4.0 ASSESSMENT OF CURRENT REGULATION

4.1 Applicability

The combination of the general applicability statement at §420.01(a) and the subcategory-specific applicability statements make Part 420 applicable to virtually all facilities that manufacture steel or process semi-finished and finished steel products. As described below, there are relatively few issues associated with applicability statements for the basic steelmaking operations; however, applying Part 420 to small, stand-alone facilities which perform some steel finishing and metal finishing operations has resulted in a number of NPDES and pretreatment issues. Following are brief reviews of the subcategory-specific applicability statements and preliminary assessments of possible modifications.

4.1.1 §420.10 - Cokemaking

The current applicability statement applies the current regulation to by-product recovery coke plants and beehive coke plants; however, operating beehive coke plants in the United States no longer exist. In addition, the applicability statement does not address nonrecovery coke batteries (discussed on pages 6-1 and 6-2). Although nonrecovery cokemaking has not been installed at any major integrated mills, this technology allows for cokemaking with comparatively few air emissions and wastewater discharges.

4.1.2 §420.20 - Sintering

The sintering applicability statement is written such that the regulation applies only to sintering plants. Currently, there are ten operating sinter plants in the United States, compared to 33 when the regulation was promulgated. Because of the potential difficulties in permitting new sinter plants from an air emissions standpoint, it is not likely that very many will be constructed in the near term. Some steel makers have been evaluating and installing hot and cold briquetting plants to recover iron values from both blast furnace and steelmaking sludges. Briquetting plants are also used at Direct-Reduced Iron (DRI) plants for agglomerating DRI into a form that can be charged to steelmaking furnaces. Although most briquetting plants use minimal process water compared to sinter plants with wet air emission control systems, they are not regulated by Part 420. Also, because sinter plants can be operated with dry air emission control systems, zero discharge could be considered for NSPS and PSNS on the basis of dry air controls. The current NSPS and PSNS are based upon wet air emission control systems. Dry air emission controls are currently used in the U.S. by three sinter plant operators to comply with current air emission regulations

4.1.3 §420.30 - Ironmaking

The ironmaking subcategory includes iron-producing blast furnaces and ferromanganese-producing blast furnaces. Ferromanganese is no longer produced in blast furnaces in the United States. The ironmaking subpart does not apply to DRI plants which can have process wastewater discharges.

4.1.4 §420.40 - Steelmaking

The applicability statement for steelmaking operations appears adequate to cover existing conventional BOF and EAF steelmaking operations. It also encompasses open hearth furnaces which are no longer used for steelmaking in the United States. Ferroalloy products are also manufactured in EAFs; however, the applicability statement for the steelmaking subcategory does not need to be amended to specifically exclude manufacture of ferroalloys in EAFs because the applicability statements in Part 424 are specific to ferroalloys.

4.1.5 §420.50 - Vacuum Degassing

The applicability statement appears adequate for existing vacuum degassing operations. Most new vacuum degassing plants are installed as part of ladle metallurgy stations that typically have dry air cleaning systems for the nondegassing operations. NSPS could be developed based upon dry air emission controls to ensure that no wet systems are installed for nondegassing ladle metallurgy operations.

4.1.6 §420.60 - Continuous Casting, §420.70 - Hot Forming, §420.80, Salt Bath Descaling

Currently, there are no known or suspected issues associated with the applicability statements for the continuous casting, hot forming, or salt bath descaling subcategories.

4.1.7 Steel Finishing: §420.90 - Acid Pickling, §420.100 - Cold Forming, §420.110 - Alkaline Cleaning, and §420.120 - Hot Coating

As noted in Section 3.0, there are a number of issues associated with the applicability of Part 420 to small, stand-alone facilities that process semi-finished steel products. The current applicability statements for the steel finishing operations (acid pickling, cold forming, alkaline cleaning, and hot coating) apply Part 420 to virtually all facilities that perform any of the above operations on steel that are not regulated under Part 433 - Metal Finishing. This raises the following issues:

- The effluent limitations guidelines and standards in Part 420 were based upon the flow rates and treated effluent quality attained at large steel finishing mills with co-treatment of compatible steel finishing and metal finishing wastewaters.

- Exceptionally low treated effluent concentrations of toxic metals are attained in these systems with conventional lime precipitation as a result of coprecipitation of toxic metals with ferrous and ferric iron present from acid pickling operations.

- Many of the small, stand-alone facilities do not have the benefit of co-treating significant volumes of pickling rinse waters and thus have difficulty readily achieving the same effluent quality with the model technologies. This is particularly true of stand-alone hot dip galvanizers.

- Small, stand-alone facilities not affiliated with major steel finishing operations tend to have higher flow rates per unit of production than do the large flat-rolled, continuous strip steel finishing facilities used as the basis for the effluent limitations guidelines and standards.

It may be appropriate to consider revision to Part 420 to address these issues. Because of their similarity to metal products and machinery facilities, small stand-alone steel finishing plants may be more appropriately regulated under the new Metal Products and Machinery Category.

The applicability statement for the alkaline cleaning subcategory should be made clearer as to how alkaline cleaning operations integral to hot coating and electroplating lines are regulated. Some permit writers have double-counted these operations within a facility.

4.1.8 §433 - Metal Finishing

Electroplating of chromium, tin, zinc, and other metals onto steel at steel finishing plants is regulated by Part 433 - Metal Finishing. As described in Section 4.3, it may be more appropriate for these operations to be regulated by Part 420 as a new subcategory.

4.1.9 New Steel Finishing Operations

During the past five to seven years, several (approximately ten) new continuous strip steel finishing facilities have been constructed to respond to demands from automobile manufacturers for higher quality electro-galvanized steels, steels coated with other metals, and new combinations of metals. At some of these plants, steel finishing and metal finishing operations are conducted on the same extended processing lines without the shearing and re-welding of coils that is typical for these types of process lines. These operations complicate the discharge permitting process because the effluent limitations guidelines and standards contained in Parts 420 and 433 are different in terms of method of application (mass-based vs. concentration-based) and level of final effluent quality (see Section 4.3). Sufficient numbers of these facilities exist to consider a separate subcategory on the basis of the mix of process operations and wastewater characteristics.

4.2 Subcategorization

Based upon the issues presented above, the following modifications to the existing subcategorization of Part 420 are presented for consideration:

Cokemaking. Delete beehive coke plants and add nonrecovery coke plants.

Sintering. Add a segment for briquetting operations.

Ironmaking. Delete ferromanganese blast furnaces, and add a segment for Direct-Reduced Iron plants.

Steelmaking. Delete open hearth furnaces.

Vacuum Degassing. Add a segment for nondegassing operations at ladle metallurgy stations.

> **Acid Pickling, Cold Forming, Alkaline Cleaning, Hot Coating**. Develop a size cut-off or otherwise modify the applicability statements to exclude small, stand-alone facilities that perform some or all of the steel finishing operations. The facilities could be covered by the new Metal Products and Machinery Category.

Deletion of existing obsolete subcategories is presented because it may not be appropriate to leave effluent limitations guidelines and standards for obsolete processes with inherent high-pollution generation rates and high process water use.

In addition to changes to existing subcategories suggested above for review, it may be appropriate to create new subcategories to better reflect the current iron and steel industry and to more effectively regulate steel and metal finishing operations conducted at steel mill sites:

> **Nonintegrated Steel Mills**. Nearly all nonintegrated steel mills (mini-mills) are configured with EAFs with dry primary and secondary air emission controls; continuous billet, round, or slab casters; and section, flat, or pipe and tube hot forming mills. A small number are also equipped with steel finishing facilities (e.g., acid pickling, cold rolling, hot coating). It is common practice at nonintegrated mills to co-treat compatible continuous caster spray water and hot forming process water in high-rate process water recycle systems, and to co-treat blowdowns from these systems. This is not the case at nearly all integrated mills where hot forming and continuous caster process waters are independently treated and recycled. The current regulation includes limitations for total lead and total zinc for continuous casters, but no limitations for these metals for hot forming mills. This has created a number of permitting issues for these facilities. A new subcategory for nonintegrated steel mills could be created to more effectively regulate these facilities.

New Continuous Strip Finishing Mills. As described in Section 4.1.11, a subcategory to specifically regulate this new type of finishing mill could be developed. The mills are characterized by continuous in-line acid pickling, cold rolling, annealing, temper rolling, and/or hot coating and electroplating operations. Some of these mills cannot be effectively regulated by either the current Part 420 or Part 433, or by a combination of the two regulations. In some cases, new metal coatings and combinations of metal coatings are applied that were not in use at the time Parts 420 and Part 433 were promulgated.

Electroplating Conducted at Steel Mills. Because of the factors described in Section 4.3, a new subcategory for electroplating of chromium, tin, zinc, other metals, and combinations of metals may be appropriate. The effluent limitations guidelines and standards for steel finishing operations were based upon performance of treatment systems that co-treat steel finishing and metal finishing process wastewaters; and the effluent limitations guidelines and standards in Part 433 are much less restrictive than the comparable effluent limitations guidelines and standards in Part 420. Accordingly, NPDES permit effluent limitations and categorical pretreatment limitations based upon a combination of the two regulations are much less restrictive than would be allowed under Part 420 alone. Some owners and operators of steel mills have sought to take advantage of this circumstance through application of the "water bubble" rule (§420.03).

4.3 Better Performing Mills

In order to assess on a preliminary basis possible advances in process water management, process wastewater treatment technologies, wastewater treatment performance, and effluent disposal practices, EPA obtained treated effluent data and production data from a number of mills believed to be among the better performing mills located in North America. Some of the data were gathered by the Ontario Ministry of the Environment as part of that agency's study of its Iron and Steel Sector for its Municipal/Industrial Strategy for Abatement (MISA) program.[39,40] Additional data were assembled during this preliminary assessment. Although the limited number of mills selected for review are believed to be among the better performing mills in North America, the selection process was based upon personal knowledge of the project team and not upon a comprehensive survey of the industry. Any technology, whether or not used on a permanent basis in the U.S. or any other country, is a candidate technology for BAT and/or NSPS. There may be other mills with equal or better performance and there are many mills that do not perform as well as the mills included in this review.

The approach taken was to obtain daily effluent performance data and total monthly production during a period of relatively high production. For purposes of this report the "long term average" is the arithmetic mean of the effluent data collected over a period of time ranging from six months to more than one year, depending upon the specific treatment system being evaluated. These data were used to compute long-term average concentrations, mass discharges of monitored pollutants, and long-term average effluent flows. The mass discharge data were divided by the long-term average production data to establish a long-term average production-normalized discharge rate for each monitored pollutant in terms of mass of pollutant discharged per mass of production (kg/kkg or lbs/1,000 lbs). These results were compared on a mill-by-mill basis to the long-term average production-normalized discharge rates in kg/kkg for the currently applicable BPT, BCT, and BAT effluent limitations guidelines and NSPS from Part 420. Where process wastewaters from manufacturing operations in different subcategories were co-treated, the long-term average discharge for each manufacturing operation was estimated in proportion to discharge flow for each operation.

