IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases, please note that in general, toxic chemical releases reported in TRI have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7% between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emission occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for storm water runoff and non-point losses must also be included.

Releases to Land -- includes disposal of toxic chemicals in waste to on-site landfills, land treated or incorporation into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Iron and Steel Industry

This section summarizes TRI data of facilities involved in the production of iron and steel products who report their operations under SIC 331. These include blast furnaces and steel mills, steel wire manufacture, and cold rolled steel products but also include a small number of nonferrous operations (such as facilities manufacturing nonferrous electrometalurgical products under SIC 3313). The *Census of Manufactures* reports 1,118 iron and steel establishments under SIC 331. Although 381 iron and steel facilities filed TRI reports in 1993 (under SIC 3312, 3313, 3315, 3316, 3317), the 155 facilities (41 percent) classified under SIC 3312 (blast furnaces and steel mills) are responsible for over 75 percent of reported releases and transfers. TRI information is likely to provide a fairly different profile for the facilities not reporting under 3312 (non-steel producing facilities).

According to TRI data, the iron and steel industry released and transferred a total of approximately 695 million pounds of pollutants during calendar year 1993. These releases and transfers are dominated by large volumes of metal-bearing wastes. The majority of these wastes (70 percent or 488 million pounds) are transferred off-site for recycling, typically for recovery of the metal content. *Transfers* of TRI chemicals account for 86 percent of the iron and steel industry's total TRI-reportable chemicals (609 million pounds) while *releases* make up 14 percent (85 million pounds). Metal-bearing wastes account for approximately 80 percent of the industry's transfers and over fifty percent of the releases.

Releases from the industry continue to decrease, while transfers increased from 1992 to 1993. The increase in transfers is likely due to increased off-site shipments for recovery of metals from wastes. This shift may also have contributed to the decrease in releases. Another factor influencing an overall downward trend since 1988 in releases and transfers is the steel mill production decrease during the 1988 to 1993 period. In addition, pollution control equipment and a shift to new technologies, such as continuous casting, are responsible for significant changes in the amount and type of pollutants released during steelmaking. Finally, the industry's efforts in pollution preventing also play a role in driving pollutant release reductions.

Evidence of the diversity of processes at facilities reporting to TRI is found in the fact that the most frequently reported chemical (sulfuric acid) is reported by only 41 percent of the facilities; the sixth most frequently reported chemical was used by just one-fourth of TRI facilities. The variability in facilities' pollutant profile may be attributable to a number of factors. Fewer than 30 of the facilities in the TRI database for SIC 331 are fully integrated plants making coke, iron, and steel products. The non-integrated facilities do not perform one or more of the production steps and, therefore, may have considerably different emissions profiles. Furthermore, steel making operations with electric arc furnaces have significantly different pollutant profiles than those making steel with basic oxygen furnaces.

Releases

The iron and steel industry releases just 14 percent of its TRI total poundage. Of these releases, over half go to on-site land disposal, and one quarter of releases are fugitive or point source air emissions (Exhibit 7). Manganese, zinc, chromium, and lead account for over 90 percent of the on-site land disposal. The industry's air releases are associated with volatilization, fume or aerosol formation in the high temperature furnaces and byproduct processing. Ammonia, lighter weight organics, such as methanol, acids and metal contaminants found in the iron ore are the principal types of chemicals released to the air. In addition to air releases of chemicals reported in TRI, the iron and steel industry is a significant source of particulates, carbon monoxide, nitrogen oxides and sulfur compounds due to combustion. Ammonia releases account for the largest part of the fugitive releases (approximately 42 percent) and 1,1,1-trichloroethane, hydrochloric acid, zinc compounds, and trichloroethylene each contribute another 4 - 5 percent. Underground injection (principally of hydrochloric acid) makes up about 14 percent of the releases reported by the industry.

Transfers

Eighty percent of transfers reported by SIC 331 industries are sent off-site for recycling. Zinc, manganese, chromium, copper, nickel, and lead are the six metals transferred by the greatest number of facilities (Exhibit 8).

Acids used during steel finishing, such as hydrochloric, sulfuric, nitric, and phosphoric acids, account for another 17 percent of transfers. These acids are most often sent off-site for recycling or for treatment. Hydrochloric acids are also managed by on-site underground injection. The next class of chemicals of significant volume in TRI are solvents and lightweight carbon byproducts, including: 1,1,1-trichloroethane, trichloroethylene, phenol, xylene, methanol, and toluene. These solvents are primarily released as fugitive air emissions, but also from point sources. A small percentage of these solvents are transferred off-site for recycling.

Chemicals sent off-site for disposal (primarily zinc, sulfuric acid, manganese, and ammonium sulfate) account for another 10 percent of transfers. Only approximately 7 percent of chemicals transferred off-site go to treatment. These chemicals are primarily hydrochloric acid, sulfuric acid, and nitric acid. Only about one percent of transfers by weight are POTW discharges (mainly sulfuric acid). Another one percent of transfers are sent for energy recovery (with hydrochloric acid as the most significant contributor).

Exhibit 7: Releases for Iron and Steel Facilities (SIC 331) in TRI, by Number of Facilities Reporting (1993 Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASE PER FACILITY
SULFURIC ACID	157	385,882	321,639	27,700	0	4,705	739,926	4,713
MANGANESE COMPOUNDS	110	472,855	808,182	145,595	4,800	21,252,405	22,683,837	206,217
CHROMIUM COMPOUNDS	108	19,821	87,971	53,107	4,800	1,953,629	2,119,328	19,623
ZINC COMPOUNDS	108	596,037	874,585	121,804	250	13,497,412	15,090,088	139,723
HYDROCHLORIC ACID	102	612,814	1,469,636	25	11,726,300	744	13,809,519	135,387
CHROMIUM	95	10,858	24,926	4,432	0	415,839	456,055	4,801
MANGANESE	94	38,655	42,782	79,069	0	791,189	951,695	10,124
NICKEL COMPOUNDS	86	9,030	12,107	11,007	1,100	654,514	687,758	7,997
NICKEL	83	10,505	19,817	9,490	3,200	126,359	169,371	2,041
NITRIC ACID	66	96,647	487,887	39	0	44,730	629,303	9,535
LEAD	61	34,634	107,468	17,088	0	126,479	285,669	4,683
LEAD COMPOUNDS	61	55,593	76,024	11,559	0	1,087,501	1,230,677	20,175
AMMONIA	59	5,162,886	1,012,664	4,836,185	860,000	6,479	11,878,214	201,326
PHOSPHORIC ACID	56	78,666	7,672	260	0	142,814	229,412	4,097
COPPER COMPOUNDS	51	10,474	81,731	8,918	1,100	1,518,033	1,620,256	31,770
COPPER	36	17,281	4,902	3,237	0	16,320	41,740	1,159
ZINC (FUME OR DUST)	36	328,089	322,975	58,831	0	3,571,000	4,280,895	118,914
XYLENE (MIXED ISOMERS)	32	172,712	76,091	510	0	274	249,587	7,800
HYDROGEN FLUORIDE	30	96,276	133,328	19	0	20,789	250,412	8,347
TOLUENE	30	222,938	408,507	513	0	328	632,286	21,076
NAPHTHALENE	26	98,890	35,809	1,830	15,000	300	151,829	5,840
BENZENE	24	482,755	347,643	911	7,000	600	838,909	34,955
CYANIDE COMPOUNDS	24	14,928	91,928	72,033	41,000	909	220,798	9,200
CHLORINE	23	16,510	6,409	48,910	0	0	71,829	3,123
ETHYLENE GLYCOL	21	52,505	255	99,306	0	6,950	159,016	7,572
ETHYLENE	20	196,170	771,732	0	0	0	967,902	48,395
BARIUM COMPOUNDS	19	847	1,260	12,523	0	140,857	155,487	8,184
1,1,1-TRICHLOROETHANE	19	1,184,793	160,942	0	0	0	1,345,735	70,828
ANTHRACENE	17	3,830	11,636	9	0	0	15,475	910
PHENOL	16	101,903	77,677	30,445	76,000	23,817	309,842	19,365
ALUMINUM (FUME OR DUST)	15	5,536	56,575	22,522	0	210,064	294,697	19,646
PROPYLENE	15	28,149	81,649	0	0	0	109,798	7,320
METHANOL	14	487,709	18	0	0	35	487,762	34,840
DIBENZOFURAN	13	2,571	29	0	0	0	2,600	200
MOLYBDENUM TRIOXIDE	13	923	852	1,860	0	6,450	10,085	776
ETHYLBENZENE	12	13,504	3,803	250	0	0	17,557	1,463
TRICHLOROETHYLENE	12	572,277	484,600	5	0	0	1,056,882	88,074
AMMONIUM SULFATE(SOLUTION)	10	5	0	5,693	0	0	5,698	570
CADMIUM COMPOUNDS	10	904	1,391	5	0	0	2,300	230
STYRENE	10	4,724	636	5	0	7	5,372	537
COBALT	9	419	684	3,709	0	760	5,572	619
GLYCOL ETHERS	8	76,065	268,798	0	0	0	344,863	43,108
DICHLOROMETHANE	7	133,725	264,215	0	0	0	397,940	56,849
COBALT COMPOUNDS	6	18	781	535	0	3,100	4,434	739
CRESOL (MIXED ISOMERS)	6	6,341	1,801	259	0	0	8,401	1,400
QUINOLINE	6	379	1,801	5	0	0	2,185	364

