VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[3] This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue togetherÓ separate data records from EPAÕs databases. This is done to create a "master listÓ of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and State agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of <u>inspected</u> facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values

presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections,Ó or the "Total ActionsÓ column.

VII.A.   Electronics/Computer Industry Compliance History

The exhibit below contains a Regional breakdown of the inspection and enforcement action over the last five years in the electronics/computer industry. As expected, the largest number of electronics/computer industry facilities is located in Region IX. However, other Regions (i.e., Regions I and II) inspected a greater number of electronics facilities than Region IX. Also, Regions IX and X have significantly higher enforcement to inspection ratios than the other Regions. In addition, 100 percent of Region VI and VII enforcement actions are led by the Federal government and 100 percent of Region VIII were enforcement actions were State-lead.

Exhibit 35
Five Year Enforcement and Compliance Summary for the Computer Industry

A	B	C	D	E	F	G	H	I	J
Computers SIC 35	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/one or more Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	N	N	N	N	N	N	N	N	N
Region II	2	2	15	8	N	N	N	N	N
Region III	2	2	11	11	N	N	0%	0%	0.18
Region IV	4	3	49	5	2	6	80%	20%	0.12
Region V	8	3	17	30	1	5	100%	N	0.29
Region VI	2	1	2	63	1	4	100%	N	2.00
Region VII	N	N	N	N	N	N	N	N	N
Region VIII	1	1	1	63	N	N	N	N	N
Region IX	3	N	N	8	N	N	N	N	N
Region X	N	N	N	N	N	N	N	N	N
Total/ Average	22	12	95	15	4	15	92%	8%	0.16

VII.B.   **Comparison of Enforcement Activity Between Selected Industries**

Exhibits 36 and 37 below present five and one year enforcement and compliance summaries for selected industries. The exhibits show that the number of inspections for the electronics/computer industry is low in comparison to other industries, and the average time between inspections is longer than other industries.

Exhibit 38 and 39 present five and one year inspection and enforcement summaries by statute. As expected, a significant percentage of inspections and enforcement actions involving electronics facilities are RCRA-related. This is in part due to the large amount of solvents used and sludges generated during various stages of the manufacturing process. The exhibit also shows a significantly lower percentage of Clean Air Act and Clean Water Act inspections and actions. This is somewhat surprising in light of the VOC emissions and the wastewaters and rinsewaters contaminated with spent solvents and acids generated by this industry.

Exhibit 36
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	844	474	3,097	16	145	470	76%	24%	0.15
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Electronics/Computers	405	222	777	31	68	212	79%	21%	0.27
Motor Vehicle Assembly	598	390	2,216	16	81	240	80%	20%	0.11
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

Exhibit 37
One Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.58
Furniture	293	160	113	66	41%	3	2%	5	0.55
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics/Computers	405	60	87	80	133%	8	13%	21	0.24
Motor Vehicle Assembly	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 38
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other *	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	293	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics/ Computers	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Motor Vehicle Assembly	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

*

     Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

Exhibit 39
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	<1%	6%
Furniture	293	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	<1%	2%
Electronics/ Computers	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Motor Vehicle Assembly	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

*   Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

VII.C.   Review of Major Legal Actions

This section provides a listing of major legal cases and supplemental enforcement projects that pertain to the Electronics/Computer Industry. Information in this section is provided by EPA's *Enforcement Accomplishments Report, FY 1991, FY 1992, FY 1993* and the Office of Enforcement.

VII.C.1.   Review of Major Cases

This section provides summary information about major cases that have affected this sector. As indicated in the EPA's *Enforcement Accomplishments Report, FY 1991, FY 1992, FY 1993* publications, 16 significant enforcement actions involving the electronics/computer industry were resolved between 1991 and 1993. CERCLA violations comprised nine of these cases, the most of any statute. Following CERCLA violations were five cases involving CWA violations, three involving RCRA violations, and one involving a TSCA violation. Two of the sites were Superfund sites. Several of the settlements required reimbursement of Superfund response costs or payment of the remedial costs. The companies against which the cases were brought are primarily manufacturers of electrical components such as printed wiring boards. The other companies performed electroplating operations and manufactured electrical equipment.

Four of the sixteen actions resulted in the assessment of a penalty. Penalties ranged from $25,000 to $300,000. The average penalty was approximately $178,125. In a case involving General Electric, the company was subject to a penalty and agreed to pay for removal and disposal of PWB electrical equipment over a period of three years at an estimated cost of one million dollars. In the case of U.S. v. Electrochemical Co., Inc., the court stated it would suspend $225,000 of a $250,000 fine if the company would clean up the contaminated area.