A modified approach was used for steel finishing mills that are currently regulated by a combination of Parts 420 and 433. For these mills, the long-term average effluent mass discharges were divided by the long-term average hydrochloric acid (HCl) pickling production data to obtain production-normalized discharge loads for each monitored pollutant in kg/kkg of HCl pickled product. To develop a comparable long-term average discharge load that would result from application of Parts 420 and 433, the long-term average mass discharge rate in kg/day was determined for both Parts 420 and 433. These discharge rates were added together and divided by the HCl pickling production rate to obtain a production-normalized discharge load in kg/kkg (lbs/1,000 lbs) of HCl pickled product that could be directly compared against the actual long-term average production-normalized discharge loads.

The results of these comparisons are presented in tabular form in Appendix B and in Figures 4-1 through 4-8. The data in Figures 4-1 through 4-8 are presented as percentages below and above the long-term average production-normalized discharge rates derived from the effluent limitations guidelines and standards (ELG LTA). The ELG LTAs are thus shown at the zero line on each figure. Performance better than the ELG LTAs is shown by negative percentages above the zero line, with negative 100% representing zero discharge. Performance less than the ELG LTAs is designated by positive percentages below the zero line. A default value of positive 100% was selected for mills with long-term average production-normalized discharges two or more times the ELG LTAs to maintain a reasonable scale for these plots. The results for each subcategory are reviewed below.

4.3.1 Cokemaking - Figure 4-1

The comparisons show performance substantially better than the ELG LTAs for most monitored pollutants for the three coke plants selected for review, the exceptions being total cyanide and phenols (4AAP). Performance of nearly 80% better than BAT is indicated. At the time of data collection, Mills A and B had coke plant biological treatment systems in place comparable to the model technologies used by EPA to establish the effluent limitations guidelines and standards. Mill C has a conventional coke plant biological treatment system that is followed by co-treatment of the coke plant effluent with blast furnace blowdown by equalization, metals precipitation, alkaline chlorination and filtration. This level of treatment is beyond that considered BAT by EPA in 1982.

There is also one U.S. coke plant equipped with a BAT type physical/chemical and biological treatment system followed by sand filtration and granular activated carbon. Performance data were not available at this writing to develop production-normalized wastewater loadings for this facility.

4.3.2 Sintering - Figure 4-2

Results for two sintering plants are presented in Figure 4-2. At Mill D, the process waters are commingled in one treatment and recycle system. A large portion of the sinter plant/blast furnace blowdown at Mill D is disposed of by slag quenching (evaporation on blast furnace slag in slag pits located at the blast furnaces). The portion of the blowdown that is discharged is not treated. At Mill E, sintering and blast furnace process waters are separately treated and recycled. The blowdowns from the recycle systems at this mill are mixed and co-treated in a blowdown treatment system consisting of metals precipitation.

The comparisons show better performance for all pollutants at Mill D and better performance for most pollutants at Mill E, the principal exceptions being ammonia-N and phenols (4AAP). Mill E has an application pending for a Section 301(g) variance from BAT for ammonia-N and phenols (4AAP). These results suggest that near zero discharge levels can be attained at mills where slag quenching is an available option and that effluent performance substantially better than BPT/BAT can be obtained for TSS, total cyanide, and total lead with metals precipitation of sinter plant recycle system blowdowns.

Figure 4-2 presents effluent quality data for Mill C transferred to the EPA model BAT sinter plant wastewater treatment system flow of 120 gallons per ton. As described in Section 4.3.1, Mill C is equipped with a blowdown treatment system comprising metals precipitation, alkaline chlorination, and filtration for treatment of combined coke plant and blast furnace process wastewaters. Except for final effluent filtration, this treatment system is equivalent to EPA's selected model BAT treatment system for sintering and ironmaking operations. The transferred data show production-normalized loadings substantially better than the BAT ELG LTAs for all pollutants except for ammonia-N, where performance is approximately 20% better than BAT.

4.3.3 Ironmaking - Figure 4-3

The blast furnace systems selected for review include those that are equipped to dispose of a portion of the gas wash water and gas cooling water recycle system blowdowns by slag quenching (Mills F and G), and those that are not equipped for slag quenching (Mills C, E, H, and I). Many blast furnace operators have applied for or obtained Section 301(g) variances from BAT for ammonia-N and phenols (4AAP). This accounts for performance less than the ELG LTAs for these pollutants. In addition to the blast furnace systems included in this review, other blast furnace systems are operated at or near zero discharge through slag quenching.

Mills H and I are equipped with metals precipitation systems for blast furnace recycle system blowdowns. Mill C (described above in Section 4.3.1 - Cokemaking) has a blast furnace blowdown treatment system equivalent to EPA's model BAT and NSPS treatment systems. This mill demonstrates better performance then the ELG LTAs for most pollutants despite a higher blowdown flow than the EPA model treatment system blowdown flow rate.

The results presented in Figure 4-3 show that performance substantially better than the ELG LTAs is being achieved for most pollutants for which treatment is provided.

4.3.4 BOF Steelmaking - Figure 4-4

Performance data for three wet - suppressed combustion BOF steelmaking shops and two wet - open combustion BOF shops are presented in Figure 4-4. Each BOF shop is equipped with a treatment and recycle system comprising partial recycle at the furnaces, external clarification facilities, and additional recycle of clarified gas cleaning water.

For the suppressed combustion systems, Mill F achieves zero discharge for extended periods of time by using carbon dioxide injection for water softening of the recirculating water to prevent fouling and scaling. Blowdowns are intermittent and average about 5 gpt. The treatment systems at Mills C and G are similar to the EPA model treatment systems. Although the treated effluent concentrations at Mill C are lower than the ELG LTAs, performance at Mill C in terms of kg/kkg (lbs/1,000 lbs) is adversely affected by blowdown flows that are much higher than those from the EPA model treatment systems.

Performance at Mill B (open combustion) is substantially better than the ELG LTAs for all monitored pollutants. Recycle system blowdown treatment consists of filtration. Performance at Mill H is better than the ELG LTAs for TSS and total lead, but not as good for total zinc. Blowdown treatment at the time these data were obtained consisted of metals precipitation using sulfide. The performance at this mill is primarily a function of blowdown flows higher than the EPA model treatment system flow rates.

Collectively, these results demonstrate that performance approaching zero discharge for suppressed combustion BOFs and performance substantially better than the ELG LTAs for open combustion BOFs can be achieved with conventional treatment technologies.

4.3.5 Vacuum Degassing - Figure 4-5

Performance data were obtained from Mills C and F for their vacuum degassers. The vacuum degasser at Mill C is equipped with a dedicated recycle system for condenser cooling water. The recycle system blowdown is combined with recycle system blowdowns from BOF steelmaking, continuous casting, and a hot strip mill before treatment in a metals precipitation system. This level of treatment is equivalent to the EPA model BAT and NSPS treatment systems.

The Mill F treatment system is essentially the same as for Mill C's except that, in Mill F, the blowdown from the dedicated vacuum degassing recycle system is treated separately for zinc in a dedicated metals precipitation system prior to discharge to a combined treatment system for a suppressed-combustion BOF and a continuous slab caster.

4.3.6 Continuous Casting - Figure 4-6

Performance results for four continuous slab casters are presented in Figure 4-6. Each caster is equipped with closed-loop cooling systems for mold and machine cooling water and spray water recycle systems consisting of scale pits with oil removal, filtration, and recycle. Mill J, which is a nonintegrated mill, operates two thin-slab casters. The blowdowns from these casters are cascaded to other process water recycle systems and ultimately disposed of through evaporation by direct contact cooling of EAF electrodes, resulting in zero discharge. This method of effluent disposal may not be applicable to all continuous casters.

Performance at the other casters demonstrates that effluent quality substantially better than the ELG LTAs can be achieved with conventional treatment.

4.3.7 Hot Forming: Hot Strip Mills - Figure 4-7

Performance data for four hot strip mills were obtained for this review. Three are located at large integrated mills and one is located at the nonintegrated mill described in Section 4.3.6. All of these mills are equipped with high-rate recycle and treatment systems consisting of scale pits, clarification and/or filtration, and cooling. Process water recycle rates at these mills exceed 95%, while the BPT/BCT model treatment system process water recycle rate for the effluent limitations guidelines and standards was 60 percent.

Process wastewater blowdown discharged from the Mill J hot strip mill is disposed of through evaporation on EAF electrodes. Discharges from the other mills are substantially below the ELG LTAs for TSS and O&G, which are the only regulated pollutants in Part 420 for hot forming operations. The ELG LTAs for total lead and total zinc shown on Figure 4-7 were derived from BAT and NSPS model treatment system effluent quality considered by EPA, but not promulgated. As shown in Figure 4-7, performance at Mill C is substantially better for total zinc and nearly 40% lower than the estimated ELG LTA for total lead.

Collectively, these results demonstrate that performance substantially better than the ELG LTAs for BPT/BCT can be achieved at hot strip mills with conventional treatment and recycle technologies. Hot strip mill performance with respect to TSS and O&G is transferrable to other hot forming operations (primary, section, flat-plate, pipe and tube) because the quality of the process waters across all hot forming operations is relatively uniform. There are, however, differences in concentrations and mass loadings of selected metals (e.g., lead, chromium and nickel) among process waters for hot forming operations processing alloy and specialty steels (e.g., leaded steels, stainless steels).

4.3.8 Steel Finishing - Figures 4-8 and 4-9

Performance data were obtained from two continuous strip finishing mills that contain acid pickling, cold rolling, alkaline cleaning, hot coating, and electroplating operations. The electroplating operations are currently regulated by Part 433 - Metal Finishing. Performance data were obtained for two periods for Mill L, designated as Mill L-1 and Mill L-2 on Figure 4-8. Each mill is equipped with treatment systems consisting of gross oil removal, mixing of compatible wastewaters, and final treatment in metals precipitation systems. Mill L has dedicated pretreatment systems for fluoride from tin electroplating operations and for hexavalent chromium.

The results demonstrate substantially better performance for all regulated pollutants at both mills. The performance with respect to the regulated metals is noteworthy because the ELG LTAs are based upon a combination of the long-term average values from Parts 420 and 433. The difference in actual mill performance versus the LTAs used to develop the effluent limitations guidelines and standards in Part 433 is highlighted in Figure 4-9, where long-term average treated effluent concentrations from three steel finishing mills are presented. Data are presented from Mills K and L-1, as well as from Mill D, which has similar production facilities plus an electrogalvanizing line. These comparisons show the actual performance from steel finishing lines is substantially better than the ELG LTAs from Part 433.