Exhibit 7 (cont.): Releases for Iron and Steel Facilities (SIC 331) in TRI, by Number of Facilities Reporting (1993 Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASE PER FACILITY
QUINOLINE	6	2,185	379	1,801	5	0	2,185	364
1,2,4-TRIMETHYLBENZENE	6	9,730	434	0	0	0	10,164	1,694
ANTIMONY COMPOUNDS	5	1,715	110	635	0	1,052	3,512	702
BIPHENYL	5	202	1	0	0	0	203	41
ANTIMONY	4	803	650	5,515	0	1,300	8,260	2,067
TETRACHLOROETHYLENE	4	34,498	10,800	0	0	0	45,290	11,325
ACETONE	3	340,285	0	0	0	0	340,285	113,428
BARIUM	3	373	996	4,416	0	117,264	123,049	41,016
CADMIUM	3	24	388	0	0	0	412	137
SEC-BUTYL ALCOHOL	3	56,794	10,650	250	0	0	67,694	22,565
VANADIUM (FUME ORþ DUST)	3	4,180	700	3,200	0	22,000	30,080	10,027
CALCIUM CYANAMIDE	2	0	0	0	0	0	0	0
CARBON DISULFIDE	2	1,638	250	0	0	0	1,888	944
DIETHANOLAMINE	2	1,900	0	25,000	0	0	26,900	13,450
HYDROGEN CYANIDE	2	5	10	0	0	0	15	8
METHYL ETHYLKETONE	2	3,700	51,400	0	0	0	55,100	27,550
N-BUTYL ALCOHOL	2	250	27,807	0	0	0	28,057	14,029
SILVER	2	5	0	0	0	0	5	3
THIOUREA	2	250	0	767	0	0	1,017	509
ALUMINUM OXIDE(FIBROUS	1	250	0	0	0	0	250	250
ARSENIC	1	15	15	0	0	0	30	30
BROMOTRIFLUOROMETHANE	1	250	0	0	0	0	250	250
BUTYL BENZYL PHTHALATE	1	0	0	0	0	0	0	0
CARBONYL SULFIDE	1	250	0	0	0	0	250	250
METHYL ISOBUTYL KETONE	1	170	0	0	0	0	170	170
POLYCHLORINATED BIPHENYLS	1	0	0	0	0	0	0	0
PYRIDINE	1	750	16,000	0	8,200	0	24,950	24,950
SELENIUM COMPOUNDS	1	0	0	0	0	0	0	0
1,3-BUTADIENE	1	250	0	0	0	0	250	250
2,4-DIMETHYLPHENOL	1	250	0	0	0	0	250	250
TOTAL	381	12,377,570	9,174,029	5,729,986	12,748,750	45,767,008	85,797,343	85,797,343

Exhibit 8: Transfers for Iron and Steel Facilities in TRI, by Number of Facilities Reporting (1993 Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFER PER FACILITY
SULFURIC ACID	157	7,192,127	11,060,393	15,416,092	6,533,083	0	40,295,552	256,660
MANGANESE COMPOUNDS	110	1,498	2,500,170	25,091,810	514,579	0	28,108,057	255,528
CHROMIUM COMPOUNDS	108	1,353	1,394,134	25,225,915	312,628	1,059	26,935,089	249,399
ZINC COMPOUNDS	108	8,611	34,813,453	157,386,808	5,021,396	3,100	197,233,368	1,826,235
HYDROCHLORIC ACID	102	217,138	395,161	32,888,151	23,981,197	8,497,000	65,978,647	646,849
CHROMIUM	95	2,289	1,010,326	32,865,366	36,816	750	33,915,547	357,006
MANGANESE	94	2,461	4,442,385	39,076,967	40,744	0	43,562,557	463,431
NICKEL COMPOUNDS	86	4,678	381,519	8,831,918	121,984	0	9,340,099	108,606
NICKEL	83	2,091	455,271	13,271,504	57,207	0	13,786,073	166,097
NITRIC ACID	66	51,087	1,616,149	54,046	3,073,168	0	4,794,450	72,643
LEAD	61	2,242	515,410	7,382,111	151,145	27	8,050,935	131,983
LEAD COMPOUNDS	61	957	682,835	13,703,747	152,866	0	14,540,405	238,367
AMMONIA	59	488,144	53,077	0	5,650	2,700	549,821	9,319
PHOSPHORIC ACID	56	9	90,626	18,000	19,549	0	128,184	2,289
COPPER COMPOUNDS	51	1,930	99,140	998,167	35,473	0	1,134,710	22,249
COPPER	36	746	63,934	5,598,545	7,123	0	5,670,348	157,510
ZINC (FUME OR DUST)	36	958	669,220	60,234,732	199,821	0	61,104,731	1,697,354
XYLENE(MIXED ISOMERS)	32	308	600	7,360	828	23,816	32,912	1,029
HYDROGEN FLUORIDE	30	28,300	387,574	15,046	827,889	0	1,258,809	41,960
TOLUENE	30	360	650	1,760	7,747	7,897	18,414	614
NAPHTHALENE	26	1,578	24,300	0	3,561	900	30,339	1,167
BENZENE	24	1,574	1,800	469	4,477	1,800	10,120	422
CYANIDE COMPOUNDS	24	29,753	3,184	0	13,238	0	46,175	1,924
CHLORINE	23	1,310	250	92,563	0	0	94,123	4,092
ETHYLENE GLYCOL	21	250	16,984	279,247	25,000	57,550	379,031	18,049
ETHYLENE	20	0	0	0	0	0	0	0
BARIUM COMPOUNDS	19	0	132,219	68,028	0	0	200,247	10,539
1,1,1-TRICHLOROETHANE	19	0	2,000	165,861	33,988	79,528	281,377	14,809
ANTHRACENE	17	0	4,200	0	2	0	4,202	247
PHENOL	16	359,945	1,176	0	108,247	6,464	475,832	29,740
ALUMINUM(FUME OR DUST)	15	5	125,775	47,675,040	0	0	47,800,820	3,186,721
PROPYLENE	15	0	0	0	0	0	0	0
METHANOL	14	720	0	0	0	0	720	51
DIBENZOFURAN	13	0	2,690	0	0	0	2,690	207
MOLYBDENUM TRIOXIDE	13	0	750	139,341	0	0	140,091	10,776
ETHYLBENZENE	12	0	325	760	250	1,502	2,837	236
TRICHLOROETHYLENE	12	0	38,556	76,036	53,726	24,191	192,509	16,042
AMMONIUM	10	0	2,000,000	0	0	0	2,000,000	200,000
CADMIUM COMPOUNDS	10	0	0	194,474	1,369	0	195,843	19,584
STYRENE	10	5	322	0	0	0	327	33
COBALT	9	0	40,026	830,040	7	0	870,073	96,675
GLYCOL ETHERS	8	0	0	0	1,273	26,000	27,273	3,409
DICHLOROMETHANE	7	0	0	8,229	8,200	750	17,179	2,454
COBALT COMPOUNDS	6	255	444	75,378	1,355	0	77,432	12,905
CRESOL(MIXED ISOMERS)	6	5	5	0	501	2,107	2,618	436
QUINOLINE	6	5	510	0	0	0	515	86