Although many cases involved civil penalties, four of the cases involved criminal convictions, resulting in penalties and/or jail sentences for the owners and operators of the facilities. All of these cases involved electroplating facilities and CWA violations. In one case, U.S. v. Robert H. Schmidt and Lawrence B. Schmidt, the owner was sentenced to 30 months in prison, followed by two years of probation. His son, the plant supervisor, was sentenced to 24 months of jail and two years of probation. Father and son were subject to penalties of $50,000 and $25,000 respectively.

VII.C.2.   Supplemental Environmental Projects

Below is a list of Supplementary Environmental Projects (SEPs). SEPs are

compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

In December, 1993, the Regions were asked by EPA's Office of Enforcement and Compliance Assurance to provide information on the number and type of SEPs entered into by the Regions. Exhibit 40 contains a representative sample of the Regional responses addressing the electronics and computer industries. The information contained in the chart is not comprehensive and provides only a sample of the types of SEPs developed for the electronics and computer industries.

Exhibit 40
Supplemental Environmental Projects
Electronics (SIC 36)

Case Name	EPA Region	Statute / Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Lane Electronic Cooperative Eugene, OR	10	TSCA	Pollution Reduction	$ 9,775	Early disposal of PCBs or PCB contaminated electrical equipment.	$ 9,775	$ 4,888
Cirtech, Inc.	9	RCRA	Pollution Prevention	$ 9,900	Purcahse and install a device to eliminate copper from the waste stream and to reduce the hazardous waste stream. Will allow corrosive etch water to be reused.	$11,400	$ 7,630
Universal Circuits	9	EPCRA	Pollution Prevention		Implement a waste water recycling project which permanently reduces the consumption of water. Sponsor and conduct an outreach program		
Trojan Battery	9	EPCRA			Eliminate wastewater discharges. Operate a battery recycling center.		
G & W Electric Company Blue Island, IL	5	EPCRA	Pollution Prevention	$ 97,000	Implement process modifications designed to eliminate the use of 72,000 lbs/yr of 1,1,1,-trichloroethane.	$ 68,000	$ 7,825
Manu-Tronics Kenosha, WI	5	EPCRA	Pollution Prevention	$ 81,700	Modify the industrial processes eliminate the use and release of 25,000 lbs/yr of Freon 113.	$ 34,000	$ 3,400
Anchor Electric Co. Manchester, NH	1	EPCRA	Pollution Prevention	$40,000	Purchase, install, and operate an aqueous washer system in place of current vapor degreaser. Change will result in virtual elimination of the use of 1,1,1,-trichloroethane.	$51,000	$13,650

VIII.   COMPLIANCE ASSURANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance.   These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A.   Sector-Related Environmental Programs and Activities

VIII.A.1.   Federal Activities

Common Sense Initiative (CSI)

The Common Sense Initiative (CSI), a partnership between EPA and private industry, aims to create environmental protection strategies that are cleaner for the environment and cheaper for industry and taxpayers. As part of CSI, representatives from Federal, State, and local governments; industry; community-based and national environmental organizations; environmental justice groups; and labor organizations, come together to examine the full range of environmental requirements affecting the following six selected industries: automobile manufacturing; computers and electronics, iron and steel, metal finishing, petroleum refining; and printing.

CSI participants are looking for solutions that:

¥   Focus on the industry as a whole rather than one pollutant
¥   Seek consensus-based solutions
¥   Focus on pollution prevention rather than end-of-pipe controls
¥   Are industry-specific.

The Common Sense Initiative Council (CSIC), chaired by EPA Administrator Browner, consists of a parent council and six subcommittees (one per industry sector). Each of the subcommittees have met and identified issues and project areas for emphasis, and workgroups have been established to analyze and make recommendations on these issues.

Design for the Environment (DfE)

DfE is an EPA program operated by the Office of Pollution Prevention and Toxics. DfE is a voluntary program which promotes the use of safer chemicals, processes, and technologies in the earliest product design stages. The DfE program assists industry in making informed, environmentally responsible design choices by providing standardized analytical tools for industry application and providing information on the comparative environmental and human health risk, cost, and performance of chemicals, processes, and technologies. DfE also helps small businesses by analyzing pollution prevention alternatives and disseminating the information to industry and the public. By helping to translate pollution prevention into meaningful terms, DfE contributes to building the institutional structure in corporations to support pollution prevention. DfE activities fall into two broad categories: (1) the industry-specific projects which encourage businesses to incorporate pollution prevention into their designs; and (2) long-term projects that translate pollution prevention into terms that make sense to professions such as chemistry, chemical engineering, marketing, accounting, and insurance.