4.4 General Provisions

4.4.1 NPDES and Pretreatment Standards Production Rate

Section 122.45(b) of the NPDES permit regulations provides that production rates used to compute mass NPDES permit effluent limitations from production-based effluent limitations guidelines and standards *"...shall be based not upon the design production capacity but rather upon a reasonable measure of actual production of the facility"*. For existing iron and steel industry manufacturing operations, this regulation has most often been interpreted to mean the daily average production, assuming three turns of operation per day (three eight-hour operating shifts), for the month with the highest production that occurred over the five-year period prior to permit issuance. This convention was established during the mid-1970s when the first effluent limitations guidelines were being developed and has continued to the present. An example of the calculation to determine the NPDES production rate is shown below for a hypothetical hot strip mill:

High Production Month:	March 1994
Total Monthly Tonnage:	225,624 net tons
Operating Turns:	84
Tons Per Turn:	2,686 net tons
NPDES Tons Per Day:	8,058 net tons

An operating schedule of 84 turns in one month is a relatively high operating rate that may occur as a result of full production with one maintenance day per month and one maintenance turn per week. The high level of operation noted in the above example may be sustained for long periods during economic expansion; however, as discussed in Section 2.5, iron and steel manufacturing operations are highly cyclic. NPDES permits and pretreatment limitations for iron and steel mills are typically not modified to account for changes in production resulting from the business cycle. Consequently, NPDES permit effluent limitations and pretreatment standards determined for a high production period can be inflated when applied during low production periods.

The inflation of effluent limitations becomes more pronounced when there are multiple steel manufacturing operations in the same or different subcategories discharging to one centralized wastewater treatment facility. In these cases, the NPDES and pretreatment permit production rates for the multiple operations may be determined from different maximum production months. Also, there are instances where multiple hot forming mills or finishing mills discharging to the same treatment facility cannot be operated simultaneously because of limited supplies of semi-finished steel. In these cases, the effluent limitations for the centralized treatment facility derived as the sum of effluent limitations for individual production units can be overstated.

In some cases where a number of like production units discharge to a common treatment facility (e.g., an integrated mill with two or more blast furnaces served by one treatment and recycle facility), mill operators have reported NPDES and pretreatment permit production rates for each production unit individually as opposed to the maximum combined rate for all like production units. This practice also results in inflated production rates and permit discharge limitations.

Given the length of economic cycles in this country, a steel mill will likely encounter both periods of high and low sustained production during the term of its NPDES or pretreatment permit. Permits for many major steel mills are not renewed on a five-year cycle. Some permits have been extended for several years beyond the normal five-year term because of administrative delays caused by requests for variances, development of state water quality-based effluent limitations, extensive public comments, and permit appeals.

Tiered effluent limitations (multiple effluent limitations set at different production levels) have been included in a limited number of iron and steel NPDES permits to account for changes in production; however, this practice is not favored by many state agencies because of the resulting complications in automated compliance tracking and enforcement.

In an expanded review of Part 420, EPA could conduct a limited number of case studies to more fully examine the potential for inflation of NPDES and pretreatment effluent limitations by selecting high production periods in which to develop mass effluent and pretreatment limitations. An important consideration in such a review is to distinguish between the need to account for maximum production in the design and operation of treatment and recycle systems (a cost issue) versus the need to develop a reasonable measure of actual production for purposes of establishing NPDES permit and pretreatment limitations (regulatory and compliance issues). To ensure uniformity of application, a revised Part 420 could include a clear statement of the production basis for applying the effluent limitations guidelines and standards for stand-alone operations and for multiple operations discharging to common treatment facilities.

4.4.2 §420.01(b) - Central Treatment

Table 4-1 lists mills and parts of mills that were temporarily excluded from Part 420 by §420.01(b). The name of the mill, the 1982 NPDES permit number, and the central treatment facility name are shown. Also shown in parentheses is the name of the current owner for mills where ownership changes have occurred since Part 420 was promulgated in 1982.

Although EPA conducted detailed evaluations of each of the central treatment facilities for which the owners or operators requested alternative effluent limitations, it did not propose alternative effluent limitations for any central treatment facility or propose that any or all facilities listed at §420.01(b) should be subject to Part 420. A draft, proposed modification to Part 420 prepared in 1984 indicates that EPA's Effluent Guidelines Division (EGD) (now the Engineering and

Analysis Division (EAD)) had concluded that all facilities listed at §420.01(b) should be subject to Part 420.[41] Details of the draft proposed rulemaking considered by EGD in 1984 are discussed further below.

In response to the requirements set out at §420.01(b), the owners or operators of the following mills elected not to provide the required information and thus became subject to Part 420 on July 26, 1982:[41]

Laclede Steel - Alton, IL
Republic Steel - Chicago, IL (LTV Steel Company)
U.S. Steel - Provo, UT (Geneva Steel)
U.S. Steel - Fairless Hills, PA
U.S. Steel - Chicago, IL

During the period 1982 through 1984 when EPA was evaluating §420.01(b), NPDES permits were issued for the mills listed below. EPA considered these permits consistent with Part 420. Mill-specific circumstances were instrumental for issuance of many of these permits: Section 301(g) variances were granted to one facility; a water bubble was used to resolve issues at another facility; and the owners or operators of other facilities conditionally withdrew their applications for alternative effluent limitations pending promulgation of proposed revisions to Part 420 resulting from the Settlement Agreement.[2,3,41] Consequently, EGD concluded that alternative, less stringent effluent limitations developed under §420.01(b) were not appropriate for these mills. The owners or operators notified EPA of their intent to withdraw their requests for alternative effluent limitations on the dates shown below:

Facility	Date of Notification
Interlake, Inc. - Riverdale, IL (Acme Metals, Inc.)	February 3, 1984
J&L Steel - Hennepin, IL (LTV Steel Company)	April 10, 1984
J&L Steel - Louisville, OH (J&L Specialty Steel)	April 10, 1984
J&L Steel - Aliquippa, PA (LTV Steel Company)	May 17, 1984
J&L Steel - Cleveland, OH (LTV Steel Company)	July 2, 1984
National Steel - Granite City, IL	May 3, 1984
National Steel - Portage, IN	April 24, 1984
Ford Motor - Dearborn, MI (Rouge Steel Company)	July 19, 1984
U.S. Steel - Lorain, OH	October 25, 1982
U.S. Steel - Gary, IN	October 25, 1982
Weirton Steel Company - Weirton, WV (formerly National Steel)	May 29, 1984

EGD conducted detailed assessments of the remaining five central treatment facilities listed below to determine whether alternative effluent limitations would be appropriate. EGD determined that the total investment cost to comply with Part 420 would need to be at least twice the total investment cost estimated by EPA for the facilities to qualify for alternative effluent limitations. Because estimated investment costs for none of the facilities were that high, EGD concluded that alternative, less stringent limitations would not be appropriate and that all facilities listed at 420.01(b) should be subject to Part 420:[41]

Armco, Inc. - Ashland, KY (AK Steel Corporation)
Bethlehem Steel, Burns Harbor - Chesterton, IN
Bethlehem Steel - Sparrows Point, MD
J&L Steel - East Chicago, IN (LTV Steel Company)
Republic Steel - Gadsden, AL (Gulf States Steel, Inc.)

As noted above, the draft proposed rulemaking developed by EGD in 1984 has not been subjected to formal agency review or set out for public notice as a proposed modification to Part 420.

The owners or operators of two mills (National Steel - Granite City, IL and Gulf States Steel, Inc. - Gadsden, AL) are currently attempting to obtain favorable treatment under §420.01(b) for their respective mills, more than twelve years after promulgation of the temporary exclusion at §420.01(b).[42,43] Because EPA has not modified §420.01(b), it remains in the regulation and has resulted in permitting and compliance issues for EPA and state agency personnel.[44,45]

4.4.3 §420.03 - Alternative Effluent Limitations (Water Bubble Rule)

As described in Section 3.6.2, §420.03 is a regulatory flexibility mechanism that allows for intraplant exchanges or "trades" of mass pollutant discharges among outfalls to minimize overall compliance costs. Section 420.03 is commonly known as the "water bubble rule". The rule allows trading like pollutants (e.g., lead for lead, not lead for zinc or ammonia-N), and requires "appropriate minimum net reduction amounts" in pollutant mass discharges resulting from trades.[46,47] The rule includes restrictions on trades involving cokemaking and cold rolling operations to avoid inadvertent excess discharges of toxic organic pollutants found in cokemaking and cold rolling wastewaters.[46] At the time Part 420 was promulgated, there was concern that transfers of regulated conventional or nonconventional pollutants to cokemaking and cold rolling operations might allow for less treatment of certain toxic organic pollutants which were regulated through direct limitations for other similar toxic pollutants.

The water bubble rule has not been used extensively in NPDES permitting of iron and steel plants. As part of a recent survey of the industry, ten trades under this rule were identified.[38] The present value of the cost reductions of intraplant trading for seven of the ten trades was estimated at $122.7 million (1993 dollars).[38] Based upon this survey, there appeared to be no administrative impediments to industry or permit writers using the water bubble rule.[38]

Many smaller mills are precluded from using the water bubble rule because they have only one treatment system and one outfall; others have water quality-based effluent limitations more stringent than technology-based effluent limitations and thus are also precluded from using the rule.

The following are issues regarding §420.03 that could be considered to expand its use:

- The requirement that trades be completed on an intraplant basis limits possible opportunities to complete interplant and intercompany trades for mills discharging to the same receiving water segment.

- Restrictions on all trades for cokemaking and cold rolling operations limits possible opportunities to affect trades where more stringent effluent limitations for cokemaking or cold rolling operations result, thereby ensuring that there would be no excess discharges of unregulated toxic organic pollutants.

- The trading of "like" pollutants limits possible opportunities to trade "similar" pollutants (e.g., one toxic metal for another toxic metal).

- Discharges at steel mill sites that are limited by 40 CFR Part 433 - Metal Finishing are not eligible for intraplant trades with discharges from operations limited by Part 420. If electroplating operations conducted at steel mill sites were regulated by Part 420, expanded use of the water bubble rule could result.

