STAKEHOLDERS ROUND TABLE
PAPER AND OTHER WEB COATING

MEETING AGENDA[a]
THURSDAY, AUGUST 5, 1999
10:00 a.m. - 3:00 p.m. EDT
EPA Environmental Resource Center--Classroom #1
Corner of Highway 54 and Alexander Drive, Research Triangle Park, NC
Call-in: 919-541-4485[b]

1) Introductions and Objectives of Meeting--Dan Brown, USEPA

2) Proposed MACT Floor--Dan Brown, USEPA, and Donna Lee Jones, EC/R , Inc.

3) Draft BID Chapters--Donna Lee Jones, EC/R, Inc.

LUNCH BREAK - 1 HOUR (Cafeteria is Available in the Building)

4) Economic Analysis Update -- Larry Sorrels, USEPA
& Small Business Impacts

5) Schedule

6) Questions/Open

Additional information regarding the stakeholder meeting will be available prior to August 5, 1999 on the EPA Coating Homepage: http://www.epa.gov/ttn/uatw/coat/coat.html

a) Please RSVP to Jeff Harris, EC/R, Inc., at 919/484-0222 (ext. 311).
b) Phone participants should ***<u>not</u>*** call in early (this will block out all others) and should also RSVP.

PAPER AND OTHER WEB COATING MACT

Stakeholder Meeting
August 5, 1999

MEETING AGENDA

- Introductions and Objectives of Meeting
- Proposed MACT Floor
- Draft BID Chapters
- Lunch Break (1 hour)
- Economic Analysis Update and Small Business Impacts
- Schedule
- Questions/Open

Proposed MACT Floor

- Data Collection Efforts
  - Data from 268 facilities representing the POWC industry
  - 210 expected to affected by the rule
    - major sources (including potential to emit)

Proposed MACT Floor

- Unit Operations with HAP Emissions
  - Coating operations: web coating application and drying on coating line(s).
  - Mixing operations: mixing and blending of coatings prior to application.
  - Cleaning operations: cleaning of coating lines and associated equipment.
  - Storage operations: storage of solvent, coating and coated products.

Proposed MACT Floor

- Data Results: Coating Operations
  - Coating operations accounted for 81% of total HAP emissions.
  - The Maximum Achievable Control Technology (MACT) for coating operations is based on the capture and control/recovery of HAP emissions.
  - Best controlled facilities were ranked in order of overall control efficiency (OCE) (capture * control) to establish MACT floor.

Proposed MACT Floor

- Data Results: Other Unit Operations
  - Best controlled facilities by OCE for coating operations were examined for HAP emission and control from other unit operations.
  - Analysis revealed few data to support a MACT floor for mixing, cleaning and storage operations.

Proposed MACT Floor

- MACT Floor Analysis for Coating Operations
- MACT Floor Equivalent to Best Controlled Sources (top 12% or top 5)
- Evaluating OCE at Best Controlled Sources
  - Data quality
    - capture device performance
    - control device performance

Proposed MACT Floor

- Issues with Reported Capture Device Efficiency
  - Facilities reported 100% capture with a PTE but did not meet criteria of EPA Method 204 and often had conflicting data suggesting 100% capture not achieved.
  - Facilities conducting material balance calculations with solvent recovery indicate not all HAP is emitted due to retention of solvent in the web.

Proposed MACT Floor

- Issues with Reported Control Device Efficiency
  - Facilities reported high control efficiencies which were often based on performance testing that may not reflect achievable emission reductions under normal operating conditions.
    - short averaging times
    - test conditions unknown but expected to be a maximum loading rate

Proposed MACT Floor

- Capture technology reported by best controlled sources included enclosures and hoods.
- Control technology reported by best controlled sources included thermal oxidation and carbon adsorption.
- OCE for thermal incineration generally based on test data
- OCE for solvent recovery generally based actual measurement and mass-balance

Proposed MACT Floor

- OCE Based on Mass Balance Considered to be More Robust Measure of MACT
  – Uncertainties with test conditions and reported results for both capture and control versus actual measurement of OCE achieved with material balance

Proposed MACT Floor

- Twenty facilities reported OCE based on material balance calculations
- OCE ranged from less than 20% to greater than 98%
- The OCE for the top five facilities ranges from 93 to 98% with a mode of 95%

Proposed MACT Floor

- Staff recommendation:
- MACT for Existing Coating Operations: 95% OCE
- MACT for New Coating Operations: still under investigation, best controlled source has been contacted to supply additional data to aid in determining if high OCE is a result of particular process or design of control technology.