DfE currently is working with the PWB industry because it is a critical component of the electronics, automotive, and defense industries. Also, MCCÕs lifecycle assessment of a computer work station study recognized that chemical processes such as those used in PWB fabrication are a significant source of hazardous waste and consume large amounts of water and energy. The potential for improvement in those areas led EPAÕs DfE Program to sponsor a project to assist the PWB industry in evaluating substitute materials and processes for making PWB holes conductive. DfE also plans to help the PWB industry identify multi-media environmental issues and the trade-offs of competing environmental objectives.

Industry/Government Partnerships

In 1993, the initial results of a six month lifecycle assessment of a computer workstation was released in a report called *Environmental Consciousness: A Strategic Competitiveness Issue for the Electronics and Computer Industry; Comprehensive Report: Analyses and Synthesis, Task Force Reports, and Appendices*. The study was conducted by Microelectronics and Computer Technology Corp. (MCC), SEMATECH (sponsored by the Semiconductor Industry Association), EPA, and the Department of Energy (DOE).

As a result of the assessment, the Department of Defense funded an industry led effort, the first phase of which involved development of the *Electronics Industry Environmental Roadmap*, which prioritizes the electronics and computer industries' environmental needs over the next ten years. The goal of the *Roadmap* is to assist U.S. companies to compete with foreign competitors who have established partnerships with their governments. MCC produced the *Electronics Industry*

Environmental Roadmap in November 1993. MCC has received funding from the Department of Defense Advanced Research Projects Agency (ARPA) and EPA to continue to working with industry task groups to compile information, learn the needs of industry, and to suggest possible solutions to environmental/economic problems.

VIII.A.2. State Activities

Several States are actively involved in promoting pollution prevention by initiating partnerships with industry to develop and implement pollution prevention and waste minimization practices. Following is a description of some State pollution prevention initiatives related to the electronics/computer industry.

The **Minnesota Technical Assistance Program (MnTAP)** is supported by a grant to the University of Minnesota's School of Public Health. MnTAP staff and interns assists Minnesota businesses in the electronics and computer industries by identifying effective waste reduction opportunities. MnTAP researches treatment options, makes on-site visits to discuss recommendations, and coordinates documentation. MnTAP developed a checklist for businesses to evaluate their waste streams and identify waste reduction opportunities. MnTAP gathered vendor and technical information that may assist facilities in the industry in their evaluations in addition to a list of recycling vendors if the options on the checklists are not feasible to implement. Pollution prevention techniques for the electronics and computer industries that were recommended by MnTAP include material substitution, process modification, and recycling.

The **State of Minnesota's Office of Waste Management (OWM)** also has a Pollution Prevention Research Award Program.   The program is part of Minnesota's efforts to promote pollution prevention.   OWM contracts with private industry to investigate available pollution prevention alternatives in the electronics and computer industries. The process involves literature searches, telephone surveys, case study development, and working with trade associations and MnTAP. In July 1992, four cases studies were written as part of a report on alternatives to cyanide solutions in electroplating. OWM encourages implementation of pollution prevention techniques such as material substitution, recycling, process modification, wastewater treatment, electroplating, and the recycling of spent printed wiring boards.

The **North Carolina Department of Natural Resources and Community Development** has a Pollution Prevention Pays Program. The program provides technical, cost (operating and capital), economic benefit, and environmental benefit information to the public and facilities in the electronics and computer industries. The program   recommends   equipment   modification,   recycling,   and   process modification/pollution prevention techniques for the treatment of wastewater generated by electroplating processes.

The **City of Los Angeles' Board of Public Works** has a Hazardous and Toxic Materials Project (HTMP). HTMP provides fact sheets to the public and facilities in the electronics and computer industry describing different strategies to reduce the cost and quantity of waste generated. Pollution prevention techniques include material substitution, process modification, and recycling. HTMP also provides information on vendors who provide alternative waste management services.

The **City of Santa Monica's Department of General Services** provides fact sheets and information on pollution prevention to businesses. The City outlines pollution prevention techniques for printed circuit board manufacturing in fact sheets. The fact sheets rate waste reduction practices in terms of easiest, more difficult, and most difficult to implement. The fact sheets also provide contacts from the Department of Health Services, small business assistance loan programs, and California agencies with waste reduction programs.

Other pollution prevention initiatives that have targeted the electronics and computer industries include: the Hazardous Waste Reduction Program of the Oregon Department of Environmental Quality (DEQ); the New Jersey Hazardous Waste Facilities Siting Commission of the Hazardous Waste Source Reduction and Recycling Taskforce; and the San Diego County Department of Health Services.

VIII.B.   EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of 17 chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given to participants who met their 1992 goals. The list of chemicals includes 17 high-use chemicals reported in the Toxics Release Inventory.