4.5 Pollutants Selected for Regulation

The Clean Water Act (CWA) establishes three classes of pollutants: conventional, nonconventional, and priority or toxic pollutants. Conventional pollutants are those defined at Section 304(a)(4) of the CWA, namely TSS, biochemical oxygen demand (BOD_5), O&G, fecal coliform, and pH. Analytical measures of TSS, BOD_5, and O&G are not chemical-specific determinations but aggregate measures of suspended particulates, oxygen-demanding substances, and hexane-extractable (formerly freon-extractable) substances in water, respectively. Specific compounds contributing to these measures may or may not exhibit toxic effects and may or not be among the 126 designated priority or toxic pollutants defined by the CWA. The priority or toxic pollutants are specifically designated elements or compounds that exhibit toxic effects in aquatic systems and, if determined to be present at significant levels, must be regulated by categorical technology-based effluent limitations guidelines and standards pursuant to Section 301(b)(2)(A) of the CWA. Nonconventional pollutants are all other pollutants that are neither the five listed conventional pollutants nor the designated 126 priority pollutants. Nonconventional pollutants may be aggregate measures such as chemical oxygen demand (COD) or adsorbable organic halides (AOX) or specific elements or compounds such as chlorine (Cl_2), ammonia-N (NH_3-N), and 2,3,7,8-tetrachloro-dibenzofuran (2,3,7,8-TCDF). Nonconventional pollutants can be nontoxic (e.g., iron at low levels) or highly toxic (e.g., 2,3,7,8-TCDF). EPA has the authority and discretion to limit nonconventional pollutants in categorical effluent limitations guidelines and standards as appropriate based upon the presence of these pollutants and findings that the removal or treatment of the pollutants is technically and economically achievable.

Note that the database used by EPA to support the current Part 420 effluent limitations guidelines and standards was collected principally during the late 1970s and was limited to the original list of 126 priority or toxic pollutants, as well as conventional and nonconventional pollutants common to the industry. EPA has not conducted broader pollutant scans of industry process wastewaters.

4.5.1 Conventional Pollutants

Conventional pollutants regulated by Part 420 are TSS, O&G, and pH. BOD_5 and fecal coliform are not regulated. TSS and pH are regulated in all subcategories. O&G is regulated in the cokemaking, sintering, continuous casting, hot forming, cold rolling, alkaline cleaning, and hot coating subcategories.

There do not appear to be any compelling reasons to regulate BOD_5 or fecal coliform at iron and steel mills. Discharges from most iron and steel process wastewater treatment systems are relatively low in organic content, the exceptions being discharges from cokemaking operations and steel finishing operations that contain oxidizable organic material from oils and rolling solutions. There are a few instances where states have proposed water quality-based effluent limitations for BOD_5 for steel finishing discharges to achieve in-stream dissolved oxygen standards; however, there may not be sufficient need to establish categorical effluent limitations for BOD_5.

Fecal coliform or E. Coli. is limited under state regulations in a number of iron and steel mill NPDES permits in discharges from on-site sanitary wastewater treatment systems. Regulation at the federal level for these nonprocess wastewaters would be duplicative.

4.5.2 Nonconventional Pollutants

The nonconventional pollutants regulated by Part 420 include ammonia-N and phenols (4AAP) in the cokemaking, sintering, and ironmaking subcategories. Phenols (4AAP) means the value obtained by the method specified in 40 CFR Part 136.3. Phenols (4AAP) is a non-specific measure of phenolic compounds present in steel industry wastewaters that respond to the analytical test conditions. Based upon findings from the field studies conducted for development of the existing regulation, following is a list of nonconventional pollutants that could be considered in a revised regulation:

<u>Cokemaking</u>

Thiocyanate
Nitrate
Total Nitrogen (Total Kjeldahl N, Ammonia-N, NO_2-N, NO_3-N)
Sulfide

Sintering, Ironmaking, Steelmaking

Fluoride

Steel Finishing

Dissolved Iron

Hot Coating (Hot Dip Galvanizing with Zinc Ammonium Chloride Flux)

Ammonia-N

Each of these pollutants was found at significant concentrations in wastewaters from the respective process operations based upon data collected during the late 1970s and published in 1982[8]. EPA did not establish effluent limitations guidelines and standards for these pollutants when Part 420 was promulgated because they would be controlled incidentally through direct limitations on conventional and toxic pollutants, and because setting limitations for different pollutants in subcategories with compatible wastewaters would complicate NPDES permitting.

Nitrate-N or total nitrogen could be regulated in cokemaking operations if BAT or NSPS were redefined to include control of total nitrogen. Under the current regulation, cokemaking treatment systems can be operated to nitrify ammonia-N to nitrate-N, without control of nitrate-N discharges. Denitrification of coke plant wastewaters is apparently demonstrated in Europe. Denitrification of coke plant wastewaters was attempted at one coke plant located in the United States in a novel nitrification-denitrification mode. That method of treatment was operated successfully for a period of time but later abandoned because of increased process wastewater flow resulting from efforts to comply with coke plant NESHAPs requirements. The increased process wastewater flow exceeded the hydraulic design of the system for operation in the nitrification-denitrification mode.[10]

4.5.3 Toxic Metal Pollutants and Cyanide

Total lead and total zinc are regulated for most subcategories, the exceptions being cokemaking, hot forming, salt bath descaling, and combination acid pickling. Total chromium and total nickel are limited for salt bath descaling, combination acid pickling, and cold forming when cold forming wastewaters are co-treated with combination acid pickling wastewaters. EPA selected these metals for limitation because they were generally present at the highest levels and, based on limited analytical data and published solubility data, control of these metals was expected to result in comparable control of other toxic metals. Total cyanide is limited in the cokemaking, sintering, ironmaking, and salt bath descaling subcategories.

Many other toxic metals are present in iron and steel wastewaters.[8] Below are potential additional candidate metals for regulation:

<u>Cokemaking</u>

Total Antimony
Total Arsenic
Total Selenium
Total Zinc

<u>Sintering, Ironmaking, Steelmaking</u>

Total Arsenic
Total Cadmium
Total Copper
Total Chromium
Total Selenium

<u>Vacuum Degassing, Continuous Casting</u>

Total Chromium
Total Copper
Total Selenium

Hot Forming

Total Chromium
Total Copper
Total Lead
Total Nickel
Total Zinc

Steel Finishing

Total Antimony
Total Arsenic
Total Cadmium
Total Copper

EPA has recently issued guidance regarding dissolved metals for purposes of establishing ambient water quality standards and implementing those standards through water quality-based effluent limitations in NPDES permits. The effluent limitations guidelines program has historically regulated total metals because the ELGs are to reflect the capabilities of process and treatment technologies to remove pollutants from process wastewater streams. Issuance of dissolved metal ELGs could allow for conversion of dissolved metals into particulate form without attendant solids removal. This, in turn, could result in metals deposition in receiving water sediments.

4.5.4 Toxic Organic Pollutants

Part 420 regulates four toxic organic pollutants in two subcategories as follows:

Cokemaking

Benzene
Benzo-a-pyrene
Naphthalene

Cold Forming

Naphthalene
Tetrachloroethylene

Benzene was regulated as an indicator pollutant for other volatile toxic organic pollutants found in cokemaking wastewaters (e.g., ethylbenzene, toluene, xylene). Benzo-a-pyrene and naphthalene were regulated as indicator pollutants for other semi-volatile toxic organic pollutants, specifically the polynuclear aromatic compounds (PAHs) (e.g., acenaphthylene, benzo-a-anthracene, chrysene, fluorene, fluoranthene, and pyrene). It appears that the limitations for these compounds are effective for regulating the volatile toxic organic compounds and the semi-volatile PAHs. Comprehensive GC/MS screens of untreated and treated cokemaking wastewaters using current, more sensitive analytical methods would be necessary to determine whether other toxic organic pollutants are present at levels where categorical effluent limitations guidelines may be appropriate.

The field investigations conducted in developing the existing regulation revealed the presence of a wide variety of toxic organic compounds present in cold rolling wastewaters. These include several PAHs, a few chlorinated phenols, and two chlorinated solvents: trichloroethylene and tetrachloroethylene. These compounds originated as components of the rolling solutions and cleaning solvents used in mill operations. Naphthalene was selected for limitation as an indicator pollutant for other PAHs and tetrachloroethylene was selected as an indicator pollutant for chlorinated solvents. Because of the potential for operators to change rolling solutions and cleaning solvents, there can be no assurance that the current regulation effectively limits discharges of toxic organic pollutants from cold rolling operations.

4.5.4.1 Chlorinated Dibenzo-*p*-dioxins and Chlorinated Dibenzofurans

Chlorinated dibenzo-*p*-dioxins and chlorinated dibenzofurans (CDDs and CDFs, respectively) are closely related families of highly toxic and persistent organic chemicals which are formed as unwanted by-products in some commercially significant chemical reactions, during high-temperature decomposition and combustion of certain chlorinated organic chemicals, and through other reactions involving chlorine and organic materials.[48-55] There are 210 CDD and CDF chemical compounds (or congeners) with varying chemical, physical, and toxicologic properties. The congener that appears to be the most toxic and has generally raised the greatest public health concerns is 2,3,7,8-tetrachlorodibenzo-p-dioxin, (2,3,7,8-TCDD).

EPA's National Dioxin Study highlighted findings of CDDs and CDFs at wire reclamation facilities and municipal waste combustors where incomplete combustion of substantial quantities of plastics containing chlorine and chlorine compounds occur. The National Dioxin Study did not examine all potential sources of combustion of plastics containing chlorine or chlorine compounds. Swedish researchers have documented formation of CDDs and CDFs in EAF steelmaking operations where steel scraps are remelted to produce and refine molten steel for subsequent casting and hot forming.[53-55] There have been no publicly reported studies of formation or emissions of CDDs and CDFs from North American EAF steelmaking operations.

EAF steelmaking and advances in continuous casting of molten steels directly into semi-finished shapes fostered development of "mini-mills", which, as the name implies, are small steel mills that generally serve local markets. Mini-mills exclusively use EAFs to produce raw steel which is then continuously cast into billets, rounds, or slabs. By the nature of their operations, mini-mills consume mostly "purchased" scrap as opposed to "home" scrap. Home scrap comprises the yield loss from processing liquid steel to the final products at a given mill, and results from processing blooms, slabs, billets, and rounds into semi-finished and finished steel products. Home scrap is usually more desirable, principally because it is of known metallurgical composition and free from unwanted alloying elements that may be present in purchased scrap.

Purchased scrap is usually classified as either "dormant" scrap or "prompt industrial" scrap. Dormant scrap comprises obsolete, worn out, or broken products of consuming industries (e.g., used steel furniture, structural members, automobiles, used ships, and appliances). Because of the variable quality of dormant scrap, careful sorting is required to prevent contamination of the steel in the furnace with unwanted alloying elements. There are over 70 different classifications for dormant scrap.[7] Prompt industrial scrap is generated by steel consumers making their products (e.g., unused portions of sheet steel used for stampings, trimmings from pressing operations, machine turnings, and rejected products). The source and composition of prompt industrial scrap can usually be readily identified.