Proposed MACT Floor

- Pollution Prevention Alternative:
  0.2 kg HAP/kg Coating Solids Applied

- Next Steps:
  - Final determination on new source MACT
  - Preamble and proposed regulation to EPA work group
  - Preamble and proposed regulation published in Federal Register

BID CHAPTERS

- See BID Chapter Handout
- Chapter 1: Introduction
- Chapter 2: Industry Profile
- Chapter 3: Emission Control Techniques

BID CHAPTERS (continued)

- Chapter 4: Model Plants
- Chapter 5: Environmental and Energy Impacts of Control Options
- Chapter 6: Costs

LUNCH BREAK - 1 HOUR

ECONOMIC ANALYSIS UPDATE

SCHEDULE

- Preamble and Proposed Rule in Federal Register March 2000
- 60 Day Public Comment Period
- Response to Comments and Final Rule November 2000

QUESTIONS/OPEN

EPA WEB SITE HOME PAGE

- Coating MACT Web Sites:
  - www.epa.gov/ttn/uatw/coat/coat.html
- For Small entities:
  - www.epa.gov/ttn/uatw/coat/smbizpg.html
- For Map/Directions to EPA, and Local Lodging and Restaurants:
  - www.epa.gov/ttn/uatw/coat/coord_issues.html

PAPER AND OTHER WEB COATING MACT

DRAFT TABLES
August 5, 1999
BACKGROUND INFORMATION DOCUMENT

Chapter 2 - The Paper and Other Web Coating Industry

C Table 2-1 shows the types of coating applicators used by respondents of the POWC Survey. The table lists the percentage of survey respondents using each application method.

C Table 2-2 lists the 18 SIC Codes of the Paper and Other Web Coating Industry, with a brief description of each one.

C Table 2-3 lists the primary products of the pressure-sensitive tapes and labels survey respondents, showing the percentage of respondents who listed each one as their primary product.

C Table 2-4 shows the types of coating applicators used by survey respondents in the pressure-sensitive tapes and labels industry segment. The table lists the percentage of survey respondents using each application method.

C Table 2-5. Shows the types of coating applicators used by survey respondents in the flexible vinyl film industry segment. The table lists the percentage of survey respondents using each application method.

C Table 2-6 shows the types of coating applicators used by survey respondents in the photographic film industry segment. The table lists the percentage of survey respondents using each application method.

C Table 2-7 shows the types of coating applicators used by survey respondents in the decorative industrial laminates industry segment. The table lists the percentage of survey respondents using each application method.

C Table 2-8 shows 1996 TRI data for facilities in the SIC codes which make up the miscellaneous POWC industry segment. Data shown include number of facilities listed by TRI for the designated SIC codes, percent of miscellaneous POWC industry segment TRI facilities represented by each SIC, TRI emissions for each SIC, percent of miscellaneous POWC industry segment TRI emissions represented by each SIC, and per facility emissions.

Table 2-1. Types of Coating Applicators Used by Respondents of the POWC Survey

Application Method	Percentage of Application Stations
Gravure	32
Roll, Reverse Roll	20
Slot Die	10
Knife	9
Flexography	8
Mayer Rod	7
Dip	5
Extrusion/calendering	3
Rotary Screen	3
Printing	2
Flow	1
Total	100

Table 2-2. The 18 SIC Codes of the Paper and Other Web Coating Industry

SIC Code	Description
2653	Corrugated and solid fiber boxes
2657	Folding paper board boxes, including sanitary
2671	Packaging paper and plastics film, coated and laminated
2672	Coated and laminated paper, not elsewhere classified
2673	Plastics, foil, and coated paper bags
2674	Bags: uncoated paper and multi wall
2675	Die-cut paper and paperboard and cardboard
2679	Converted paper and paper board, not elsewhere classified
2754	Commercial printing, gravure
2761	Manifold business forms
3074	Plastic aseptic packaging
3081	Unsupported plastics film and sheet
3083	Laminated plastics plate, sheet, and profile shapes
3291	Abrasive products
3497	Laminated aluminum (metal) foil and leaf, flexible packaging
3861	Photographic equipment and supplies
3955	Carbon paper and inked ribbons
3996	Linoleum, asphalted-felt-base, and other hard surface floor coverings, not elsewhere classified

Note: There are likely a number of facilities in each SIC that do not do coating and these 18 SIC's are not necessarily an exhaustive list of facilities that may do coating.