Exhibit 8 (cont.): Transfers for Iron and Steel Facilities in TRI, by Number of Facilities Reporting (1993 Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFER PER FACILITY
QUINOLINE	6	5	510	0	0	0	515	86
1,2,4-TRIMETHYLBENZENE	6	0	380	0	250	750	1,380	230
ANTIMONY COMPOUNDS	5	0	410	0	0	0	410	82
BIPHENYL	5	0	550	0	0	0	550	110
ANTIMONY	4	0	34,855	0	0	0	34,855	8,714
TETRACHLOROETHYLENE	4	0	4,000	13,853	0	3,517	21,370	5,343
ACETONE	3	0	1	0	4,308	0	4,309	1,436
BARIUM	3	0	5	3,105	0	0	3,110	1,037
CADMIUM	3	0	17,400	82,944	0	0	100,344	33,448
SEC-BUTYL ALCOHOL	3	0	0	0	990	0	990	330
VANADIUM (FUME OR DUST)	3	0	0	0	0	0	0	0
CALCIUM CYANAMIDE	0	0	0	0	0	0	0	0
CARBON DISULFIDE	0	0	0	0	0	0	0	0
DIETHANOLAMINE	0	0	0	0	0	0	0	0
HYDROGEN CYANIDE	0	0	0	0	0	0	0	0
METHYL ETHYL KETONE	2	0	0	0	0	339	0	170
N-BUTYL ALCOHOL	2	0	0	0	0	500	2	250
SILVER	2	5	0	2,666	0	0	2	1,336
THIOUREA	0	0	0	0	0	0	2	0
ALUMINUM OXIDE(FIBROUS	1	0	0	0	52,117	0	1	52,117
ARSENIC	0	0	0	0	0	0	1	0
BROMOTRIFLUOROMETHANE	0	0	0	0	0	0	1	0
BUTYL BENZYL PHTHALATE	0	0	0	0	0	0	1	0
CARBONYL SULFIDE	0	0	0	0	0	0	1	0
METHYL ISOBUTYL KETONE	0	0	0	0	0	0	1	0
POLYCHLORINATED BIPHENYLS	1	0	18,691	0	6,428	0	1	25,119
PYRIDINE	0	0	0	0	0	0	1	0
SELENIUM COMPOUNDS	1	0	736	0	0	0	1	736
1,3-BUTADIENE	0	0	0	0	0	0	1	0
2,4-DIMETHYLPHENOL	0	0	0	0	0	0	1	0
TOTAL	381	8,402,697	63,104,571	487,776,079	41,420,180	8,742,247	609,539,881	1,599,842

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector based on pounds released are listed below. Facilities that have reported only the SIC codes covered under this notebook appear on the first list. The second list contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations - some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 9: Top 10 TRI Releasing Iron and Steel Facilities[a]

Rank	Facility	Total TRI Releases in Pounds
1	Elkem Metals Co* - Marietta, OH	18,604,572
2	Northwestern Steel & Wire Co. - Sterling, IL	14,274,570
3	Granite City Steel - Granite City, IL	5,156,148
4	Midwest Steel Div. Midwest Steel Div. - Portage, IN	4,735,000
5	AK Steel Corp. Middletown Works - Middletown, OH	4,189,050
6	Bethlehem Steel Corp. Burns Harbor Div. - Burns Harbor, IN	3,899,470
7	Wheeling-Pittsburgh Steel Corp Mingo Junction Plant - Mingo Junction, OH	3,089,795
8	USS Gary Works - Gary, IN	2,403,348
9	LTV Steel Co. Inc. Cleveland Works - Cleveland, OH	1,985,131
10	Gulf States Steel Inc. - Gadsden, AL	1,959,707

Source: U.S. EPA *Toxic Release Inventory Database* , 1993.
* This is an Electrometallurgical Products facility (SIC 3313), not a steel mill.

[a] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 10: Top 10 TRI Releasing Facilities Reporting SIC 331 Operations[b]			
Rank	**SIC Codes Reported in TRI**	**Facility**	**Total TRI Releases in Pounds**
1	3313	Elkem Metals Co* - Marietta, OH	18,604,572
2	3312, 3315	Northwestern Steel & Wire Co. - Sterling, IL	14,274,570
3	3312, 3274	Inland Steel Co. - East Chicago, IN	10,618,719
4	3313, 2819	Kerr-McGee Chemical Corp. Electrolytic Plant - Hamilton, MS*	5,446,555
5	3312	Granite City Steel - Granite City, IL	5,156,148
6	3316	Midwest Steel Div. Midwest Steel Div. - Portage, IN	4,735,000
7	3312	AK Steel Corp. Middletown Works - Middletown, OH	4,189,050
8	3312	Bethlehem Steel Corp. Burns Harbor Div. - Burns Harbor, IN	3,899,470
9	3312	Wheeling-Pittsburgh Steel Corp Mingo Junction Plant - Mingo Junction, OH	3,089,795
10	3312	USS Gary Works - Gary, IN	2,403,348

Source: U.S. EPA *Toxic Release Inventory Database* , 1993.
* This is an Electrometallurgical Products facility (SIC 3313), not a steel mill.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reduction over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

[b] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), and the Hazardous Substances Data Bank (HSDB), accessed via TOXNET. TOXNET is a computer system run by the National Library of Medicine. It includes a number of toxicological databases managed by EPA, the National Cancer Institute, and the National Institute for Occupational Safety and Health.[c] 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. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766.

Ammonia (CAS: 7664-41-7)

Sources. In cokemaking, ammonia is produced by the decomposition of the nitrogen-containing compounds which takes place during the secondary thermal reaction (at temperatures greater than 700°C (1296°F)). The ammonia formed during coking exists in both the water and gas that form part of the volatile products. The recovery of this ammonia can be accomplished by several different processes where the by-product ammonium sulfate is formed by the reaction between the ammonia and sulfuric acid.[23]

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system.

Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

[c] 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).

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters.

Ammonia is a central compound in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a corrosive and severely irritating gas with a pungent odor.

Hydrochloric Acid (CAS: 7647-01-1)

Sources. During hot rolling, a hard black iron oxide is formed on the surface of the steel. This "scale" is removed chemically in the pickling process which commonly uses hydrochloric acid.[24]

Toxicity. Hydrochloric acid is primarily a concern in its aerosol form. Acid aerosols have been implicated in causing and exacerbating a variety of respiratory ailments. Dermal exposure and ingestion of highly concentrated hydrochloric acid can result in corrosivity.

Ecologically, accidental releases of solution forms of hydrochloric acid may adversely affect aquatic life by including a transient lowering of the pH (i.e., increasing the acidity) of surface waters.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of hydrochloric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Concentrated hydrochloric acid is highly corrosive.

Manganese and Manganese Compounds (CAS: 7439-96-5; 20-12-2)

Sources. Manganese is found in the iron charge and is used as an addition agent added to alloy steel to obtain desired properties in the final product. In carbon steel, manganese is used to combine with sulfur to improve the ductility of the steel. An alloy steel with manganese is used for applications involving relatively small sections which are subject to severe service conditions, or in larger sections where the weight saving derived from the higher strength of the alloy steels is needed.[25]

Toxicity. There is currently no evidence that human exposure to manganese at levels commonly observed in ambient atmosphere results in adverse health effects. However, recent EPA review of the fuel additive

MMT (methylcyclopentadienyl manganese tricarbonyl) concluded that use of MMT in gasoline could lead to ambient exposures to manganese at a level sufficient to cause adverse neurological effects in humans.

Chronic manganese poisoning bears some similarity to chronic lead poisoning. Occurring via inhalation of manganese dust or fumes, it primarily involves the central nervous system. Early symptoms include languor, speech disturbances, sleepiness, and cramping and weakness in legs. A stolid mask-like appearance of face, emotional disturbances such as absolute detachment broken by uncontrollable laughter, euphoria, and a spastic gait with a tendency to fall while walking are seen in more advanced cases. Chronic manganese poisoning is reversible if treated early and exposure stopped. Populations at greatest risk of manganese toxicity are the very young and those with iron deficiencies.