There are ten major grades of carbon steel scrap and one nonspecific category.[25,26] No. 1 heavy melting steel (sections of beams, crop ends from ingots, billets, etc.) accounted for about 32% of carbon steel scrap consumption in 1988; No. 1 and No. 2 bundles (baled scrap) together accounted for nearly 15%; and, shredded or fragmentized scrap accounted for nearly 11 percent. No. 1 and electric furnace bundles are made from prompt industrial scrap. No. 2 bundles comprise junked automobiles and appliances, usually painted goods. Shredded scrap is manufactured from the same items.

Shredded scrap is prepared from junked automobiles and appliances by passing partially stripped automobile and appliance bodies through rotary shredders. Ferrous metal in chip form is then separated magnetically. Plastics, which may comprise up to 30% of the stripped automobile by weight, consists of the residual "fluff" which is difficult to dispose of or recycle due to combinations of various thermosets and thermoplastics in the mix. Separation of the ferrous metal from the fluff is not 100% efficient. Thus, shredded scrap used in EAFs often contains plastic residues.

In EAF steelmaking, a mix of scrap is selected to make up the furnace charge. Various types are used to obtain the smallest number of bucket charges, the most rapid melting, lowest power utilization, and the lowest electrode consumption, consistent with the price of the scrap mix charged.[7] For efficient operations, common practice is to charge the furnace with two buckets, with 60% of the charge contained in the first bucket. If the charge comprises mostly lighter scrap, a three-bucket charge of 40%, 30%, and 30% may be used.[7] Depending upon scrap availability, buckets are prepared with a layer of light scrap on the bottom followed by heavier scrap. The light scrap provides protection for the bottom of the furnace during charging. Shredded scrap is used for this purpose. It is also desirable to place any large pieces of scrap low in the furnace to prevent damage to electrodes from falling steel during the melting cycle. Medium weight scrap is charged next. Light scrap (shredded scrap) is usually also charged on top to ensure quick boredown of the electrode tips such that furnace roof wear will be minimized and high voltages can be applied more quickly.[7]

Consumption of shredded scrap in the United States has steadily increased as a percentage of total scrap used for steelmaking. Consumption has increased from approximately 1.7 million tons in 1973 to approximately 3.5 million tons in 1981, then dropped precipitously with overall steel production in 1982 and 1983.[25,26] Since that time, consumption of shredded scrap has steadily increased with increases in EAF steelmaking to about 6.1 million tons in 1992.[26] The amount of shredded scrap used in EAF shops is variable and dependent upon operating practice, price, quality, and availability of other light scrap.

At the start of the melting process, electrodes are lowered to the scrap charge in the furnace. The initial melting is characterized by violent reactions and uncontrolled combustion and melting of the scrap charge. It is likely that CDDs and CDFs form at that time from incomplete combustion of residual plastics and other chlorine-containing materials in the scrap charge. Table 4-2 shows experimental levels of CDDs and CDFs formed from EAF melting of scrap with the indicated contaminants.[54] Of interest is indicated formation of 0.8 μg/ton of TCDD equivalents (Nordic - a 2,3,7,8-TCDD toxicity equivalence scheme very similar to, although not identical to, the I-TEF/89 2,3,7,8-TCDD toxicity equivalence scheme adopted by EPA and environmental agencies in many other countries) with "no chlorine" in feedstocks, 1.5 μg/ton with feedstocks contaminated with cutting oils, and 30 μg/ton with feedstocks contaminated with PVC.

Most EAF shops in the U.S. are equipped with dry primary air emission controls and many are equipped with dry secondary emission controls. At the time Part 420 was promulgated in 1982, there were nine EAF shops with wet scrubbers for air emission controls and three semi-wet

EAFs.[15] There are no publicly available data or studies showing actual or potential wastewater discharges of CDDs and CDFs from EAF steelmaking operations.

Formation of CDDs and CDFs in BOF steelmaking has not been reported in the literature. The potential for such formation would appear to be lower than with EAF steelmaking because comparatively less scrap is used per ton of raw steel produced, and the scrap is charged to the furnace prior to adding hot metal; consequently, there is less opportunity for uncontrolled combustion as in EAFs. Also, in open-combustion BOFs, any CDDs and CDFs formed would likely be combusted in the zone above the furnace. Performance at suppressed combustion BOFs might be different because furnace off-gases are not combusted until after wet scrubbing. In these systems, there would appear to be a greater potential for any CDDs and CDFs formed to reach the wastewater treatment systems. There are also no publicly available data regarding the potential or actual discharge of CDDs and CDFs from BOF steelmaking operations.

Because of the nature of the combustion operations and the feed materials used, formation of CDDs and CDFs may also occur at sintering plants.

4.5.4.2 Other Toxic Organic Pollutants

There has been growing concern about whether low level, chronic exposure to estrogenic substances might account for the increasing frequency of infertility and associated disorders of the male reproductive systems in humans.[56] Alkylphenol polyethoxylates (APEOs), which were introduced in the 1940s, are the second largest group of nonionic surfactants in commercial production.[57] They are widely used in detergents, paints, herbicides, pesticides, and many other formulated products including water and wastewater treatment chemicals. Nonylphenol polyethoxylates account for about 80% of APEOs (>300,000 tons are produced annually worldwide) and octylphenol polyethoxylates make up most of the remaining 20 percent.[57] It has been estimated that 60% of the APEOs produced are released to the aquatic environment,[58] most entering via sewage treatment works, where they are readily degraded to form relatively stable metabolites.[59,60] Some of these metabolites are hydrophobic (e.g., alkylphenols, nonylphenol, and octylphenol) and tend to accumulate in sewage sludges and river sediments. Recently, British researchers demonstrated that 4-nonylphenol, 4-octylphenol, 4-nonylphenoldiethoxylate and 4-octylphenoxycarboxylic acid, all compounds found in groundwater and tap water in the U.S.[59,61,62], are estrogenic in fish, avian and mammalian cells, and they mimic the effects of 17β-estradiol (a natural estrogen) by binding to the estrogen receptor.[57]

Possible sources of nonylphenol and octylphenol in the steel industry include water and wastewater treatment chemicals, cleaning solutions used in steel finishing operations, and cleaning solutions used in maintenance operations.[63] A review of the composition of water treatment chemicals and the cleaning solutions used in the steel industry and the possible fate of alkylphenol compounds in steel industry wastewater treatment systems could be conducted to determine whether and to what extent the industry contributes to the mass loadings of these anthropogenic compounds to the environment.

4.6 Preliminary Estimates of Pollutant Loadings and Order-of-Magnitude Costs

Estimates for current industry pollutant loadings were made using the Toxics Release Inventory Database, the Permit Compliance System Database, and by using a modelling approach for the industry. The modelling approach was then used to estimate pollutant loadings if the industry were to upgrade to the level of better performing mills presented in Section 4.3, and the order-of-magnitude costs for this upgrade. The pollutant loading and cost estimates are presented in the following sections.

4.6.1 Modelled Estimates

4.6.1.1 Modelled Estimates of Pollutant Loadings at Current Regulation and at Level of Better Performing Mills

As described in Section 2.3, U.S. iron and steel manufacturing sites can be classified into the following five groups:

- Stand-alone by-product coke plants;
- Integrated steel mills;
- Nonintegrated steel mills;
- Stand-alone finishing mills; and
- Other stand-alone operations.

Because of the configuration of wastewater control and treatment technologies used in the industry and the data available to characterize the performance of those technologies, a modified industry classification was used to develop estimated baseline (current) pollutant loadings and projected loadings that may be achieved if the industry was upgraded to the level of the better performing mills identified in Section 4.3. The modified industry classification is as follows:

- Cokemaking (all plants);
  - -- Direct dischargers;
  - -- Indirect dischargers;
  - -- Other coke plants;

- Sintering (all plants);

- Ironmaking (all blast furnaces);

- BOF steelmaking, vacuum degassing, continuous casting (integrated mills);
- Hot forming (integrated mills);
- Finishing (integrated and stand-alone finishing mills);
- Nonintegrated mills (all operations combined);
- Hot forming (stand-alone hot forming mills);
- Cold forming (stand-alone cold forming mills); and
- Wire (stand-alone wire mills).

Cokemaking. Cokemaking is performed at either stand-alone by-product coke plants or at integrated steel mills. This was the only industry classification where distinctions were made between direct and indirect discharges (although there are many stand-alone steel finishing operations with discharges to POTWs, most of these are smaller facilities and were not included in these estimates).

The "other coke plants" subclassification represents two coke plants where untreated wastewaters are disposed of by dirty-water coke quenching and underground injection in deep wells, respectively. Because these sites do not currently discharge to a surface water or POTW, and are subsequently not subject to the current regulation, they are not included in the total industry summary table (Table 4-3). Data for these two sites are presented in Table 4-6, representing potential cross-media benefits to air quality and reductions in subsurface discharges.

Sintering. This classification includes all sintering plants in the industry with wet air pollution controls, including those designated as "other stand-alone operations" in Section 2.3.

Ironmaking. This classification includes all ironmaking blast furnaces, including those designated as "other stand-alone operations" in Section 2.3.

BOF steelmaking, vacuum degassing, continuous casting. This classification includes the combination of these operations performed at integrated mills.

Hot forming (integrated). This classification includes hot forming operations performed at integrated mills.

Finishing. This classification includes acid pickling, cold rolling, alkaline cleaning, hot dip coating, and electroplating performed at either integrated mills or stand-alone finishing mills. Electroplating operations are currently regulated under 40 CFR Part 433, but are included in this review for the reasons cited in Section 4.3.

Nonintegrated mills. This classification includes the principal operations typically performed at nonintegrated mills: EAF steelmaking with dry air emission controls, vacuum degassing, continuous casting, and hot forming. Because there are a limited number (approximately 5%) of nonintegrated mills with cold forming, acid pickling, alkaline cleaning, and hot dip coating operations, loadings were not developed for these finishing operations.

Hot forming (stand-alone). This classification includes hot forming operations performed at stand-alone hot forming mills.

Cold forming. This classification includes cold forming operations performed at stand-alone cold forming mills, including stand-alone mills manufacturing pipes and tubes.

Wire mills. This classification includes wire manufacturing operations performed at stand-alone wire mills. Pollutant loading estimates were not prepared for mills in this group because they produced less than 1% of industry shipments in 1993 and because data to generate baseline and projected production-normalized pollutant loading estimates are not readily available.

The classifications presented above include all of the current Part 420 subcategories except salt bath descaling. Only a few salt bath descaling operations remain in the U.S., and the production rates for these lines are relatively low. Therefore, pollutant loading estimates were not prepared for this subcategory.