Thirty-four companies and 72 facilities listed under SIC 36 (the electronics/computer industry) are currently participating in the 33/50 program. They account for approximately 17 percent of the 406 companies under SIC 36, which is slightly higher than the average for all industries of 14 percent participation. (Contact: Mike Burns 202-260-6394 or the 33/50 Program 202-260-6907)

Exhibit 41 lists those companies participating in the 33/50 program that reported under SIC code 36 to TRI. Many of the participating companies listed multiple SIC codes (in no particular order), and are therefore likely to conduct operations in addition to electronics/computer industry. The table shows the number of facilities within each company that are participating in the 33/50 program; each company's total 1993 releases and transfers of 33/50 chemicals; and the percent reduction in these chemicals since 1988.

Exhibit 41
Electronics/Computer Industry Facilities (SIC 36)
Participating in the 33/50 Program

Parent Facility name	Parent City	ST	SIC Codes	# of	1993 Releases	% Reduction
Aluminum Company Of America	Pittsburgh	PA	3674	1	2,403,017	51
American Telephone & Telg Co	New York	NY	3672, 3661	3	512,618	50
Amp-Akzo Corporation	Chadds Ford	PA	3672	3	51,196	1
Benton International Inc	North Haven	CT	3672	1	26	2
Boeing Company	Seattle	WA	3728, 3769, 3672	1	4,789,875	50
Buckbee-Greig Holding Corp	Minneapolis	MN	3672	1	500	**
Burle Industries Inc	Lancaster	PA	3671, 3663, 3699	1	12,200	*
Eaton Corporation	Cleveland	OH	3674	1	450,211	50
General Motors Corporation	Detroit	MI	3651, 3694, 3679, 3672, 3471	3	16,751,198	
Gti Corporation	San Diego	CA	3674	1	13,961	*
Hadco Corporation	Salem	NH	3672	2	63,469	91
Harris Corporation	Melbourne	FL	3674	3	110,355	**
Hewlett-Packard Company	Palo Alto	CA	3674	2	7,400	50
IBM	Armonk	NY	3674	6	1,411,304	1
Intel Corporation	Santa Clara	CA	3674	3	18,105	50
Itt Corporation	New York	NY	3670, 3674	2	735,332	7
Litton Industries Inc	Beverly Hills	CA	3672	1	332,264	**
Lucerne Products Inc	Hudson	OH	3699, 3674	1	2,505	***
Martin Marietta Corporation	Bethesda	MD	3672, 3761, 3812	1	223,286	73
Motorola Inc	Schaumburg	IL	3674	4	226,357	50
National Semiconductor Corp.	Santa Clara	CA	3674	3	23,173	6
North American Philips Corp	New York	NY	3674	2	1,281,928	50
Photocircuits Corporation	Glen Cove	NY	3672, 3471	2	292,178	92
Raytheon Company	Lexington	MA	3674	2	706,045	50
Rockwell International Corp	Seal Beach	CA	3669, 3672	1	1,007,043	50
Seh America Inc.	Vancouver	WA	3674, 3339	1	53,140	100
Sony USA Inc	New York	NY	3674	2	869,577	51
Talley Industries Inc	Phoenix	AZ	3672, 3822, 3548	1	3,804	***
Tektronix Inc	Beaverton	OR	3672	1	12,393	*
Texas Instruments Incorporated	Dallas	TX	3674	5	344,225	25
Thomson Consumer Electronics	Indianapolis	IN	3671	4	2,110,314	43
Varian Associates Inc	Palo Alto	CA	3671	3	67,417	50
Westinghouse Electric Corp	Pittsburgh	PA	3672, 3812	3	1,137,198	28
Zenith Electronics Corporation	Glenview	IL	3671	1	917,894	25
* = not quantifiable against 1988 data.						

Energy Star Computer Program

The Energy Star Computer program is a voluntary partnership between the EPA and computer companies that manufacture energy-efficient computer equipment such as desktop computers, printers, and monitors. The companies that participate in this program comprise 70 percent of all U.S. sales of desktop computers and 90 percent of laser printers. In order for a computer to qualify and display the EPA Energy Star logo, it must operate on low power when inactive and can "sleep" or "power-down," and then awaken by touching the mouse or keyboard. The program requires that the central processing unit, printer, and monitor of the computer must enter a standby mode when not in use and use no more than 30 watts. Energy-efficient computers were available to the public and businesses as of June 1993.