Ecologically, although manganese is an essential nutrient for both plants and animals, in excessive concentrations manganese inhibits plant growth.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Manganese is an essential nutrient for plants and animals. As such, manganese accumulates in the top layers of soil or surface water sediments and cycles between the soil and living organisms. It occurs mainly as a solid under environmental conditions, though may also be transported in the atmosphere as a vapor or dust.

1,1,1-Trichloroethane (CAS: 71-55-6)

Sources. Used for surface cleaning of steel prior to coating.

Toxicity. Repeated contact of 1,1,1-trichloroethane (TCE) with skin may cause serious skin cracking and infection. Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations.

Exposure to high concentrations of TCE causes reversible mild liver and kidney dysfunction, central nervous system depression, gait disturbances, stupor, coma, respiratory depression, and even death. Exposure to lower concentrations of TCE leads to light-headedness, throat irritation, headache, disequilibrium, impaired coordination, drowsiness, convulsions and mild changes in perception.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of TCE to surface water or land will almost entirely volatilize. Releases to air may be transported long distances and may partially return to earth in rain. In the lower atmosphere, TCE degrades very slowly by photooxidation and slowly diffuses to the upper atmosphere where photodegradation is rapid.

Any TCE that does not evaporate from soils leaches to groundwater. Degradation in soils and water is slow. TCE does not hydrolyze in water, nor does it significantly bioconcentrate in aquatic organisms.

Zinc and Zinc Compounds (CAS: 7440-66-6; 20-19-9)

Sources. To protect steel from rusting, it is coated with a material that will protect it from moisture and air. In the galvanizing process, steel is coated with zinc.[26]

Toxicity. Zinc is a nutritional trace element; toxicity from ingestion is low. Severe exposure to zinc might give rise to gastritis with vomiting due to swallowing of zinc dusts. Short-term exposure to very high levels of zinc is linked to lethargy, dizziness, nausea, fever, diarrhea, and reversible pancreatic and neurological damage. Long-term zinc poisoning causes irritability, muscular stiffness and pain, loss of appetite, and nausea.

Zinc chloride fumes cause injury to mucous membranes and to the skin. Ingestion of soluble zinc salts may cause nausea, vomiting, and purging.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Significant zinc contamination of soil is only seen in the vicinity of industrial point sources. Zinc is a relatively stable soft metal, though burns in air. Zinc bioconcentrates in aquatic organisms.

IV.C. Other Data Sources

The toxic chemical release data obtained from TRI captures the vast majority of facilities in the iron and steel industry. It also allows for a comparison across years and industry sectors. Reported chemicals are limited however to the 316 reported chemicals. Most of the hydrocarbon emissions from iron and steel facilities are not captured by TRI.[27] The EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SOx, NOx, CO, particulates, etc.) from many iron and steel manufacturing sources.[28]

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 11 summarizes annual releases (from the industries for which a Sector Notebook Profile was prepared) of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs). With 1.5 million short tons/year of carbon monoxide, the iron and steel industry emissions are estimated as more than twice as much as the next largest releasing industry, pulp and paper. Of the eighteen industries listed, the iron and steel industry also ranks as one of the top five releasers for NO_2, PM10, PT, and SO_2. Carbon monoxide releases occur during ironmaking (in the burning of coke, CO produced reduces iron oxide ore), and during steelmaking (in either the basic oxygen furnace or the electric arc furnace). Nitrogen dioxide is generated during steelmaking. Particulate matter may be emitted from the cokemaking (particularly in quenching operations), ironmaking, basic oxygen furnace (as oxides of iron that are emitted as sub-micron dust), or from the electric arc furnace (as metal dust containing iron particulate, zinc, and other materials associated with the scrap). Sulfur dioxide can be released in ironmaking or sintering.

Exhibit 11: Pollutant Releases (short tons/year)

Industry Sector	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Production	123,756	42,658	14,135	63,761	9,419	41,423
Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	541,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	103,575	4,107	39,062	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,155	369,058
Rubber and Misc. Plastics	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	**1,518,642**	**138,985**	**42,368**	**83,017**	**238,268**	**82,292**
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Computer and Office Equipment	24	0	0	0	0	0
Electronics and Other Electrical Equipment and Components	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

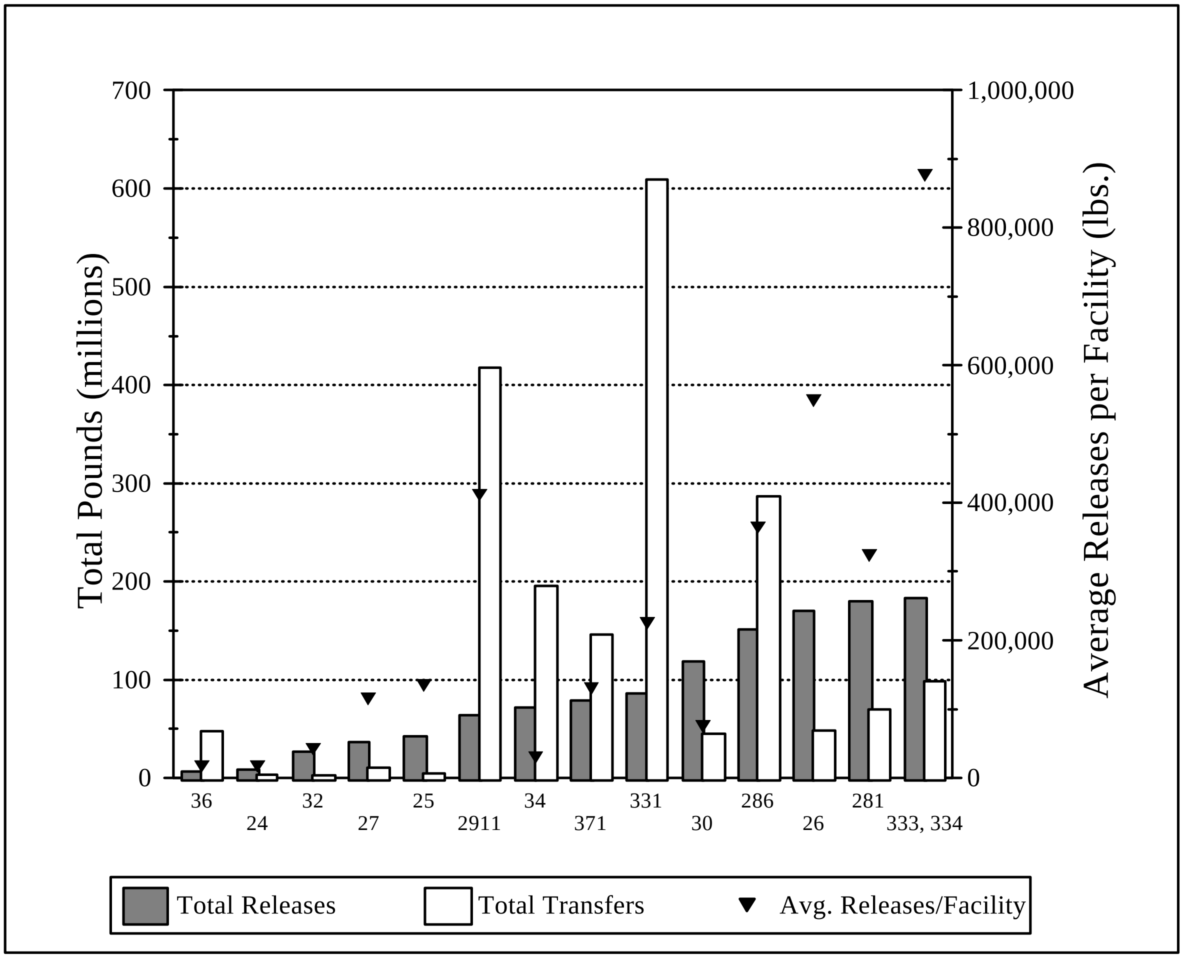
Source: U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Exhibit 12 is a graphical representation of a summary of the 1993 TRI data for the iron and steel industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangular points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 13 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the iron and steel industry, the 1993 TRI data presented here covers 381 facilities. These facilities listed SIC 331 (Steel Works, Blast Furnaces, and Rolling and Finishing Mills) as a primary SIC code.