The following data sources were used to estimate the number of facilities, the facility classifications, and industry production rates:

- 1994 Association of Iron and Steel Engineers' Directory of Iron and Steel Plants;
- 1993 American Iron and Steel Institute Annual Statistical Summary (preliminary);
- 1994 International Trade Commission Report on Cokemaking;
- 1982 EPA Development Document for Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category; and
- 1991 Industry Round-up Article from 33 Metal Producing.

The following data sources were used to estimate current and projected pollutant loadings:

- 1982 EPA Development Document for Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category;
- 1994 EPA mill visits;
- 1991 Municipal-Industrial Strategy for Abatement (MISA) program - Ontario Ministry of the Environment; and
- 1980 SATS Coke Plant Verification Study (EPA Study).

To the extent possible, industry and mill production data were based directly upon published references. Recent mill performance data were used to determine production-normalized loadings of the better performing mills. Data from the 1982 Development Document were used to fill data gaps for pollutants present but not routinely monitored by the identified better performing mills.

The loadings and reductions estimates are presented in Tables 4-3 through 4-14. Table 4-15 summarizes the baseline technologies assumed to be in place for estimating current pollutant loadings, and presents those technologies used to estimate the projected loadings and pollutant loading reductions presented in Tables 4-3 through 4-14. The major assumptions used for this effort are as follows:

- For the purposes of estimating baseline pollutant loadings, the 1982 Development Document long-term average production-normalized pollutant loadings were used at BPT for regulated and nonregulated conventional pollutants and at BAT/PSES for regulated and nonregulated nonconventional and priority pollutants.

- Projected pollutant loadings were calculated using performance data from the better performing mills presented in Section 4.3, and the number of currently operating production facilities listed below. Projected pollutant loading *reductions* were computed as the difference between the baseline loadings and the projected pollutant loadings.

- The following are the number of mills within each classification as estimated using the above references sources:

--	Cokemaking	
	- Direct dischargers	12
	- Indirect dischargers	13
	- Other coke plants	2
--	Sintering plants	10
--	Ironmaking	22
--	BOF steelmaking, vacuum degassing, continuous casting	22
--	Hot Forming (integrated)	22
--	Finishing	53
--	Nonintegrated mills	100

--	Hot forming (stand-alone)	26
--	Cold forming	76
--	Wire mills	43

- Based upon an assessment of the current industry status, it was estimated that 50% of the hot forming mills (integrated and stand-alone) have high-rate treatment and recycle systems approximating those described as BAT - Option 1 or NSPS, and 50% have treatment systems with partial recycle approximating the EPA BPT model treatment technology.

- Nonintegrated mills were assumed to be equipped with electric furnaces with dry air emission controls, continuous casters and hot forming operations. The continuous casters, and hot forming mills were assumed to be equipped with high-rate treatment and recycle systems.

- Specialty steel mills are more likely to discharge higher levels of chromium and nickel than carbon steel or low alloy steel mills. Because specialty steel production accounts for approximately 2% of total steel production in the U.S., these mills were not differentiated in the pollutant loading estimates.

- The pollutants presented in Tables 4-3 through 4-14 represent the pollutants of concern identified during the 1982 rulemaking effort, and are not necessarily those currently regulated by 40 CFR Part 420. The list of pollutants limited by 40 CFR Part 420 is presented in Table 3-2.

- Table 4-5 presents estimated mass loading data for discharges from indirect discharge steel mills to POTWs. These data do not represent discharges to receiving waters.

Other specific assumptions made to develop the pollutant loading estimates are included in the record for this project.

4.6.1.2 Modelled Estimates of Order-of-Magnitude Costs to Upgrade Industry Performance

Table 4-16 summarizes preliminary estimates of total capital investment and annual operating and maintenance costs to upgrade the industry to the level of the better performing mills for each industry classification listed in Section 4.6.1.1. In all cases, assumptions were made about the baseline level of process wastewater treatment and recycle technologies currently installed in the industry. Technologies necessary to upgrade mills to the level of the better performing mills, including increased recycling, were then identified. Cost estimates were developed based upon model plant cost data presented in the 1982 Development Document that were scaled to wastewater flow rate and/or production rate for actual mill production capacities for cokemaking and sintering operations and typical mill sizes for the other classifications.

The 1978 cost data presented in the 1982 Development Document were upgraded to 1994 costs using the Chemical Engineering Plant Cost Index. Because of the number and nature of the assumptions that were made in this analysis and the use of a cost index over a relatively long period of time, these estimates must be considered preliminary and subject to wide variation. The assumptions made to develop the cost estimates and the bases for the cost estimates for each classification are included in the record for this project.

Using an equipment life of 20 years and annual interest rates of 7% and 10% for 1994, the iron and steel industry totals presented in Table 4-16 for total capital investment and annual operating and maintenance costs were converted to total annualized costs of $64.3 million per year and $72.1 million per year, respectively.

To determine cost effectiveness, the differences in toxicity among the various pollutants is accounted for by using toxic weighting factors (TWFs). TWFs are calculated such that relatively more toxic pollutants have higher TWFs. In the majority of cases, TWFs are derived from both chronic freshwater aquatic criteria and human health criteria established for the consumption of fish. These factors are then standardized by relating them to copper. When TWFs are multiplied by pollutant mass loadings in units such as pounds per year, the resulting values are in units of toxic pound-equivalents. Mass loadings from different pollutants can be summed together after they are converted to toxic pound-equivalents. TWFs are presented in the last column of Table 4-3.

Using the data presented in Table 4-3, the toxic pounds-equivalents removed by upgrading to the level of better performing mills was estimated at 1.9 million lbs-eq/yr. The total annualized cost and the toxic pounds-equivalents removed can be divided to determine the cost-effectiveness of upgrading to the level of better performing mills. For the industry as a whole, the cost-effectiveness based on these modelled estimates is $34/lbs-eq removed and $38/lbs-eq removed for annual interest rates of 7% and 10%, respectively.

4.6.2 Toxics Release Inventory (TRI) Database

Table 4-17 summarizes EPCRA Section 313 Toxics Release Inventory (TRI) wastewater discharge data reported by the iron and steel industry for 1992. The summary includes data from manufacturing facilities within SIC Codes 3312, 3315, 3316, and 3317. For the purpose of estimating baseline pollutant loadings and pollutant loading reductions, the TRI database has the following limitations:

- Most integrated mills have large-volume noncontact cooling water discharges from cokemaking and ironmaking operations and associated steam- and power-producing units. It is common practice to discharge treated, low-volume process wastewaters through high-volume noncontact cooling water discharges. In some cases, direct discharged TRI pollutant loadings may have been estimated based upon the gross amount of pollutants discharged from the combined noncontact cooling water flows. For large-volume noncontact cooling water discharges in river systems where upstream or background concentrations for selected pollutants are measurable (e.g., ammonia-N), discharge loadings calculated in this manner would not be representative and would overstate the actual pollutant loadings contributed by the steel mill from the treated process wastewaters.

- At many mills, TRI estimates for direct and indirect discharges are not based upon actual discharge measurements of all TRI pollutants used or processed above TRI threshold levels. The TRI estimates may not account for relatively low-concentration discharges of toxic pollutants that can amount to significant annual mass loadings when considering the industry as a whole.

Because these concerns could not be investigated within the scope of this project, baseline and projected pollutant loading estimates and estimated pollutant loading reductions were developed as described in Section 4.6.1.1.

4.6.3 Permit Compliance System (PCS) Database

Table 4-18 summarizes pollutant loading data from the EPA Permit Compliance System (PCS) Database for 1992. The summary includes wastewater discharge data from manufacturing facilities within SIC Codes 3312, 3315, 3316, and 3317. Many steel mills have multiple treatment systems in which NPDES permit effluent limitations and monitoring requirements are applied at the discharge of the treatment systems prior to mixing with noncontact cooling waters and other nonregulated flows (e.g., stormwater). In many cases, the pollutants limited and monitored at the internal monitoring stations are not limited or monitored at the final discharge point. From examination of the PCS database, there are several examples at integrated steel mills, nonintegrated steel mills, and stand-alone finishing mills where NPDES monitoring data for internal monitoring stations have not been included in the database. Several pollutants that are limited and monitored are missing from the database for selected mills. Based on this review, the PCS database was judged to be deficient for estimating baseline pollutant loadings and pollutant loading reductions for this project.

Table 4-1

40 CFR 420.01(b)
Central Treatment Facilities Temporarily Excluded from Part 420

Plant	NPDES Permit No. 1982	Central Treatment Facility
Armco Steel, Ashland, KY (AK Steel Corporation)	KY 0000485	Total Plant
Bethlehem Steel, Sparrows Point, MD	MD 0001201	Humphrey's Creek - Outfall 014
Bethlehem Steel, Burns Harbor, IN	IN 0000175	Total Plant
Ford Motor Co., Dearborn, MI (Rouge Steel Company)	MI 0003361	Schaefer Road Treatment Plant
Interlake, Inc., Riverdale, IL (Acme Metals, Inc.)	IL 0002119	Discharge to POTW
J&L Steel, Aliquippa, PA (LTV Steel Company)	PA 0006131	Chemical Rinse Treatment Plant Outfall 018
J&L Steel, Cleveland, OH (LTV Steel Company)	OH 0000850	Hot Forming and Finishing
J&L Steel, Hennepin, IL (LTV Steel Company)	IL 0002631	Total Plant
J&L Steel, Louisville, OH (J&L Specialty Steel)	OH 0007188	Total Plant
J&L Steel, East Chicago, IN (LTV Steel Company)	IN 0000205	Terminal Treatment Plant
Laclede Steel, Alton, IL	IL 0000612	Total Plant
National Steel, Granite City, IL	IL 0000329	Total Plant
National Steel, Portage, IN	IN 0000337	Total Plant
National Steel, Weirton, WV (Weirton Steel Company)	WV 0003336	Outfall B
Republic Steel, Gadsden, AL (Gulf States Steel, Inc.)	AL 0003522	Total Plant
Republic Steel, Chicago, IL (LTV Steel Company)	IL 0002593	Discharge to POTW
U.S. Steel, Lorain, OH (USX/Kobe Steel)	OH 0001562	Pipe Mill Lagoon

Table 4-1 (Continued)

40 CFR 420(b)
Central Treatment Facilities Temporarily Excluded from Part 420

Plant	NPDES Permit No. 1982	Central Treatment Facility
U.S. Steel, Provo, UT (Geneva Steel)	UT 0000361	Total Plant
U.S. Steel, Fairless Hills, PA	PA 0013463	Terminal Treatment Plant
U.S. Steel, Gary, IN	IN 0000281	Terminal Lagoons
U.S. Steel, Chicago, IL	IL 0002691	Discharge to POTW

( ) = Current Mill Owner.

