Unit number	Total record-keeping and reporting cost	Total baseline operating cost
110	110	Stericycle, Inc.		$15,222	$755,684
120	120--1	Municipality of Chambers County, Resource Recovery Center	Unit 1	$15,222	$1,373,582
120	120--2	Municipality of Chambers County, Resource Recovery Center	Unit 2	$15,222	$1,241,625
125	125	East Carolina University, Health Sciences Campus, HSC Utility Plant		$15,222	$478,312
130	130	Department of Veterans Affairs Medical Center		$15,222	$708,214
13	13	University of Maryland at Baltimore, Environmental Health and Safety Facility		$15,222	$162,796
16	16	Johns Hopkins Medical Institute, Department of Health, Safety, and Environment		$15,222	$140,218
18	18	Franklin Square Hospital Center		$15,222	$199,636
21	21	Washington County Hospital		$15,222	$137,221
25	25	Holy Spirit Hospital		$15,222	$130,197
30	30	Riddle Memorial Hospital		$15,222	$160,266
34	34	Pennsylvania State University, Animal Diagnostic Lab Incinerator		$15,222	$152,396
38	38	Wilkes-Barre General Hospital		$15,222	$215,565
41	41	Thomas Memorial Hospital		$15,222	$134,838
47	47	Malcolm Randall Veterans Affairs Medical Center		$15,222	$127,124
63	63	St. Jude Children's Research Hospital		$15,222	$238,018
81	81	South Bend Medical Foundation		$15,222	$163,506
82	82	Good Samaritan Hospital		$15,222	$111,438
88	88	Medina General Hospital		$15,222	$100,806
95	95	St. Joseph's Hospital		$15,222	$179,873
108	108--1	Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases	Unit 1	$15,222	$134,897
111	111	Wyoming Medical Center		$15,222	$119,617
86	86	Fairfield Medical Center		$15,222	$213,247
129	129	Centers for Disease Control and Prevention--Clifton, Building 18	Unit 3	$15,222	$153,287
115	115	Kona Community Hospital		$11,616	$69,085
116	116	Yukon-Kuskokwim Delta Regional Hospital		$11,616	$59,798
Total large				$548,005	$25,985,786
Total medium				$258,780	$2,608,413
Total small				$30,445	$366,535
Total small rural				$23,231	$128,882
Total nationwide				$860,461	$28,871,702

Note:
Included CO CEMS cost for one unit. CO CEMS annual cost = $26,300 ($25,000 x 525.4/499.6). Source is e-mail from Dan Bivins, EPA, to Mary Johnson, EPA. September 27, 2006.