Computer equipment is the fastest growing user of electricity in the commercial sector. Currently, computers account for five percent of commercial electricity consumption, and this is expected to grow to 10 percent by the year 2000. The Energy Star sleep feature can reduce electricity consumption by 50 to 75 percent. In addition, the efficient systems generate less heat while the computer sleeps, which reduces electricity needed to cool a building by five to ten percent. These computers are predicted to diminish electricity consumption by 25 billion kilowatts hours per year by the year 2000. The reduction of electricity use would eliminate the need for 10 coal-fired plants and reduce carbon-dioxide emissions by up to 20 million tons. An Executive Order, which was issued in April 1993 and took effect in October 1993, directed the U.S. government to purchase only Energy Star computer equipment where available and if performance needs are met. Implementation of the Executive Order is expected to save $40 million annually. (Contact: Maria Tikoff (202) 233-9178)

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. (Contact: Tai-ming Chang, ELP Director (202) 564-5081 or Robert Fentress (202) 564-7023)

Motorola ELP Project

Motorola is participating in a pilot phase of the Environmental Leadership Program

with EPA and the State of Texas. Their Oak Hill facility located in Austin, Texas, will encompass two key projects, both in the pursuit of better environmental compliance. They are mentoring another facility and applying an environmental management system that aims to go beyond compliance status. (Contact: Steve Hoover (202) 564-7007)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice. (Contact: Jon Kessler at (202) 260-4034)

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; Federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard at (202) 233-9065 or the Green Light/Energy Star Hotline at (202) 775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and

implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn (202) 260-0700 or the WasteWi$e Hotline at (800) 372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman (202) 260-4407)

NICE[3]

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE[3]). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office (303) 275-4729)

VIII.C.   Trade Association Activity

Many trade associations have been involved in researching ways to reduce pollution associated with the manufacturing of semiconductors, printed wiring boards, and cathode ray tubes. Following is description of the trade association environmental programs or partnerships. A list of some of the major trade associations and contacts is also provided.

VIII.C.1.   Environmental Programs

The Semiconductor Industry Association (SIA), in association with EPA and DOE, released a report in March 1993 called *Environmental Consciousness: A Strategic Competitiveness Issue for the Electronics and Computer Industry.* This report contains the initial results of a six month, lifecycle assessment of a computer workstation. The report indicates that the industry should pursue the development of pollution prevention and waste minimization techniques in the printed wired board (PWB) manufacturing industry. As a result of this study, EPA provided funding to the Institute for Interconnecting and Packaging Electronic Circuits (IPC) and Microelectronics and Computer Technology Corporation (MCC) to redesign PWB manufacturing processes in order to reduce the amount of chemicals used during production.

According to IPC, environmental research is also being conducted by the Interconnection Technology Research Institute (ITRI) and by many independent companies.

According to SIA, the Department of Defense has awarded SEMATECH $10 million to perform research into pollution prevention and environmentally friendly microchip

manufacturing processes. As part of a separate initiative, SIA produced a report, *The National Technology Roadmap for Semiconductors*. The *Roadmap* acts as a guide for R&D investment decisions.

SIA's *Roadmap* calls for reducing the use of approximately 60 hazardous chemicals in various stages of the manufacturing process (e.g., mask making, photolithography, cleaning, leadframe plating, deflashing, and soldering). The chemicals include solvents, acids, toxics, alcohols, and other organic and inorganic substances. The goal of the *Roadmap* is to phase out ozone depleting substances and targeted ethylene glycol ethers during the next 15 years. The *Roadmap* identifies 46 projects for implementation in 1994 that involved process modifications. The majority of the process modifications center around alternatives to wet chemical processes and continued progress in development of alternative technologies for applying layers of silicon to the wafer. The development of water-based (or gas process) cleaners and resists is also a priority.

VIII.C.2.   Trade Associations

Electronic Industries Association (EIA) 2500 Wilson Boulevard Arlington, VA 22201 Phone: (703) 907-7500 Fax: (703) 907-7501	Members: 1200 Staff: 150 Budget: $25,000,000 Contact: Peter McCloskey

EIA was founded in 1924, and represents manufacturers of electronic components, parts, systems, and equipment for communications, industrial, government, and consumer use. EIA publishes a free, semiannual *EIA Publications Index* that contains price, content, and ordering information for their publications. EIA works to develop sound environmental practices by promoting research, workshops, and tool development through a variety of industry committees.

American Electronics Association (AEA) 5201 Great American Parkway, Suite 520 Santa Clara, CA 95054 Phone: (408) 987-4200 Fax: (408) 970-8565	Members: 3500 Staff: 140 Budget: NA Contact: J. Richard Iverson

AEA was founded in 1943, and is a trade association that represents the U.S. electronics/computer industry. Formerly known as the West Coast Electronic Manufacturer Association (WEMA), AEA's programs and services include: public affairs, educational meetings conferences, and executive summits. AEA publishes an annual directory; a monthly association and trade news publication, *American Electronics Association*, which includes legislative briefs, industry statistics, and a calendar of events; a periodic California Legislative Bulletin; and handbooks, manuals, and surveys. In addition, AEA sponsors an annual Systems/USA trade show.