Exhibit 12: Summary of 1993 TRI Data: Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333,334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

Exhibit 13: Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	1993 TRI Releases: Total Releases (million lbs.)	1993 TRI Releases: Average Releases per Facility (pounds)	1993 TRI Transfers: Total Transfers (million lbs.)	1993 TRI Transfers: Average Transfers per Facility (pounds)	Total Releases + Transfers (million lbs.)	Average Releases+ Transfers per Facility (pounds)
Stone, Clay, and Concrete	32	634	26.6	42,000	2.2	4,000	28.8	46,000
Lumber and Wood Products	24	491	8.4	17,000	3.5	7,000	11.9	24,000
Furniture and Fixtures	25	313	42.2	135,000	4.2	13,000	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	32,000	46.7	147,000
Electronic Equip. and Components	36	406	6.7	17,000	47.1	116,000	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	75,000	45	29,000	163.4	104,000
Motor Vehicles, Bodies, Parts, and Accessories	371	609	79.3	130,000	145.5	239,000	224.8	369,000
Pulp and Paper	2611-2631	309	169.7	549,000	48.4	157,000	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72	30,000	195.7	83,000	267.7	123,000
Iron and Steel	**331**	**381**	**85.8**	**225,000**	**609.5**	**1,600,000**	**695.3**	**1,825,000**
Nonferrous Metals	333, 334	208	182.5	877,000	98.2	472,000	280.7	1,349,000
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting.						
Nonmetal Mining	14	Industry sector not subject to TRI reporting.						
Dry Cleaning	7216	Industry sector not subject to TRI reporting.						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.
In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the iron and steel industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

Most of the pollution prevention activities in the iron and steel industry have concentrated on reducing cokemaking emissions, Electric Arc Furnace (EAF) dust, and spent acids used in finishing operations. Due to the complexity, size, and age of the equipment used in steel manufacturing, projects that have the highest pollution prevention potential often require significant capital investments. This section describes pollution prevention opportunities for each of the three focus areas (cokemaking, EAF dust, and finishing acids), and then lists some general pollution prevention opportunities that have been identified by the iron and steel industry.

Cokemaking

The cokemaking process is seen by industry experts as one of the steel industry's areas of greatest environmental concern, with coke oven air emissions and quenching waste water as the major problems. In response to expanding regulatory constraints, including the Clean Air Act National Emission Standards for coke ovens completed in 1993, U.S. steelmakers are turning to new technologies to decrease the sources of pollution from, and their reliance on, coke. Pollution prevention in cokemaking has focused on two areas: reducing coke oven emissions and developing cokeless ironmaking techniques. Although these processes have not yet been widely demonstrated on a commercial scale, they may provide significant benefits for the integrated segment of the industry in the form of substantially lower air emissions and wastewater discharges than current operations.

Eliminating Coke with Cokeless Technologies

Cokeless technologies substitute coal for coke in the blast furnace, eliminating the need for cokemaking. Such technologies have enormous potential to reduce pollution generated during the steelmaking process. The capital investment required is also significant. Some of the cokeless technologies in use or under development include:

• *The Japanese Direct Iron Ore Smelting (DIOS) process.* This process produces molten iron directly with coal and sinter feed ore. A 500 ton per day pilot plant was started up in October, 1993 and the designed production rates were attained as a short term average. During 1995, the data generated will be used to determine economic feasibility on a commercial scale.

• *HIsmelt process.* A plant using the HIsmelt process for molten iron production, developed by HIsmelt Corporation of Australia, was started up in late 1993. The process, using ore fines and coal, has achieved a production rate of 8 tons per hour using ore directly in the smelter. Developers anticipate reaching the production goal of 14 tons per hour. During 1995, the data generated will be used to determine economic feasibility on commercial scale. If commercial feasibility is realized, Midrex is expected to become the U.S. engineering licensee of the HIsmelt process.

• *Corex process.* The Corex or Cipcor process has integral coal desulfurizing, is amenable to a variety of coal types, and generates electrical power in excess of that required by an iron and steel mill which can be sold to local power grids. A Corex plant is in operation in South Africa, and other plants are expected to be operational in the next two years in South Korea and India.

Reducing Coke Oven Emissions

Several technologies are available or are under development to reduce the emissions from coke ovens. Typically, these technologies reduce the quantity of coke needed by changing the method by which coke is added to the blast furnace or by substituting a portion of the coke with other fuels. The reduction in the amount of coke produced proportionally reduces the coking emissions. Some of the most prevalent or promising coke reduction technologies include:

• *Pulverized coal injection.* This technology substitutes pulverized coal for a portion of the coke in the blast furnace. Use of pulverized coal injection can replace about 25 to 40 percent of coke in the blast furnace, substantially reducing emissions associated with cokemaking operations. This reduction ultimately depends on the fuel injection rate applied to the blast furnaces which will, in turn be dictated by the aging of existing coking facilities, fuel costs, oxygen availability, capital requirements for fuel injection, and available hot blast temperature.

• *Non-recovery coke battery*. As opposed to the by-product recovery coke plant, the non-recovery coke battery is designed to allow combustion of the gasses from the coking process, thus consuming the by-products that are typically recovered. The process results in lower air emissions and substantial reductions in coking process wastewater discharges.

• *The Davy Still Autoprocess.* In this pre-combustion cleaning process for coke ovens, coke oven battery process water is utilized to strip ammonia and hydrogen sulfide from coke oven emissions.

• *Alternative fuels.* Steel producers can also inject other fuels, such as natural gas, oil, and tar/pitch, instead of coke into the blast furnace, but these fuels can only replace coke in limited amounts.

Recycling of Coke By-products

Improvements in the in-process recycling of tar decanter sludge, a RCRA listed hazardous waste (K087) are common practice. Sludge can either be injected into the ovens to contribute to coke yield, or converted into a fuel that is suitable for the blast furnace.

Reducing Wastewater Volume

In addition to air emissions, quench water from cokemaking is also an area of significant environmental concern. In Europe, some plants have implemented technology to shift from water quenching to dry quenching in order to reduce energy costs. However, major construction changes are required for such a solution and considering the high capital costs of coke batteries, the depressed state of the steel industry, and increased regulations for cokemaking, it is unlikely that this pollution prevention opportunity will be widely adopted in the U.S.

Electric Arc Furnace Dust

Dust generation in the EAF, and its disposal, have also been recognized as a serious problem, but one with potential for pollution prevention through material recovery. EAF dust is a RCRA listed waste (K061) because of its high concentrations of lead and cadmium. With 550,000 tons of EAF dust generated annually in the U.S., there is great potential to reduce the volume of this hazardous waste.[27] Steel companies typically pay a disposal fee of $150 to $200 per ton of dust. With an average zinc concentration of 19 percent, much of the EAF dust is shipped off-site for zinc reclamation. Most of the EAF dust recovery options are only economically viable for dust with a zinc content of at least 15 - 20 percent. Facilities producing specialty steels such as stainless steel with a lower zinc content, still have opportunities to recover chromium and nickel from the EAF dust.

In-process recycling of EAF dust involves pelletizing and then reusing the pellets in the furnace, however, recycling of EAF dust on-site has not proven to be technically or economically competitive for all mills. Improvements in technologies have made off-site recovery a cost effective alternative to thermal treatment or secure landfill disposal.

Pickling Acids

In finishing, pickling acids are recognized as an area where pollution prevention efforts can have a significant impact in reducing the environmental impact of the steel mill. The pickling process removes scale and cleans the surface of raw steel by dipping it into a tank of hydrochloric or sulfuric acid. If not recovered, the spent acid may be transported to deep injection wells for disposal, but as those wells continue to close, alternative disposal costs are rising.

Large-scale steel manufacturers commonly recover hydrochloric acid in their finishing operations, however the techniques used are not suitable for small- to medium-sized steel plants.[28] Currently, a recovery technique for smaller steel manufacturers and galvanizing plants is in pilot scale testing. The system under development removes iron chloride (a saleable product) from the hydrochloric acid, reconcentrates the acid for reuse, and recondenses the water to be reused as a rinse water in the pickling process. Because the only by-product of the hydrochloric acid recovery process is a non-hazardous, marketable metal chloride, this technology generates no hazardous wastes. The manufacturer projects industry-wide hydrochloric acid waste reduction of 42,000 tons/year by 2010. This technology is less expensive than transporting and disposing waste acid, plus it eliminates the associated long-term liability. The total savings for a small- to medium-sized galvanizer is projected to be $260,000 each year.