Table 2-3. Primary Products of the Pressure-sensitive Tapes and Labels Survey Respondents

Primary Product	Percent of Respondents
bonding and mounting	18
carton sealing	12
abrasion resistant	10
application/pre-mask	10
double side	9
identification/safety, warning	4
anti-skid	3
anti-stick	3
book binding	3
bundling	3
label	3
coated textile for care labels	1
correction/cover-up	1
electrical	1
electronic applications	1
fastening	1
freezer	1
office/stationery	1
packaging	1
printable	1
protective - long term	1
pressure-sensitive adhesive-coated films	1
silicone	1
specialty fabric tapes	1
surface protection	1
trainer tapes - cotton based	1
transfer	1
vibration/sound damping	1
vinyl graphics film	1
Total	**100**

Table 2-4. Types of Coating Applicators Used by Survey Respondents in the Pressure-sensitive Tapes and Labels Industry Segment

Application Method	Percentage of Application Stations
Gravure	33
Roll, Reverse Roll	26
Slot Die	12
Mayer Rod	11
Knife	9
Flexography	4
Extrusion/calendering	3
Dip	1
Flow	1
Total	100

Note: Seventy-five percent of the flexography coating stations are flexography printing.

Table 2-5. Types of Coating Applicators Used by Survey Respondents in the Flexible Vinyl Film Industry Segment

Application Method	Percentage of Application Stations
Gravure	40
Flexography	20
Knife/Air Knife	11
Roll/Reverse Roll	9
Rotary screen	7
Dip	3
Die	3
Mayer Rod	3
Other[a]	4
Total	100

Table 2-6. Types of Coating Applicators Used by Survey Respondents in the Photographic Film Industry Segment

Application Method	Percentage of Application Stations
Die	44
Roll/reverse roll	28
Gravure	12
Knife/Air knife	11
Mayer Rod	2
Calender	2
Flow	1
Total	100

Table 2-7. Types of Coating Applicators Used by Survey Respondents in the B-stage Industry Segment

Application Method	Percentage of Application Stations
Dip	36
Gravure	34
Roll, Reverse Roll	20
Mayer Rod	5
Knife	5
Total	100

Table 2-8. 1996 TRI Facilities and Emissions for the Miscellaneous POWC Industry Segment(a)

SIC	INDUSTRY DESCRIPTION (b)		Number of TRI Facilities	Percent of TRI Facilities	TRI Emissions (tpy)	Percent of TRI Emissions	Per Facility Emissions (tpy)
2679	Misc. Converted Paper Products	Converted paper and paperboard products, nec (gift wrap, paper wall paper, cigarette paper)	38	27%	3,282	42%	86
2653	Paperboard Containers and Boxes	Corrugated and solid fiber boxes	19	13%	1,576	20%	83
3291	Misc. Nonmetallic Mineral Products	Abrasive products	46	32%	1,422	18%	31
2761	Printing and Publishing	Manifold business forms	16	11%	847	11%	53
2657	Paperboard Containers and Boxes	Folding paperboard boxes, including sanitary	17	12%	336	4%	20
3955	Pens, Pencils, Office, & Art Supplies	Carbon paper and inked ribbons	6	4%	272	3%	45
2675	Misc. Converted Paper Products	Die-cut paper and board	1	1%	81	1%	81
3074		Plastic aseptic packaging	0	0%	0	0%	0
		Total	**143**		**7,816**		

(a) Data is taken directly from TRI and does not account for facilities reporting under multiple SIC codes.
(b) nec = not elsewhere classified.

Chapter 3 - Emission Control Techniques

- Table 3-1 presents HAP control efficiency ranges for control devices commonly used in the POWC industry, both as reported in EPA literature and as reported in POWC survey responses from the POWC industry.

- Table 3-2 shows examples of work practice standards for several activities common in some POWC industry facilities.