National Electronic Manufacturing Association (NEMA) 2101 L Street, NW, Suite 300 Washington, DC 20037 Phone: (202) 457-8400 Fax: (202) 457-8411	Members: 600 Staff: 100 Budget: $10,000,000 Contact: Malcolm O'Hagan

NEMA was established in 1926. NEMA represents companies that manufacture equipment used for the generation, transmission, distribution, control, and utilization of electric power. NEMA was formed by the merger of Associated Manufacturers of Electrical and Supplies and the Electronic Power Club. NEMA's areas of interest include: electrical machinery; motors; and industrial automation, construction, utility, medial diagnostic imaging, transportation, communication, and lighting equipment. NEMA's objectives are to maintain and enhance the quality and reliability of products, ensure safety standards in the manufacturing and use of products, and to organize and act upon members' interest in areas such as energy conservation, efficiency and foreign competition. NEMA conducts regulatory and legislative analysis on issues of concern to electronic manufacturers, and compiles periodic summaries of statistical data on sales and production. In addition, NEMA publishes a periodic directory; a free, semiannual catalog of its publications and materials; *Tech Alert* bimonthly; and manuals, guidebooks, and other material on wiring, equipment installation, lighting, and standards.

Semiconductor Equipment and Materials International (SEMI) 805 E. Middlefield Road Mountain View, CA 94043 Phone: (415) 964-5111 Fax: (415) 967-5375	Members: 1750 Staff: NA Budget: NA Contact: William H. Reeds

SEMI was founded in 1970, and represents firms, corporations, and individuals who participate in supplying fabrication equipment, materials, or services to the semiconductor industry. SEMI operates an industry data collection program, conducts SEMI Technical Education Programs, and provides an annual Information Services Seminar (ISS) forecast. SEMI is the former Semiconductor Equipment and Materials Institute. SEMI publishes an annual *Book of SEMI Standards*, the annual *Business Outlook for the Semiconductor Equipment and Materials Industry*; a bimonthly newsletter providing general industry news; a quarterly newsletter, *SEMI Outlook*, that provides information on industry trends, analyses, and opinions; and the SEMICON Technical Proceedings which contains the proceedings and paper topics from the Institute's technical symposia.

Institute for Interconnecting and Packaging Electronic Circuits (IPC) 2215 Sanders Road, Suite 200 South Northbrook, IL 60062 Phone: (708) 677-2850 Fax: (708) 677-9570	Members: 1900 Staff: 42 Budget: NA Contact: Thomas Dammrich

Founded in 1957, IPC represents companies that produce and use electronic interconnections for electronic equipment. IPC's primary members are independent PWB manufacturers and contract assembly companies that mount components onto bare PWBs to produce printed wiring assemblies (PWAs) or electronic assemblies. IPC also represents original equipment manufacturers (OEMs), suppliers, academia, and technical members of the industry. IPC has over 100 committees, that cover all aspects of the industry including: technical standards; specifications and guidelines; education and training; technology research and development; market research and publications; management practices; environmental and safety programs; and government regulations.

Semiconductor Industry Association (SIA) 4300 Stevens Creek Boulevard Suite 271 San Jose, CA 95129 Phone: (408) 246-2711 Fax: (408) 246-2830	Members: 40 Staff: 14 Budget: $2,000,000 Contact: Andrew Procassini

SIA represents companies that produce semiconductor products including discrete components, integrated circuits, and microprocessors. This association compiles industry trade statistics and maintains a private library and sponsors the Semiconductor Research Corporation and SEMATECH. SIA's publications include the following: *Circuit*, a free, quarterly newsletter; Semiconductor Yearbook and Directory, which contains a review of programs sponsored by the association, key industry statistics, analyses by industry experts, public policy discussions, and sales volume; and essays, research reports, and proceedings.

Computer and Communications Industry Association (CCIA) 666 11th Street, NW Washington, DC 20001 Phone: (202) 783-0070 Fax: (202) 783-0534	Members: 60 Staff: 10 Budget: $1,000,000 Contact: A.G.W. Biddle

Comprised of computer manufacturers, CCIA provides information processing and telecommunication-related products and services. CCIA represents the interests of its members before Congress, Federal agencies, and the courts in the areas of domestic and foreign trade, tax policy, Federal procurement policy, and telecommunication policy. It hosts policy briefings on legislative and regulatory matters to keep members

aware of policy, political, technological, and market and economic developments and trends.   CCIA publishes *CEO Report* semimonthly and *Federal Procurement Policy Report*, *International Trade Report*, and *Telecommunication Report* on a monthly basis.