The pilot scale testing project is funded in part by a grant from the U.S. Department of Energy under the NICE^3 program (see section VIII.B. for program information) and the EPA. (Contact: Bill Ives, DOE, 303-275-4755)

To reduce spent pickling liquor (K062) and simultaneously reduce fluoride in the plant effluent, one facility modified their existing treatment process to recover the fluoride ion from rinse water and spent pickling acid raw water waste streams. The fluoride is recovered as calcium fluoride (fluorspar), an input product for steelmaking. The melt shop in the same plant had been purchasing 930 tons of fluorspar annually for use as a furnace flux material in the EAF at a cost of $100 per ton. Although the process is still under development, the recovered calcium fluoride is expected to be a better grade than the purchased fluorspar, which would reduce the amount of flux used by approximately 10 percent. Not only would the generation rate of sludge from spent pickling liquor treatment be reduced (resulting in a savings in off-site sludge disposal costs), but a savings in chemical purchases would be realized.

Other areas with pollution prevention opportunities

Other areas in iron and steel manufacturing where opportunities may exist for pollution prevention are listed below, in three categories: process modifications, materials substitution, and recycling.

Process Modification

Redesigning or modifying process equipment can reduce pollution output, maintenance costs, and energy consumption, for example:

• Replacing single-pass wastewater systems with closed-loop systems to minimize chemical use in wastewater treatment and to reduce water use.
• Continuous casting, now used for about 90% of crude steel cast in the U.S., offers great improvements in process efficiency when compared to the traditional ingot teeming method. This increased efficiency also results in a considerable savings in energy and some reduction in the volume of mill wastewater.

Materials Substitution

• Use scrap steel with low lead and cadmium content as a raw material, if possible.
• Eliminate the generation of reactive desulfurization slag generated in foundry work by replacing calcium carbide with a less hazardous material.

Recycling

Scrap and other materials are recycled extensively in the iron and steel industry to reduce the raw materials required and the associated pollutants. Some of these recycling activities include:
• Recycle or reuse oils and greases.
• Recover acids by removing dissolved iron salts from spent acids.
• Use thermal decomposition for acid recovery from spent pickle liquor.
• Use a bipolar membrane/electrodialytic process to separate acid from metal by-products in spent NO_3-HF pickle liquor.
• Recover sulfuric acid using low temperature separation of acid and metal crystals.

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A. contains a general overview of major statutes
- Section VI.B. contains a list of regulations specific to this industry
- Section VI.C. contains a list of pending and proposed regulations

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation and Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and record keeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under

RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized approximately forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or

State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing, or raw material storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, consult the regulation.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-

leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to

POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

Spill Prevention, Control and Countermeasure Plans

The 1990 Oil Pollution Act requires that facilities posing a substantial threat of harm to the environment prepare and implement more rigorous Spill Prevention Control and Countermeasure (SPCC) Plan required under the CWA (40 CFR §112.7). As iron and steel manufacturing is an energy intensive industry, an important requirement affecting iron and steel facilities is oil response plans for above ground storage. There are also criminal and civil penalties for deliberate or negligent spills of oil. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and Facility Response Plans to oil discharges (40 CFR Part 112) and for PCB transformers and PCB-containing items are being revised and finalized in 1995.[29]

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control** (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs).

Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT)." The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide nitrous oxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.
Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2,000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Regulatory Requirements

The steel industry has invested substantial resources in compliance with environmental regulations. Expenditures for environmental air control totaled $279 million in 1991, while water and solid waste control combined totaled $66 million. This translates to 15 percent of total capital expenditures for the industry in 1991. The high percentage of total environmental capital expenditures for air control (81 percent) is primarily due to keeping coke ovens operating in compliance with the Clean Air Act. Although coke ovens are considered by many industry experts to be the biggest environmental problem of the iron and steel industry, environmental regulations affect the industry throughout all stages of the manufacturing and forming processes. An overview of how federal environmental regulations affect this industry follows.

Clean Air Act (CAA)

The CAA, with its 1990 amendments (CAAA), regulates the pollutants that steel mills can add to the air. Title I of the Act addresses requirements for the attainment and maintenance of the National Ambient Air Quality Standards (NAAQS) (40 CFR, §50). EPA has set NAAQS for six criteria pollutants, which states must plan to meet through state implementation plans (SIPs). NAAQS for nitrogen dioxide, lead, and particulate matter frequently affect the iron and steel industry.

One of the most significant impacts of the CAAA on the iron and steel industry is tied to the standards developed for toxic air emissions or Hazardous Air Pollutants (HAPs). For the steel industry, these standards, National Emission Standards for Hazardous Air Pollutants (NESHAPs), have a significant effect on the industry's coke ovens. In late 1991, the coking industry entered into a formal regulatory negotiation with EPA and representatives of environmental groups, state and local air pollution control agencies, and the steelworkers union to develop a mutually acceptable rule to implement the terms of the Act's coke oven provisions. After a year of discussions, an agreement on a negotiated rule was signed. In exchange for a standard that is structured to give operators certainty and flexibility in the manner they demonstrate compliance, the industry agreed to daily monitoring, to install flare systems to control upset events, and to develop work practice plans to minimize emissions. National Emissions Standards currently in effect that pertain to the iron and steel industry include:

- Coke Oven Batteries (40 CFR §63 Subpart L). As of April 1, 1992, there were 30 plants with 87 by-product coke oven batteries that would be affected by this regulation.

- Benzene Emissions from Coke By-product Recovery Plants (40 CFR §61 Subpart L). Regulates benzene sources in coke by-product recovery operations by requiring that specified equipment be enclosed and the emissions be ducted to an enclosed point in the by-product recovery process where they are recovered or destroyed. Monitoring requirements are also stated.

- Halogenated Solvent Cleaning (40 CFR §63 Subpart T). Emission standards for the source categories listed in §112(d), including solvents used in the iron and steel industry such as 1,1,1-trichloroethane, trichloroethylene, and methylene chloride.

- Chromium - Industrial Process Cooling Towers (40 CFR §63 Subpart Q). This standard will eliminate chromium emissions from industrial process cooling towers. Industrial process cooling towers using chromate-based water treatment programs have been identified as potentially significant sources of chromium air emissions; chromium compounds being among the substances listed as HAPs in §112(e).

The CAA also impacts the minimill segment of the industry. The Electric Arc Furnace was identified as a possible source of hazardous air pollutants subject to a MACT determination, however, EPA data indicates that the impact is much less than originally anticipated and there are currently no plans for establishing a MACT standard.

The 1990 CAAA New Source Review (NSR) requirements apply to new facilities, expansions of existing facilities, or process modifications. New sources of the "criteria" pollutants regulated by the NAAQS in excess of levels defined by EPA as "major" are subject to NSR requirements (40 CFR Section 52.21(b)(1)(i)(a)-(b)). NSRs are typically conducted by the state agency under standards set by EPA and adopted by the state as part of its state implementation plan (SIP). There are two types of NSRs: Prevention of Significant Deterioration (PSD) reviews for facilities in areas that are meeting the NAAQS, and Nonattainment (NA) reviews for areas that are violating the NAAQS. Permits are required to construct or operate the new source for PSD and NA areas.

For NA areas, permits require the new source to meet the lowest achievable emission rate (LAER) standards and the operator of the new source must procure reductions in emissions of the same pollutants from other sources in the NA area in equal or greater amounts to the new source. These "emission offsets" may be banked and traded through state agencies.

For PSD areas, permits require the best available control technology (BACT), and the operator or owner of the new source must conduct continuous on-site air quality monitoring for one year prior to the new source addition to determine the effects that the new emissions may have on air quality. This one year waiting period before construction can be disruptive to some mills' expansion plans. In several cases, mills looking to construct or expand have attempted to be reclassified as a "synthetic minor," where they ask the state to put tighter restrictions on their quantity of emissions allowed on their air permit. With these reduced emissions, they become a minor instead of a major source, thereby becoming exempt from the lengthy and expensive PSD review.