Table 3-1. Common Control Devices and Associated HAP Control Device Efficiency Ranges (Percent)

Control Device	HAP Control Device Efficiency Reported in EPA Literature	HAP Control Device Efficiency Reported in POWC Survey Responses
Thermal oxidizer	98 - 99+	86 - 99.96
Catalytic oxidizer	95 - 99	25 - 99.5
Carbon adsorber	95 - 99	40 - 99.9
Condenser	50 - 90	50 - 99.9

Table 3-2. Examples of Work Practice Standards

Activity	Example Work Practice Standard
Solvents use in cleaning	--Used cleaning solvents must be put into an enclosed container. --During atomized cleaning of a spray gun, the cleaning solvent must be directed into a waste container fitted with a capture device.
Solvent handling and transfer	--Handling and transfer of solvents must be conducted in such a manner to reduce spills. Spills must be wiped up immediately and the wipe rags stored in covered containers.
Open vessels	--Waste solvent will be stored in closed containers that may have an opening for pressure relief but do not allow for liquid to drain.

Chapter 4 - Model Plants, Control Options, and Enhanced Monitoring

- Table 4-1 gives specifications for the POWC model plants, including coating line overall hap control efficiency, controlled coating line HAP emissions, average number of coating lines, average number of coating stations, uncontrolled coating line hap emissions, HAP capture efficiency, HAP destruction efficiency, and percentage of database major sources.

- Table 4-2 presents the three control options for the POWC industry that include ranges in capture system and add-on control performance, and the use of low-HAP coatings.For add-on controls, any combination of capture and control device efficiency that produces 95 percent overall control efficiency is equivalent to the control option. For low-HAP coatings, the control options is a level of 0.2 pounds (lb) of HAP emitted per lb of coating solids.

Table 4-1. Specifications for Model Plants Representing the POWC Industry[a]

Model Plant No.	Coating Line Overall HAP Control Efficiency, percent	Controlled Coating Line HAP Emissions, tpy	Coating Use, tpy	Average Number of Coating Lines	Average Number of Coating Stations	Uncontrolled Coating Line HAP Emissions, tpy	HAP Capture Efficiency, percent	HAP Destruction Efficiency, percent	Percent of Database Major Sources
1a	0	99	2,108	2	5	99	0	0	20
1b	0	1,765	7,521	12	9	1,765	0	0	3
1c	0[b]	48	6,597	3	17	48	0	0	10
2a	50	138	8,607	5	11	276	55	90	25
2b	50	1,261	369,929	31	154	2,522	53	95	1
3a	80	183	7,518	3	8	915	89	90	11
3b	80	1,378	14,516	8	15	6,890	84	95	1
4	90	99	3,431	4	12	990	95	95	24
5	95	40	5,498	5	19	800	97	98	4

[a] tpy = tons per year.

[b] Although a control efficiency of zero is stated, this model plant is assumed to be using compliant coatings with #0.20 pound HAP per pound coating so that no additional control is needed.

Table 4-2. Control Options for the POWC Industry

Control Option	Overall Facility Coating Line Average[a]			
	HAP Capture Efficiency, percent	Control Device HAP Collection/ Destruction Efficiency, percent	Type of Control Device	Overall HAP Control Efficiency
1	95-100	95-100	thermal oxidizer, carbon adsorber/ solvent recovery	95
2	95-99	95-100	inert oven with solvent recovery	95
3	NA[b]	NA	low-HAP coatings (#0.2 lb HAP per lb coating solids)	NA

[a] Straight average of the control efficiencies of all coating lines.
[b] NA = Not applicable.

Chapter 5 - Environmental and Energy Impacts of Control Options

- Table 5-1 shows the nine POWC model plants and the estimated number of facilities nationwide represented by each model plant category. A total of 203 major sources are estimated nationwide.

- Table 5-2 shows the energy impacts for the POWC model plants in terms of incremental increases in consumption of fan power (electricity) in kilowatt-hours per year (kW-hr/yr) and natural gas in standard cubic feet per year (scf/yr).

- Table 5-3 shows the estimated national energy impacts of the application of control option 1 (thermal oxidation) to the POWC industry.

- Table 5-4 shows the emissions impacts of control option 1 (thermal oxidation), in terms of incremental HAP reduced and secondary pollutant emissions for each of the POWC model plants.