Table 4-2

Levels of CDDs and CDFs in Electric Arc Furnace Flue Gases Before and After Bag House Filter During Continuous Charge Through The Furnace Lid
(Results in TCDD Equivalents - Nordic (Eadon))

Feedstock	Chlorine Charge (kg Cl/ton)	Baghouse	
		Before	After
"No Chlorine"	--	0.2 (0.2) ng/Nm^3 0.8 (1.1) μg/ton	0.1 (0.1) ng/Nm^3 0.5 (0.7) μg/ton
$CaCl_2$	0.3	0.5 (0.5) ng/Nm^3 2.8 (2.7) μg/ton	0.04 (0.04) ng/Nm^3 0.2(0.2) μg/ton
Cutting Oils	0.4	0.3 (0.4) ng/Nm^3 1.5 (2.1) μg/ton	0.1(0.2) ng/Nm^3 0.6(1.0) μg/ton
PVC	1.3	5.9 (6.4) ng/Nm^3 30 (33) μg/ton	1.5(3.9) ng/Nm^3 7.7(20) μg/ton

Source: Tysklind, 1989 (Reference 54)

Notes:

(1) The first number presented in columns three and four represents 2,3,7,8-TCDD Toxicity Equivalents (TEQs) using the Nordic convention. The number in parentheses represents 2,3,7,8-TCDD TEQs using the Eadon convention.

(2) Mixtures of CDDs and CDFs are reported as 2,3,7,8-TCDD TEQs to simplify reporting and to commonly express the potential toxicity of mixtures of CDDs and CDFs in terms of the toxicity of 2,3,7,8-TCDD. The International Toxicity Equivalents Factors convention (I-TEF/89) was adopted in 1989 by the U.S. and most foreign countries. The Nordic convention is similar to the I-TEF/89 convention.

Table 4-3

Pollutant Loadings for Total Iron and Steel Industry

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction	Toxic Weighting Factor
Total suspended solids	34,000,000	5,000,000	29,000,000	85	*
Oil and grease	8,200,000	1,300,000	6,900,000	84	*
Ammonia - N	900,000	190,000	710,000	79	*
Total cyanide	180,000	34,000	150,000	83	1.1
Phenols (4AAP)	300,000	1,200	300,000	99.6	*
Acrylonitrile	2,000	160	1,800	90	0.85
Parachlorometacresol	1,200	40	1,200	97	0.0043
2,4-Dimethylphenol	13,000	660	12,000	92	0.0053
Ethlybenzene	6,100	240	5,900	97	0.0014
Fluoranthene	5,600	2,800	2,800	50	0.92
Isophorone	2,400	80	2,300	96	0.00073
Phenol	310,000	510	310,000	99.8	0.028
Benzo-a-anthracene	1,600	79	1,500	94	24
Benzo-a-pyrene	700	340	360	51	4,300
Chrysene	1,800	240	1,600	89	18
Acenaphthalene	7,900	160	7,700	97	0.0084
Fluorene	1,600	160	1,400	88	0.70
Naphthalene	490	340	150	31	0.015
Pyrene	1,800	400	1,400	78	0.98
Benzene	490	340	150	31	0.018
Toluene	4,000	400	3,600	90	0.0056
Xylenes	2,400	160	2,200	92	0.0015
Total arsenic	7,900	3,200	4,700	59	4.0
Total cadmium	3,500	750	2,800	80	5.2

*Toxic Weighing Factors are not applicable for these parameters.

Table 4-3 (Continued)

Pollutant Loadings for Total Iron and Steel Industry

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction	Toxic Weighting Factor
Total chromium	90,000	61,000	29,000	32	0.027
Total copper	12,000	2,500	9,500	79	0.47
Total lead	39,000	7,300	32,000	82	1.8
Total nickel	14,000	3,400	11,000	79	0.036
Total selenium	1,600	790	810	51	1.1
Total zinc	200,000	21,000	180,000	90	0.051

*Toxic Weighing Factors are not applicable for these parameters.

Table 4-4

Pollutant Loadings for Direct Discharging Coke Plants

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	2,600,000	73,000	2,500,000	96
Oil and grease	180,000	33,000	150,000	83
Ammonia - N	110,000	11,000	99,000	90
Total cyanide	38,000	8,200	30,000	79
Phenols (4AAP)	300	190	110	37
Benzo-a-pyrene	300	150	150	50
Naphthalene	300	150	150	50
Benzene	300	150	150	50

Table 4-5

Pollutant Loadings for Indirect Discharging Coke Plants

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	790,000	630,000	160,000	20
Oil and grease	120,000	48,000	72,000	60
Ammonia - N	480,000	96,000	380,000	79
Total cyanide	130,000	24,000	110,000	85
Phenols (4AAP)	290,000	960	290,000	99.7
Acrylonitrile	2,000	160	1,800	90
Parachlorometacresol	1,200	40	1,200	97
2,4-Dimethylphenol	7,900	40	7,900	99.5
Ethlybenzene	6,400	240	6,200	97
Fluoranthene	1,600	160	1,400	88
Isophorone	2,400	79	2,300	96
Phenol	240,000	40	240,000	99.98
Benzo-a-anthracene	1,600	79	1,500	94
Benzo-a-pyrene	400	190	210	53
Chrysene	1,600	79	1,500	94
Acenaphthalene	7,900	160	7,700	97
Fluorene	1,600	160	1,400	88
Naphthalene	190	190	0	0
Pyrene	1,600	240	1,400	88
Benzene	190	190	0	0
Toluene	4,000	400	3,600	90
Xylenes	2,400	160	2,200	92
Total arsenic	7,900	3,200	4,700	60
Total selenium	1,600	790	810	51
Total zinc	1,600	790	810	51

Table 4-6

Pollutant Loadings for Other Coke Plants

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	260,000	24,000	240,000	92
Oil and grease	390,000	11,000	380,000	97
Ammonia - N	3,100,000	3,400	3,100,000	99.9
Total cyanide	260,000	2,700	260,000	99
Phenols (4AAP)	1,600,000	61	1,600,000	99.99
Acrylonitrile	4,000	98	3,900	98
Parachlorometacresol	2,000	24	2,000	99
2,4-Dimethylphenol	16,000	24	16,000	99.9
Ethlybenzene	9,900	150	9,800	99
Fluoranthene	2,600	98	2,500	96
Isophorone	1,600	49	1,600	97
Phenol	910,000	24	910,000	99.99
Benzo-a-anthracene	990	49	940	95
Benzo-a-pyrene	520	49	470	90
Chrysene	1,300	49	1,300	96
Acenaphthalene	12,000	98	12,000	99
Fluorene	2,000	98	1,900	95
Naphthalene	160,000	49	160,000	99.97
Pyrene	2,000	150	1,900	95
Benzene	180,000	49	180,000	99.97
Toluene	82,000	250	82,000	99.7
Xylenes	40,000	98	40,000	99.8
Total arsenic	6,600	2,000	4,600	70
Total selenium	660	490	170	26
Total zinc	660	490	170	26

Table 4-7

Pollutant Loadings for Sintering

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	600,000	80,000	520,000	87
Oil and grease	110,000	17,000	93,000	85
Ammonia - N	93,000	80,000	13,000	14
Total cyanide	3,100	1,800	1,300	42
Phenols (4AAP)	230	40	190	83
Fluoranthene	1,500	160	1,300	87
Phenol	770	160	610	79
Chrysene	160	160	0	0
Pyrene	160	160	0	0
Total cadmium	160	160	0	0
Total chromium	3,100	2,300	800	26
Total copper	310	310	0	0
Total lead	1,900	730	1,200	63
Total nickel	160	160	0	0
Total zinc	2,300	970	1.300	57

Table 4-8

Pollutant Loadings for Ironmaking

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	2,300,000	1,900	2,300,000	99.9
Ammonia - N	190,000	1,900	190,000	99
Total cyanide	7,700	41	7,700	99
Phenols (4AAP)	460	1	460	99.8
2,4-Dimethylphenol	4,600	620	4,000	87
Fluoranthene	2,500	2,500	0	0
Phenol	65,000	310	65,000	99.5
Total cadmium	3,100	310	2,800	90
Total chromium	6,200	4,600	1,600	26
Total copper	930	620	310	33
Total lead	3,400	17	3,400	99.5
Total nickel	3,100	460	2,600	84
Total zinc	4,600	22	4,600	99.5

Table 4-9

Pollutant Loadings for BOF Steelmaking, Vacuum Degassing, Continuous Casting

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	3,900,000	26,000	3,900,000	99
Oil and grease	680,000	76,000	600,000	88
Total cadmium	280	280	0	0
Total chromium	2,800	770	2,000	71
Total copper	2,800	770	2,000	71
Total lead	7,500	370	7,100	95
Total nickel	6,900	2,300	4,600	67
Total zinc	120,000	5,800	110,000	92

Table 4-10

Pollutant Loadings for Hot Forming (Integrated Mills)

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	8,700,000	740,000	8,000,000	92
Oil and grease	1,800,000	340,000	1,500,000	83
Total chromium	640	71	570	89
Total copper	7,000	780	6,200	89
Total lead	4,500	450	4100	91
Total nickel	3,800	430	3,400	89
Total zinc	31,000	3,500	28,000	90

Table 4-11

Pollutant Loadings for Finishing

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	10,000,000	3,200,000	6,800,000	68
Oil and grease	4,400,000	760,000	3,600,000	82
Total chromium	77,000	53,000	24,000	31
Total lead	10,000	4,800	5,200	52
Total zinc	21,000	8,300	13,000	62

Table 4-12

Pollutant Loadings for Nonintegrated Mills

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	3,900,000	83,000	3,800,000	97
Oil and grease	790,000	18,000	770,000	97
Total lead	11,000	760	10,000	91
Total zinc	16,000	1,000	15,000	94

Table 4-13

Pollutant Loadings for Hot Forming (Stand-alone)

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	570,000	49,000	520,000	91
Oil and grease	118,000	22,000	96,000	81
Total chromium	42	5	37	88
Total copper	460	52	410	89
Total lead	290	33	260	90
Total nickel	250	28	220	88
Total zinc	2,000	230	1,800	90

Table 4-14

Pollutant Loadings for Cold Forming

Pollutant	Current Loading (lbs/yr)	Projected Loading (lbs/yr)	Loading Reduction (lbs/yr)	Percent Reduction
Total suspended solids	47,000	47,000	0	0
Oil and grease	21,000	21,000	0	0
Total lead	290	110	180	62
Total zinc	180	180	0	0

Table 4-15

Comparison of Baseline and Projected Technologies

Process Operations	Baseline Technology	Project Technology
Indirect Discharge Coke Plants	Ammonia stills with caustic; equalization; dephenolizer at some plants	Mill W: Ammonia stills with caustic; equalization; temperature control; two-stage biological treatment with secondary clarification
Direct Discharge Coke Plants	Ammonia stills with caustic; equalization; tar separation; temperature control; two-stage biological treatment with secondary clarification	Mill C: Same as baseline with metals precipitation, alkaline chlorination, and filtration
Other Coke Plants	No wastewater treatment	Same as for direct discharge coke plants
Sintering	Recycle of emission control wastewaters with 120 gpt blowdown	Transfer from Mill C: Same as baseline with metals precipitation, alkaline chlorination, and filtration
Ironmaking	Recycle of gas cooling and cleaning waters with 70 gpt blowdown	Mill C: Same as baseline with metals precipitation, alkaline chlorination, and filtration
Steelmaking Vacuum Degassing Continuous Casting	Separate recycles systems with average blowdowns of 50 gpt for BOF steelmaking and 25 gpt for vacuum degassing and continuous casting	Mill F: Increased recycle for steelmaking with CO_2 addition for water softening; optimization, and cascading of blowdowns for vacuum degassing and continuous casting; metals precipitation and filtration
Hot Forming - Integrated	Half of mills: equivalent to BPT; Half of mills: equivalent to BAT/NSPS	Mill D: equivalent to BAT/NSPS; scale pits; partial scale pit recycle; filtration; cooling; and high rate recycle (>96%) with blowdown of 200 gpt.