EPA sets the minimum standards for LAER and BACT for iron and steel mill NSRs in its new source performance standards (NSPS), 40 CFR 60:

- Standards of Performance for Steel Plants: Electric Arc Furnaces (40 CFR §60, Subpart AA). Regulates the opacity and particulate matter in any gases discharged from EAFs constructed after October 21, 1974 and on or before August 17, 1983. Also requires a continuous monitoring system for the measurement of the opacity of emissions discharged from control equipment.

- Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels (AODs) (40 CFR §60, Subpart AAa). Regulates the opacity and particulate matter in any gases discharged from EAFs and AODs (used to blow argon and oxygen or nitrogen into molten steel for further refining) constructed after August 7, 1983. Also requires a continuous monitoring system for the measurement of the opacity of emissions discharged from EAF and AOD air pollution control equipment.

- Standards of Performance for Primary Emissions from Basic Oxygen Process Furnaces (BOPF) (40 CFR §60, Subpart N). Regulates the discharge of gases for particulate matter and opacity. These standards apply to BOPFs for which construction is commenced after June 11, 1973. Primary emissions refer to particulate matter emissions from the BOPF generated during the steel production cycle and captured by the BOPF primary control system.

- Standards of Performance for Secondary Emissions from Basic Oxygen Process Steelmaking Facilities (40 CFR §60, Subpart Na). Regulates the discharge of gases for particulate matter and opacity for BOPFs for which construction is commenced after January 20, 1983. Secondary emissions means particulate matter emissions that are not captured by the BOPF primary control system.

Clean Water Act (CWA)

The steel industry is a major water user and 40 CFR 420 established Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category. These are implemented through the NPDES permit program and through state and local pretreatment programs. Part 420 contains production-based effluent limitations guidelines and standards, therefore steel mills with higher levels of production will receive higher permit discharge allowances. The regulation contains 12 subparts for 12 distinct manufacturing processes:

A. Cokemaking	G. Hot Forming
B. Sintering	H. Salt Bath Descaling
C. Ironmaking	I. Acid Pickling
D. Steelmaking	J. Cold Forming
E. Vacuum Degassing	K. Alkaline Cleaning
F. Continuous Casting	L. Hot Coating

The pollutants regulated by 40 CFR 420 are divided into three categories:

1. *Conventional Pollutants:* Total Suspended Solids, Oil and Grease, pH
2. *Nonconvention Pollutants:* Ammonia-N, Phenols
3. *Priority or Toxic Pollutants:* Total cyanide, total chromium, hexavalent chromium, total lead, total nickel, total zinc, benzene, benzo(a)pyrene, naphthalene, tertrachloroethylene.

Wastewater is often recycled "in-plant" and at the "end-of-pipe" to reduce the volume of discharge. Process wastewater is usually filtered, and/or clarified on-site before being directly or indirectly discharged. Oil and greases are removed from the process wastewater by several methods which include oil skimming, filtration, and air flotation. These oils can then be used as lubricants and preservative coatings. The remaining sludge contains waste metals and organic chemicals. Iron in the sludges can be recovered and reclaimed through sintering and pelletizing operations. Many steel mills discharge industrial waste water through sewers to publicly owned treatment works.

The Storm Water Rule (40 CFR 122.26(b)(14) subparts (i, ii)) requires the capture and treatment of storm water at primary metal industry facilities including iron and steel manufacturing. Management of storm water will reduce discharges with respect to conventional pollutants (suspended solids and biological oxygen demand (BOD)), as well as other pollutants, such as certain metals and oil and grease.

Resource Conservation and Recovery Act (RCRA)

Several RCRA-listed wastes are produced during coke, iron, and steelmaking, forming, and cleaning/descaling operations. These wastes are identified below by process.

Coke Manufacturing

- Tar residues (K035, K087, K141, K142, and K147)
- Oil (K143 and K144)
- Naphthalene residues (K145)
- Lime sludge (K060)
- Wastewater sump residues containing benzene and polynuclear aromatic hydrocarbons (K144)
- Coke oven gas condensate from transfer and distribution lines

Iron and Steel Manufacturing

- EAF emission control dust and sludge (K061). Annually, 550,000 short tons of K061 are produced; 90 percent of this waste (500,000 short tons) is managed for metal recovery.[29]

Finishing

- Wastewater sludge from cooling, descaling, and rinsing (D006, D007, D008, D009, D010, and D011)
- Spent pickle liquor (K062). An exemption for this waste is detailed in 40 CFR 261.3(c)(2)(ii)(A). 904,945 short tons of K062 are generated annually in the U.S. and 52 percent of this waste is managed for recovery of iron, chromium, and nickel.[30]

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The metals and metal compounds used in steelmaking, as well as steelmaking process chemicals, are often found in steel mills' air emissions, water discharges, or waste shipments for off-site disposal include chromium, manganese, nickel copper, zinc, lead, sulfuric acid, and hydrochloric acid. Metals are frequently found at CERCLA's problem sites. When Congress ordered EPA and the Public Health Service's Agency for Toxic Substances and Disease Registry (ATSDR) to list the hazardous substances most commonly found at problem sites and that pose the greatest threat to human health, lead, nickel, and aluminum all made the list.[31] Several sites of former steel mills are on the National Priorities List. Compliance with the requirements of RCRA lessens the chances that CERCLA compliance will be an issue in the future.

VI.C. Pending and Proposed Regulatory Requirements

The iron and steel industry has been identified in the Source Reduction Review Project (SRRP) as an industry for which a more integrated (across environmental media) approach to rulemaking is warranted. Efforts such as the Office of Water's review of the need for revised effluent guidelines for the industry (described below) and the technology-based standards for coke oven emissions under the Clean Air Act Amendments will be coordinated among several media offices.

Clean Air Act

Even with the flexibility the industry gained through the formal negotiations to develop the rule to implement the coke oven provisions of the CAA, coke-producing steel companies face difficult decisions of how best to utilize scarce capital to meet the CAAA standards. Additionally, coke oven operators still face unknown technology-based standards in 2010 and risk-based standards in 2020.

The Act's air toxic provisions will also ultimately have other major impacts. Included on the list of chemicals under the air toxics program are compounds of chromium, nickel, manganese, cadmium and other heavy metals. Because many of these metals are routinely found in iron ore, scrap, and alloying materials that are processed in iron and steel plants, most steelmaking processes will be affected in some way. EPA's priority list of source categories calls for the development of regulations for most of these sources by 2000, but until EPA identifies the technology corresponding to MACT for these sources and promulgates regulations, it is difficult to determine the additional impacts and costs to the industry for this program.

Tightening the national ambient air quality standard for particulate matter (PM-10) may also affect the iron and steel industry. Under the CAAA, EPA will be reviewing the basis for the existing ambient air PM-10 standard. A lower standard may cause more areas of the country to be classified as non-attainment areas and would trigger requirements for states to impose much more stringent emission control standards for sources of particulate matter, including iron and steel sources.

Hydrochloric acid and chlorine are among the pollutants listed as hazardous air pollutants in §112 of the CAAA. Steel pickling processes that use hydrochloric acid have been identified by the EPA as potentially significant sources of hydrochloric acid and chlorine air emissions and, as such, a source category for which national emission standards are likely. EPA is expected to make a determination on the steel pickling process sometime in 1995, with the final rule promulgation scheduled for 11/96. Many facilities either are already in compliance, or they have the required control equipment, but need to upgrade it or perform maintenance procedure to come into compliance. (Contact: James Maysilles, EPA Office of Air Quality Planning and Standards, 919-541-3265).

Title III of the CAAA, requires EPA to develop national emission standards for hazardous air pollutants (NESHAP) from specific stationary sources including iron and steel mills (contact: Phil Murine, EPA Office of Air Quality Planning and Standards, 919-541-5289) and iron and steel foundries (contact: James Maysilles, EPA Office of Air Quality Planning and Standards, 919-541-3265). Both of these types of facilities have been identified by the EPA as potentially significant sources of air emissions of substances that are among the pollutants listed as hazardous air pollutants in §112 of the CAAA. As such, these industries may be source categories for which national emission standards may be warranted. In integrated iron and steel mills, air emission of HAPs may include compounds of chromium, lead, manganese, and polycyclic organic matter, in quantities sufficient to designate these facilities as major sources. Emission standards were to be developed for Electric Arc Furnaces also. However, EPA data does not show that EAFs emit sufficient hazardous pollutants to include them on the list of major sources of these pollutants. Therefore, a proposed regulatory action is scheduled to remove this category from the list of sources where new regulations will be promulgated.