- Table 5-5 shows the estimated national emissions impacts of the application of control option 1 (thermal oxidation).

Table 5-1. POWC Model Plants and Their Estimated Correspondence to the National POWC Industry

Model Plant	Coating Line OCE, percent	HAP Capture Efficiency, percent	HAP Destruction Efficiency, percent	Number of Major Sources in POWC Database	Percent of Database Major Sources, percent	Estimated Number of U.S. Facili- ties
1a	0	0	0	18	20	41
1b	0	0	0	3	3	7
1c[a]	0	0	0	9	10	21
2a	50	55	90	22	25	50
2b	50	53	95	1	1	2
3a	80	89	90	10	11	23
3b	80	84	95	1	1	2
4	90	95	95	21	24	48
5	95	97	98	4	4	9
Total				89	100	203

[a] Model Plant 1(c) consists of facilities using low-HAP coatings that meet the criteria of # 0.2 lb HAP per lb solids (Option 3).

Table 5-2. Energy Impacts of Control Option 1 for the POWC Model Plants

Model Plant	Energy Impacts of Control Option 1	
	Fan Power, 10^6 kW-hr/yr	Natural Gas, 10^6 scf/yr
1a	2.2	43.5
1b	7.5	92.5
1c	0	0
2a	1.1	17.8
2b	16.4	0
3a	1.1	16.7
3b	2.2	0
4	1.1	0
5	0	0

Note: This analysis assumes the use of thermal oxidizers for Control Option 1.

Table 5-3. Total Estimated Energy Impacts of Control Option 1 for the National POWC Industry

Energy Impacts	Total U.S. Impact for Control Option 1
Fan Power, 10^6 kW-hr/yr	313
Natural Gas, 10^9 scf/yr	3.7

Note: This analysis assumes the use of thermal oxidizers for Control Option 1.

Table 5-4. Air Impacts of Control Option 1
for the POWC Model Plants

Model Plant	Air Impacts of Control Option 1, tons per year					
	HAP/VOC Reduced	NO_x Emitted	SO_2 Emitted	CO Emitted	CO_2 Emitted	PM Emitted
1a	67	4.3	4.7	1.9	3,382	0.3
1b	1,677	11.8	16.1	4.2	8,194	0.7
1c	0	0	0	0	0	0
2a	124	2.0	2.4	0.8	1,459	0.1
2b	1,135	15.6	34.8	0.6	5,739	0.7
3a	137	1.8	2.2	0.7	1,370	0.1
3b	1,034	2.1	4.6	0.1	755	0.1
4	50	1.0	2.3	0.04	386	0.04
5	0	0	0	0	0	0

Note: This analysis assumes the use of thermal oxidizers for Control Option 1.

Table 5-5. Total Estimated Air Impacts of Control Option 1 for the National POWC Industry

Air Impact	Total U.S. Impacts of Control Option 1, tons per year
HAP/VOC Reduced	31,673
NO_x Emitted	484
SO_2 Emitted	666
CO Emitted	168
CO_2 Emitted	331,986
PM Emitted	27

Note: This analysis assumes the use of thermal oxidizers for Control Option 1.

Chapter 6 - Model Plant Control Option Costs

- Table 6-1 is a summary of the specifications for the model plants representing the POWC industry on which the costs were based (This is the same as Table 4-1).

- Table 6-2 shows the capture and control approaches to implementing control option 1 for the model plants (use of a thermal oxidizer).

- Table 6-3 shows the capital costs associated with the design and installation of a Permanent Total Enclosure (PTE) for the POWC model plants.

- Table 6-4 shows the annual PTE costs for each of the model plants.

- Table 6-5 shows the annual costs associated with installation of new thermal oxidizers and associated PTEs at model plants 1a and 1b.

- Table 6-6 presents the capital costs of increasing the destruction efficiency of existing thermal oxidizers for Model Plants 2a and 3a.

- Table 6-7 presents the annual monitoring, reporting, and recordkeeping costs for each of the model plants.

- Table 6-8 shows the total capital investment (capital cost) for each capture and control approach for the nine model plants with control option 1.

- Table 6-9 shows the total annual costs of the capture and control approach to control option 1 for the nine model plants.

- Table 6-10 presents the cost effectiveness of the capture and control approaches for the nine model plants calculated based on the dollars per ton of pollutant controlled.