IX.   BIBLIOGRAPHY/OTHER MATERIALS AVAILABLE

For further information on selected topics within the electronic and computer industries, a list of publications are provided below:

General Profile

1992 Census of Manufacturers Industry Series: Preliminary Report, Bureau of the Census, November 1994. (MC92-1 - 36 E(P)).

1987 Census of Manufacturers Industry Series 36A: Electronic Transmission and Distribution Equipment, Bureau of the Census, April 1990. (MC87-I-36A).

1987 Census of Manufacturers Industry Series 36B: Household Appliances, Bureau of the Census, April 1990. (MC87-I-36B).

1987 Census of Manufacturers Industry Series 36C: Electric Lighting and Wiring Equipment, Bureau of the Census, April 1990. (MC87-I-36C).

1987 Census of Manufacturers Industry Series 36D: Communication Equipment, Bureau of the Census, April 1990. (MC87-I-36D).

1987 Census of Manufacturers Industry Series 36E: Electronic Components, Bureau of the Census, April 1990. (MC87-I-36E).

1987 Census of Manufacturers Industry Series 36F: Miscellaneous Electrical Equipment and Supplies, Bureau of the Census, April 1990. (MC87-I-36F).

1992 Globalisation of Industrial Activities: Four Case Studies: Auto Parts, Chemicals, Construction and Semiconductors. Organization for Economic Co-Operation and Development, Paris, 1992.

American Electronics Association (AEA), Personal communication with Roger Stabeele, February 8, 1994.

Annual 1993 Current Industrial Reports MA36QÑSemiconductors, Printed Circuit Boards, and Other Electronic Components, Bureau of the Census Bulletin Board Service, Washington, D.C., 1994.

Annual 1992 Current Industrial Reports MA36Q(92)-IÑSemiconductors, Printed Circuit Boards, and Other Electronic Components, Bureau of the Census Bulletin Board Service, Washington, D.C.

Burris, G.R., Manager of Corporate Environmental Engineering, Indianapolis, IN.

Background information on cathode ray tubes, 1995.

Developing The Electronics Industry, Bjšrn Wellenius, The World Bank, 1993.
Dun & Bradstreet, Dun's Market Identifiers, DIALOG Information Services, 1994.

Electronic Industry Environmental Roadmap, Microelectronics and Computer Technology Corporation (MCC), Austin, TX, 1994.

Electronic Industries Association (EIA), Arlington, VA, News release dated JanuaryÊ2, 1995.

Electronic Market Data Book, EIA, Arlington, VA, ,1994.

Encyclopedia of Associations, 27th ed., Deborah M. Burek, ed., Gale Research Inc., Detroit, Michigan, 1992.

Enforcement Accomplishments Report, FY 1991, U.S. EPA, Office of Enforcement (EPA/300-R92-008), April 1992.

Enforcement Accomplishments Report, FY 1992, U.S. EPA, Office of Enforcement (EPA/230-R93-001), April 1993.

Enforcement Accomplishments Report, FY 1993, U.S. EPA, Office of Enforcement (EPA/300-R94-003), April 1994.

Federal Environmental Regulations Potentially Affecting The Computer Industry, U.S. EPA, Office of Pollution Prevention and Toxics (EPA 744-B-93-002), April 1994.

Getting A Charge Out Of The Waste Stream, David Hurd, New York State Department of Economic Development, February 1992.

Industry and Trade Summary: Semiconductors, U.S. International Trade Commission, December 1993.

Institute for Interconnecting and Packaging Electronic Circuits (IPC), Washington, DC. Background information on printed wiring boards, 1995.

Options Proposed for Managing Discarded Fluorescent and Other Lights that Contain Mercury, Environmental Fact Sheet, U.S. EPA, Solid Waste and Emergency Response (EPA 530-F-94-022), July 1994.

Polychlorinated Biphenyl (PWB) Information Package, TSCA Information Service, April 1993.

Standard Industrial Classification Manual, Office of Management and Budget, 1987.

U.S. Industrial Outlook 1994, Department of Commerce 1994.

Process Descriptions, Release Profiles, and Pollution Prevention

1992 Toxic Release Inventory (TRI) Public Data Release, U.S. EPA, Office of Pollution Prevention and Toxics, April 1994. (EPA/745-R94-001)

Circuit Board Packet, U.S. EPA, Pollution Prevention Information Center.

Case Studies from the Minnesota Technical Assistance Program and the Oregon Hazardous Waste Reduction Program: Metal Finishing, U.S. EPA, Office of Environmental Engineering and Technology Demonstration and the Office of Pollution Prevention, November 1989.

Case Studies from the Pollution Prevention Information Center (PPIC): Electroplating, U.S. EPA, Office of Environmental Engineering and Technology Demonstration and the Office of Pollution Prevention, November 1989.