Other, more general, proposed regulatory actions under the CAA have an effect on some facilities within the iron and steel industry. These include:

• Risk Management Program for Chemical Accidental Release Prevention (40 CFR 68). Requires facilities where a regulated substance is present (defined by the list, with threshold quantities, promulgated under §112(r)(3)) to prepare and implement a risk management plan and provide emergency response. The final rule will be promulgated by 3/29/96.

• New Source Review Reform (40 CFR 51, 52). This action will amend the new source review regulations to reduce the level of program complexity. The final rule will be promulgated 1/96.

• Revised New Source Performance Standard for NOx (40 CFR 60, Subpart Db). Revisions apply to NOx emissions from fossil fuel-fired steam generating units, including industrial boilers and must reflect improvements in NOx reduction methods. The final rule will be promulgated by 12/31/96.

• Title V Federal Air Operating Permit Rules (40 CFR 70 and 71). Sets requirements for state permitting programs for major stationary air pollutants. Also establishes a federal permitting program for use where states fail to establish or implement an adequate program. The final rule will be promulgated by 11/95.

• Title V State Air Operating Permit Rules (40 CFR 70). Revisions of the state operating permit rules promulgated in 1992. This regulation is intended to restructure the process for issuing and revising permits, to give state agencies more flexibility. States will be allowed to issue a single permit covering both New Source Review and Title V permitting requirements.

Clean Water Act (CWA)

Since approximately 80 percent of the nation's integrated steelmaking capacity is located in the Great Lakes states, the current efforts to develop uniform water quality standards under the Great Lakes Water Quality Initiative may have a significant impact on the industry. According to the American Iron and Steel Institute (AISI), the industry is concerned with the establishment of uniform water quality guidance for all waters. AISI believes that states should be given the responsibility of designating uses and associated water quality standards for all water bodies within their jurisdictions. These designations, AISI believes, should take into account the feasibility of the attainment of swimmable and fishable waters where naturally occurring pollutants prevent its attainment, where pollution sources prevent attainment and correction of these sources would cause more environmental harm than good, or where attainment would result in unreasonable social and economic impacts. AISI concludes that requiring discharges of non-contact cooling water to be cleaner than when drawn from the stream or lake, while at the same time disregarding the water quality impacts of non-point sources such as urban or agricultural runoff, will impose huge costs, restrict growth, or force zero discharge on direct dischargers. By March 23, 1997, the Great lakes states (Illinois, Indiana, Michigan, Minnesota, New York, Pennsylvania, Ohio, and Wisconsin), as well as tribes in the area, must adopt rules and procedures consistent with the Water Quality Guidance for the Great Lakes System (40 CFR 132; also amends 122, 123, and 131). The Guidance places particular emphasis on decreasing bioaccumulative toxics and also provides a process for addressing both point and non-point source pollution.

The EPA is currently revisiting the CWA Effluent Guidelines and Standards for Iron and Steel Manufacturing Point Source Category. A two-year study is scheduled to be completed in late 1995 which reviews the existing regulations to determine what changes have been made in the industry since the 1982 regulations were promulgated. One focus of the project is to investigate the types of pollution prevention measures that have been implemented. The study was initiated as a result of a Natural Resources Defense Council (NRDC) consent decree. (Contact: George Jett, EPA Office of Water, 202-260-7151).

The Office of Water is also initiating a 3-year data collection and analysis effort (which began in 1994) to quantify the adverse impacts from cooling water intake structures and the efficacy of certain control mechanisms. Regulatory options will be developed and a regulation proposed based on the study results. This regulation may have a relatively significant impact on the iron and steel industry.

Resource Conservation and Recovery Act (RCRA)

Under RCRA, emission control dust and sludge from electric arc furnaces (EAF) are a listed hazardous waste (K061) and are subject to land disposal restrictions. This pollution control dust/sludge is composed of various metals: primarily iron with lesser concentrations of zinc, lead, cadmium, and sometimes nickel and chromium. The metals primarily recovered are iron or nickel alloys or zinc. Two or the primary hazardous constituents, lead and cadmium, are not initially recovered, although they are usually shipped off-site for further recovery. Annually, 550,000 short tons of K061 are produced; 90 percent of this waste (500,000 short tons) is managed for metal recovery.[32] EPA's treatment standards were originally based on high temperature metals recovery, but were recently revised to generic treatment levels. As a result, a generator may select one of a variety of options, including stabilization, as alternatives to recycling. Other recovery alternatives include: use as a fertilizer ingredient, use an ingredient in glass grit for abrasive blast, roofing shingles, glass ceramic or ceramic glaze, use as an ingredient in the production of cement, use as an ingredient in the production of special aggregates.[33]

Such recovery practices reduce the quantity of hazardous waste disposed of, however, the industry is concerned with the limitations that are placed on the disposal or uses of non-hazardous residuals from the high temperature metals recovery processes that might serve to discourage or inhibit metal recovery practices. According to several steel industry trade associations (SMA, SSINA, AISI), RCRA has discouraged metal recovery from hazardous wastes generated in steel production. For example, the derived-from rule has discouraged investment in on-site or regional recycling operations because of the additional cost of residual management. The trade associations also state that the lack of adequate metal recovery capacity in the U.S. requires their members to spend an average of $650,000 annually in transportation costs to ship K061 off-site, and a total of $1.4 million annually to recycle K061.[34] Other RCRA impediments stated by the trade associations include the 90-day storage limit for generators, and corrective action/financial assurance.

As part of a 1992 settlement agreement, EPA has agreed to propose (by June 30, 1995) and promulgate (by June 30, 1996) regulations for land disposal restrictions on mineral processing wastes. These regulations will set land disposal restrictions and standards for those mineral processing wastes that are found to be hazardous under RCRA Subtitle C. Currently, all extraction and beneficiation wastes, as well as 20 mineral processing wastes, are exempt from federal hazardous waste regulations.

Under a proposed regulation, "Hazardous Waste Management System: Amendment to Generic Exclusion for Encapsulated Uses (K061, K062, F006)," (40 CFR 261), the slags created from the treatment of pollution control dusts resulting from scrap metal recycling (i.e., electric arc furnace dust), will be reclassified as nonhazardous and be allowed for road-related uses if the toxic metals in the wastes have been reduced to safe levels by treatment. The final rule will be promulgated by 6/13/96.

Also under RCRA Subtitle C (40 CFR 261), the "Hazardous Waste Identification Rule" will be proposed in 1995 to allow listed wastes which are low risk to be removed from the hazardous waste regulatory scheme. This rule is intended to better align the burden of RCRA regulation with the risks being controlled.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Steel companies involved in Superfund sites would be affected by changes under impending CERCLA reauthorization. Questions of liability, funding mechanisms, selection of remedial actions, and application of risk concepts are all of concern to the steel industry.

Safe Drinking Water Act (SDWA)

The 1986 SDWA amendments required EPA to complete a study of Class V underground injection wells. These are all wells not included in Classes I through IV; they vary from simple septic systems and shallow cesspools to deep, technically sophisticated wells with a wide range of environmental impacts. As a follow up to the study, EPA developed a strategy to assess whether additional controls of these wells would be appropriate. A proposed regulation on Class V wells is being developed as part of this strategy and could potentially affect some iron and steel facilities. Final rule promulgation is scheduled for 11/96.

Global Climate Change

Legislative initiatives that address global climate change will also affect the iron and steel industry. Steel is a highly energy intensive industry, where 15 to 20 percent of the manufacturing cost of steel is for energy. Most of that energy is derived from coal, principally in the form of coke. Consequently, a carbon tax could have a major impact on the steel industry. While such a tax is designed to reduce carbon dioxide emissions and to curb energy consumption, industry analysts expect such a tax would also results in 177,000 to 362,000 job losses across the country, according to Wilbur Steger, president of CONSAD Research Corp., as reported in the March 1993 issue of *Iron Age*.

Increasing the corporate average fuel economy (CAFE) of automobiles has been identified as a means of encouraging energy conservation and reducing carbon dioxide emissions. An increase in fuel economy standards may lead to downsizing automobiles, which will affect steel markets by reducing demand for certain steel products.