Table 6-1. Specifications for Model Plants Representing the POWC Industry[a]

Model Plant No.	Coating Line Overall HAP Control Efficiency, percent	Controlled Coating Line HAP Emissions, tpy	Coating Use, tpy	Average Number of Coating Lines	Average Number of Coating Stations	Uncontrolled Coating Line HAP Emissions, tpy	HAP Capture Efficiency, percent	HAP Destruction Efficiency, percent
1a	0	99	2,108	2	5	99	0	0
1b	0	1,765	7,521	12	9	1,765	0	0
1c[b]	0	48	6,597	3	17	48	0	0
2a	50	138	8,607	5	11	276	55	90
2b	50	1,261	369,929	31	154	2,522	53	95
3a	80	183	7,518	3	8	915	89	90
3b	80	1,378	14,516	8	15	6,890	84	95
4	90	99	3,431	4	12	990	95	95
5	95	40	5,498	5	19	800	97	98

[a] tpy = tons per year.

[b] Although a control efficiency of zero is stated, this model plant is assumed to be using compliant coatings with less than or equal to 0.20 lb HAP per lb coating that are considered equivalent to 95 percent overall control. Therefore, no additional control is needed to comply with control option 1.

Table 6-2. Capture and Control Approach for the POWC Model Plants with Control Option 1

Model Plant	Model Plant Coating Line Overall HAP Control Efficiency, percent	Model Plant HAP Capture Efficiency, percent	Model Plant HAP Destruction Efficiency, percent	Approach for Capture and Control to Comply with Control Option 1[a,b]
1a	0	0	0	PTE and new T.O., plus MR&R
1b	0	0	0	PTE and new T.O., plus MR&R
1c	0	0	0	MR&R
2a	50	55	90	PTE and increase T.O. destruction efficiency, plus MR&R
2b	50	53	95	PTE, plus MR&R
3a	80	89	90	PTE and increase T.O. destruction efficiency, plus MR&R
3b	80	84	95	PTE, plus MR&R
4	90	95	95	PTE, plus MR&R
5	95	97	98	MR&R

[a] PTE = permanent total enclosure; T.O. = thermal oxidizer; MR&R = monitoring, recording, and recordkeeping.

[b] Control option 1 is the use of a PTE and a thermal oxidizer operating at 95 percent destruction efficiency to achieve an overall control efficiency of 95 percent.

Table 6-3. Capital Costs of Permanent Total Enclosures for the POWC Model Plants

Model Plant	Exhaust, scfm	PTE Cost, $	Engineering Cost, $	Air-conditioning Capital Cost, $	Total PTE-related Capital Cost, $
1a	61,829	20,000	2,000	93,000	115,000
1b	212,620	130,000	13,000	320,000	463,000
1c	71,089	N/A	N/A	N/A	N/A
2a	115,751	50,000	5,000	170,000	225,000
2b	1,690,700	260,000	26,000	2,500,000	2,786,000
3a	108,703	20,000	2,000	160,000	182,000
3b	222,390	100,000	10,000	330,000	440,000
4	113,698	50,000	5,000	170,000	225,000
5	92,320	N/A	N/A	N/A	N/A

Assumptions:
1) All costs 1998 dollars.
2) Base permanent total enclosure (PTE) cost based on case studies[1,2] and engineering judgement.
3) PTE costs of individual model plants based on estimated relative size of coating room, and engineering judgement.
4) Engineering cost estimated as 10 percent of PTE cost.
5) Air conditioning (AC) calculations assume spot air conditioning is installed.
6) Air-conditioning cost based on cost factors of 25 tons per 20,000 scfm, and $30,000 per 25 tons capacities.[3]
7) Electricity required for AC capacity calculated using an equation from the literature.[4]

Table 6-4. Annual Costs Associated with Installation and Operation of Permanent Total Enclosures (PTE) for the POWC Model Plants

Model Plant	1a	1b	1c	2a	2b	3a	3b	4	5
Total Capital Investment, $	115,000	463,000	N/A	225,000	2,786,000	182,000	440,000	225,000	N/A
ANNUAL COSTS, 1998 DOLLARS									
Electricity, $/yr	26,967	92,737	N/A	50,486	737,418	47,412	96,998	49,591	N/A
Capital Recovery, $/yr	16,373	65,921	N/A	32,035	396,664	25,913	62,646	32,035	N/A
Total Annual Costs	$43,341	$158,657	N/A	$82,521	$1,134,082	$73,325	$159,644	$81,626	N/A