Electroplating Packet, U.S. EPA, Pollution Prevention Information Center.
Facility Pollution Prevention Guide, U.S. EPA, Office of Research and Development (EPA/600/R-92/088), May 1992.

"Etching Away with Ion Beams", *The Washington Post*, Elizabeth Corcoran, April 18, 1995, p. D1.

Guidelines for Waste Reduction and Recycling: Metal Finishing, Electroplating, and Printed Circuit Board Manufacturing, Oregon Department of Environmental Quality, Hazardous Waste Reduction Program, July 1989.

Green Lights: Third Annual Report, U.S. EPA, Office Air and Radiation (EPA 430-R-94-005), March 1994.

Hazard Assessment and Control Technology in Semiconductor Manufacturing II, American Conference of Government Industrial Hygienists, 1993.

Industry Profile and Description of chemical for the Semiconductor Industry, March 1993.

Industry Profile for the Metal Finishing Industry: Preliminary Draft, U.S. EPA, Office of Pollution Prevention and Toxics, Design for the Environment, June 24, 1994.

Industry Profile and Description of Chemical Use for the Printed Wiring Board Industry: Preliminary Draft, U.S. EPA, Office of Pollution Prevention and Toxics, Design for the Environment, March 1993.

Industry Profile and Description of Chemical Use for the Semiconductor Industry:

Preliminary Draft, U.S. EPA, Office of Pollution Prevention and Toxics, Design for the Environment, March 1993.

Light Brief: Green Lights Program, U.S. EPA, Office Air and Radiation (EPA 430-F-92-009), August 1992.

Lighting Waste Disposal, U.S. EPA Office Air and Radiation, January 1994.

McGraw-Hill Encyclopedia of Science & Technology, vols. 4, 6, 7, 9, 11, 14, 16, 17,18, 19 McGraw-Hill Book Company, New York, New York, 1987, 1992.

Metals Handbook: Cleaning and Finishing Stainless Steel, 9th ed., American Society for Metals, 1982.

Metals Handbook: Fabrication of Wrought Stainless Steel, 9th ed., American Society for Metals, 1982.

Microchip Fabrication: *A Practical Guide to Semiconductor Processing,* 2nd ed., Peter Van Zant, McGraw Hill, Inc. 1990.

Metal Industries - Metal Finishing Manufacturing Packet, U.S. EPA, Pollution Prevention Information Center.

Pollution Prevention 1991 Progress on Reducing Industrial Pollutants, U.S. EPA, Office of Pollution Prevention (EPA 21 P-3003), October 1991.

Pollution Prevention in Metal Manufacturing: Saving Money Through Pollution Prevention, U.S. EPA, Office of Pollution Prevention and Toxics (EPA/530-SW-89/056), October 1989.

Pollution Prevention Research Project: Evaluation of Alternatives to Halogenated Solvents for Cleaning and Drying Printed Circuit Boards-Final Report, Minnesota Office of Waste Management and Capsule Environmental Engineering Inc., July 30, 1992.

Printed Circuit Board Basics: Quick and Easy Guide, 2nd Ed., Michael Flatt, 1992.

Semiconductor Business: The Economics of Rapid Growth and Decline, Franco Malerba, University of Wisconsin, 1985.

Semiconductor Technology for the Non-Technologist, 2nd ed., Robert I. Scace, U.S. Department of Commerce, September 1990.

Sustainable Industry: Promoting Strategic Environmental Protection in the Industrial Sector, Phase 1 Report, U.S. EPA, Office of Emergency and Remedial Response, June 1994.

Title II Section 313 Release Reporting Guidance: Estimating Chemical Releases from Semiconductor Manufacturing, U.S. EPA, Office of Pesticides and Toxic Substances (EPA 560/4-88-004e), January 1998.

Contacts	Organization	Telephone
John Kim	EPA Region IX Inspector	415-744-1263
Greg Arthur	EPA Region IX Inspector	415-744-1900
Bill Hurley	AEA	408-987-4200
Debbie Boger	EPA Design for the Environment	202-260-0880
Steven Pederson	MCC	512-250-2758
Karen Phillips	EPA Region IX Inspector	415-749-4979
Dave Dellarco	EPA Region X, Office of Policy, Planning, and Pollution Prevention	206-553-4978
Daryl Burns	CA Air Resource Board	916-445-0960
Jack Bean	EPA Region IX, Air Quality Manager	415-749-4748
Michael Avery	West Coast Circuits, Inc.	408-728-4271
Christopher Rhodes	IPC	708-677-2850
Melissa Coggeshall Carey	EIA	703-907-7501
George Burris	Thompkins Consumer Electronics	317-587-4335
Bill Rowe	Zenith	708-450-4122

[1]**EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).**

[2] TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

[3]   **EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI,**

MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).