Assumptions:
1) Total capital investment includes cost of PTE, engineering, and spot air conditioning capacity, as described in Table 6-3.
2) PTE capital costs based on estimated size of coating room, case study cost data, and engineering judgement.[5]
3) Electricity required for calculated AC capacity calculated using equation presented in the literature.[6]
4) Capital recovery based on a 10-year equipment life, 7 percent interest rate.[7,8,9]
5) Electricity costs based on 6,600 hours of operation per year and a unit rate of $0.0451/kWh, based on information from Energy Information Administration for 1998.[10]

Table 6-5. Regenerative Thermal Oxidizer Capital and Annual Operating Costs for POWC Model Plants[a,b,c]

Model Plant	1a	1b
Flowrate to Thermal Oxidizer, scfm	61,829	212,620
CAPITAL INVESTMENT		
T.O. and auxiliaries (A)	$2,351,820	$6,467,733
PTE (B)	$115,000	$463,000
MR&R (C)	$20,000	$120,000
Total Capital Investment (A+B+C)	$2,486,820	$7,050,733
ANNUAL COSTS		
Operating labor	$7,780	$7,780
Supervisory labor	$1,167	$1,167
Maintenance labor	$1,079	$1,079
Maintenance materials	$1,079	$1,079
Natural gas	$134,940	$286,649
Electricity associated with T.O. operation	$71,903	$247,096
Electricity associated with PTE operation	$26,967	$92,737
Overhead	$6,663	$6,663
Taxes, insurance, administration	$98,673	$277,229
Capital recovery for T.O. and PTE	$351,220	$986,780
Capital recovery for MR&R	$2,848	$17,088
MR&R	$27,440	$164,640
Total Annual Costs	$731,758	$2,089,987

(Continued)

Table 6-5. (continued)

[a] Calculated using the EPA cost spreadsheet program for regenerative thermal oxidizers.[11]
[b] In 1998 dollars.
[c] T.O. = thermal oxidizer, PTE = permanent total enclosure, MR&R = monitoring, recording, and recordkeeping

Assumptions:

1) Permanent total enclosure (PTE) costs estimated based on case studies and engineering judgement.[12,13]
2) PTE costs assume engineering = 10 percent PTE cost; spot air conditioning, 10-year life, 7 percent interest rate.[14,15,16]
3) MR&R equal to sum of annual MR&R operating costs and capital recovery costs for temperature monitors, assuming 10-year life, 7 percent interest (based on industry-supplied data).[17]
4) Because regenerative thermal oxidizers are field built, it was assumed that ductwork costs are included in the Total Capital Investment estimate.[18,19]
5) Assumes 95 percent heat recovery, 20 inch pressure drop, 6,600 operating hours per year.[20]
6) Operator labor rate = $18.86/hr, maintenance labor rate = 1.1*operator rate =$20.75/hr. Both based on Bureau of Labor Statistics data for 1998.[21]
7) Electricity cost $0.0451/kWh, natural gas cost $3.099/mscf, both based on information from Energy Information Administration for 1998.[22,23]

Table 6-6. Capital and Annual Costs of Increasing Destruction Efficiency of Existing T.O.s in the POWC Industry [a,b]

MODEL PLANT	2a	3a
CAPITAL COSTS		
Improvements to existing T.O. (A)	$382,480	$363,044
PTE (B)	$225,000	$182,000
MR&R (C)	$50,000	$30,000
Total Capital Costs (A+B+C)	$657,481	$575,044
ANNUAL COSTS		
Capital recovery of A,B,C above	$93,612	$81,874
Increased fuel and electricity (T.O.)	$55,090	$51,718
Increased electricity for PTE	$50,486	$47,412
MR&R	$68,600	$41,160
Total Annual Costs	$267,788	$222,164

[a] All costs in 1998 dollars.
[b] T.O. = thermal oxidizer. PTE = permanent total enclosure
MR&R = monitoring, reporting, and recordkeeping

Assumptions:
1) Overall control efficiencies of existing oxidizers were increased to 95 percent by a) adding a PTE, b) increasing combustion temperature, and c) making any necessary capital improvements to the existing oxidizers to allow increased destruction efficiency to be achieved.
2) Cost of capital recovery calculated based on a 10-year equipment life and 7 percent interest rate (according to OMB guidance).[24,25,26]
3) Increased fuel and electricity costs for thermal oxidizer were calculated (using the EPA regenerative thermal oxidizer spreadsheet) as the difference in fuel and electricity costs for an oxidizer of the appropriate size operating at combustion temperatures of 1300°F and 1600°F.[27]
4) Operator labor rate = $18.86/hr, maintenance labor rate = 1.1*operator rate =$20.75/hr. Both based on Bureau of Labor Statistics data for 1998.[28]
5) Electricity cost $0.0451/kWh, natural gas cost $3.099/mscf, both based on information from Energy Information Administration for 1998.[29,30]

Table 6-7. Capital and Annual Operating Costs Associated with Monitoring, Recording, and Recordkeeping (MR&R) Requirements for the POWC Model Plants

Model Plant	MR&R Capital Investment	MR&R Capital Recovery	MR&R Annual Operating Cost	Total Annual MR&R Costs
1a	$20,000	$2,848	$27,440	$30,288
1b	$120,000	$17,088	$164,640	$181,728
1c	$0	$0	$41,160	$41,160
2a	$50,000	$7,120	$68,600	$75,720
2b	$310,000	$44,144	$425,320	$469,464
3a	$30,000	$4,272	$41,160	$45,432
3b	$80,000	$11,392	$109,760	$121,152
4	$40,000	$5,696	$54,880	$60,576
5	$50,000	$7,120	$68,600	$75,720

Assumptions:

1) All costs 1998 dollars.
2) Capital costs based on information provided by an industry representative and the assumption of one monitor per coating line, at a cost of $10,000 each.[31]
3) Annual operating costs based on number of coating lines and per line estimate of 220 hours per year per coating line provided by industry representative.[32]
4) Capital recovery calculation based on 10-year equipment life, 7 percent interest rate, according to OMB guidance.[33,34,35]

Table 6-8. Total Model Plant Capital Costs for Complying with Control Option 1

Model Plant	Approach for Capture and Control[a]	Total Model Plant Capital Costs[b]
1a	PTE and new control device	$2,486,820
1b	PTE and new control device	$7,050,733
1c	no change	$0
2a	PTE and increase T.O. efficiency	$657,481
2b	PTE	$3,096,000
3a	PTE and increase T.O. efficiency	$575,044
3b	PTE	$520,000
4	PTE	$265,000
5	no change	$50,000

[a] PTE = permanent total enclosure
T.O. = thermal oxidizer
[b] Includes MR&R for all model plants (no capital investment associated with MR&R for Model Plant 1c).

Table 6-9. Total Model Plant Annual Costs for Complying with Control Option 1

Model Plant	Approach for Capture and Control[a]	Total Annual Model Plant Costs[b]
1a	PTE and new control device	$731,758
1b	PTE and new control device	$2,089,987
1c	no change	$41,160
2a	PTE and increase T.O. efficiency	$267,788
2b	PTE	$1,603,546
3a	PTE and increase T.O. efficiency	$222,164
3b	PTE	$280,796
4	PTE	$142,202
5	no change	$75,720

[a] PTE = permanent total enclosure; T.O. = thermal oxidizer
[b] Includes MR&R for all model plants.

Table 6-10. Cost Effectiveness of Capture and Control Approaches to Control Option 1 for the POWC Model Plants

Model Plant	Approach for Capture and Control[a]	Additional HAP Reduction, tpy	Annual Cost, 1998$	Cost Effectiveness, $/ton
1a	PTE and new control device	94	$731,758	7,785
1b	PTE and new control device	1,677	$2,089,987	1,246
1c	Compliant coatings/no change	0	$41,160	N/A
2a	PTE and increase T.O. efficiency	124	$267,788	2,160
2b	PTE	1,135	$1,603,546	1,413
3a	PTE and increase T.O. efficiency	137	$222,164	1,622
3b	PTE	1,034	$280,796	272
4	PTE	50	$142,202	2,844
5	no change	0	$75,720	N/A

[a] PTE = permanent total enclosure
T.O. = thermal oxidizer