Table 4-15 (Continued)

Comparison of Baseline and Projected Technologies

Process Operations	Baseline Technology	Project Technology
Steel Finishing Mills	Pretreatment for cold rolling solutions; metals precipitation and clarification	Mill K: Same as baseline with upgraded treatment performance. (Filtration used for estimating costs for upgrades).
Nonintegrated Steel Mills	EAFs with dry air emission controls; high rate recycle systems for continuous casting and hot forming process waters with combined blowdown of 200 gpt of raw steel	Transfer of effluent quality from Mill C: same as baseline with combined blowdown of 50 gpt of raw steel; metals precipitation; and filtration.
Stand-Alone Hot Forming Mills	Same as hot forming mills at integrated steel mills	Same as hot forming mills at integrated steel mills.
Stand-Alone Cold Forming Mills (Cold Rolling and Tube Mills)	Pretreatment for cold rolling solutions	Mill F: same as baseline with improved performance. (Filtration used for estimating costs for upgrades).

Table 4-16

Costs to Upgrade to the Level of Better Performing Mills

Classification	Cost Estimates (Millions of 1994 Dollars)	
	Total Capital Investment	Operating and Maintenance
Direct discharging coke plants	19.5	3.25
Indirect discharging coke plants	30.1	5.09
Other coke plants	29.2	4.87
Sinter plants	12.9	1.29
Ironmaking	25.1	4.19
BOF steelmaking, vacuum degassing, continuous casting	11.0	1.65
Hot forming (integrated mills)	119.4	7.55
Finishing	30.6	1.32
Nonintegrated mills	34.4	1.68
Hot forming (stand alone)	21.3	1.09
Cold forming	5.8	0.26
Industry total	339	32.2

Table 4-17
Summary of 1992 TRI Data

CAS	Chemical Name	Number of Facilities	Total Pollutants Discharged (lbs/yr)	Toxic Weighting Factor	Total Priority Pollutants Discharged (lbs/yr)	Total Priority Pounds-Equiv. Discharged (lbs-eq/yr)	Carcinogens in Discharges	Systemic Toxicants in Discharges
10	ANTIMONY COMPOUNDS	1	20					
40	BARIUM COMPOUNDS	2	12,564					
90	CHROMIUM COMPOUNDS	75	57,428					
96	COBALT COMPOUNDS	7	1,276					
100	COPPER COMPOUNDS	36	24,370					
106	CYANIDE COMPOUNDS	22	80,943					
420	LEAD COMPOUNDS	44	27,187					
450	MANGANESE COMPOUNDS	54	217,863					
495	NICKEL COMPOUNDS	53	26,609					
740	SILVER COMPOUNDS	1	250					
982	ZINC COMPOUNDS	81	287,014					
62566	THIOUREA	1	720	6.2E-02				
67561	METHANOL	1	5	9.3E-06				Yes
71432	BENZENE	8	41,263	1.8E-02	41,263	743	Yes	
71556	1,1,1-TRICHLOROETHANE	4	9,557	4.3E-03	9,557	41		Yes
75092	DICHLOROMETHANE	1	250	4.2E-04	250	0	Yes	Yes
78922	SEC-BUTYL ALCOHOL	1	250	1.3E-05				
79016	TRICHLOROETHYLENE	1	5	6.3E-02	5	0	Yes	
91203	NAPHTHALENE	10	4,447	1.5E-02	4,447	67		Yes
91225	QUINOLINE	1	10	5.0E+00			Yes	
95476	O-XYLENE	1	5	8.5E-03				Yes
100414	ETHYLBENZENE	1	250	1.4E-03	250	0		Yes
100425	STYRENE	1	10	1.4E-02				Yes
107211	ETHYLENE GLYCOL	11	622,927	8.4E-05				Yes
108883	TOLUENE	7	2,392	5.6E-03	2,392	13		Yes
108907	CHLOROBENZENE	1	5	2.9E-03	5	0		Yes
108952	PHENOL	20	683,460	2.8E-02	683,460	19,137		Yes
111422	DIETHANOLAMINE	2	50,000	1.8E-03				
120127	ANTHRACENE	1	5	2.5E+00	5	13	Yes	Yes
132649	DIBENZOFURAN	1	5	2.0E-02				
1313275	MOLYBDENUM TRIOXIDE	4	1,076	8.0E-04				
1319773	CRESOL (MIXED ISOMERS)	3	20	2.6E-03			Yes	Yes
1330207	XYLENE (MIXED ISOMERS)	7	2,048	4.2E-03				Yes

Table 4-17
Summary of 1992 TRI Data

CAS	Chemical Name	Number of Facilities	Total Pollutants Discharged (lbs/yr)	Toxic Weighting Factor	Total Priority Pollutants Discharged (lbs/yr)	Total Priority Pounds-Equiv. Discharged (lbs-eq/yr)	Carcinogens in Discharges	Systemic Toxicants in Discharges
7429905	ALUMINUM (FUME OR DUST)	6	51,910	6.4E-02				
7439921	LEAD	37	8,679	1.8E+00	8,679	15,622	Yes	Yes
7439965	MANGANESE	33	69,780	1.4E-02				Yes
7440020	NICKEL	43	12,984	3.6E-02	12,984	467		Yes
7440360	ANTIMONY	2	5,938	1.9E-01	5,938	1,128		Yes
7440393	BARIUM	1	4,600	2.0E-03				Yes
7440439	CADMIUM	1	2	5.2E+00	2	10	Yes	Yes
7440473	CHROMIUM	50	6,968	2.7E-02	6,968	188		Yes
7440484	COBALT	3	193	1.1E-01				
7440508	COPPER	24	7,924	4.7E-01	7,924	3,724		
7440622	VANADIUM (FUME OR DUST)	1	3,500	6.2E-01				Yes
7440666	ZINC (FUME OR DUST)	20	30,081	5.1E-02	30,081	1,534		Yes
7647010	HYDROCHLORIC ACID	19	238,266	2.4E-05				
7664382	PHOSPHORIC ACID	9	14,297					
7664393	HYDROGEN FLUORIDE	11	488					
7664417	AMMONIA	32	2,506,347	3.7E-03				
7664939	SULFURIC ACID	27	15,769,384	1.3E-03				
7697372	NITRIC ACID	13	86,820					
7782505	CHLORINE	8	6,675	4.9E-01				Yes
7783202	AMMONIUM SULFATE (SOLUTION)	1	12,522	1.5E-03				
	TOTALS:	236	20,991,592		814,210	42,689	8	24
			(lbs/day)		(lbs/day)	(lbs-eq/day)		
	TOTALS PER DAY (assuming 365 days/year):		57,511		2,231	117		
	AVERAGE PER FACILITY:				9.45	0.50		

Table 4-18
Summary of 1992 PCS Data

CAS	Chemical Name	Number of Facilities	Total Pollutants Discharged (lbs/yr)	Toxic Weighting Factor	Total Priority Pollutants Discharged (lbs/yr)	Total Priority Pounds-Equiv. Discharged (lbs-eq/yr)	Carcinogens in Discharges	Systemic Toxicants in Discharges
50328	Benzo(a)pyrene	11	118.22	4.3E+03	118.22	508,330.16	Yes	
57125	Cyanide	41	99,643.92	1.1E+00	99,643.92	109,608.31		Yes
67663	Trichloromethane	4	152.78	2.1E-03	152.78	0.32	Yes	Yes
71432	Benzene	11	370.38	1.8E-02	370.38	6.67	Yes	
71556	Trichloroethane, 1,1,1-	3	0.23	4.3E-03	0.23	0.00		Yes
75003	Chloroethane	1	0.02	2.7E-04	0.02	0.00		
75274	Bromodichloromethane	1	26.54	7.4E-02	26.54	1.96	Yes	Yes
75354	Dichloroethene, 1,1-	1	0.02	1.8E-01	0.02	0.00	Yes	Yes
79016	Trichloroethene	1	0.02	6.3E-02	0.02	0.00	Yes	
84662	Diethyl phthalate	1	0.65	6.1E-04	0.65	0.00		Yes
84742	Di-n-butyl phthalate	1	0.83	1.2E-02	0.83	0.01		Yes
85018	Phenanthrene	1	0.09	1.9E+01	0.09	1.71	Yes	
91203	Naphthalene	15	120.83	1.5E-02	120.83	1.81		Yes
108883	Toluene	2	4.29	5.6E-03	4.29	0.02		Yes
108952	Phenol	1	521.87	2.8E-02	521.87	14.61		Yes
117817	Bis(2-ethylhexyl) phthalate	1	132.11	1.1E-01	132.11	14.53	Yes	Yes
124481	Dibromochloromethane	1	13.41	1.3E-01	13.41	1.74	Yes	Yes
127184	Tetrachloroethene	4	19.46	7.4E-02	19.46	1.44	Yes	Yes
129000	Pyrene	2	0.21	9.8E-01	0.21	0.20	Yes	Yes
156605	Dichloroethene, trans-1,2-	1	0.14	9.3E-05	0.14	0.00		Yes
206440	Fluoranthene	1	0.09	9.2E-01	0.09	0.08		Yes
1330207	Xylenes	2	0.58	4.2E-03				Yes
7429905	Aluminum	4	52,732.65	6.4E-02				
7439896	Iron	43	2,066,545.60	5.6E-03				
7439921	Lead	65	27,943.38	1.8E+00	27,943.38	50,298.09	Yes	Yes
7439954	Magnesium	1	198.04	8.7E-04				
7439965	Manganese	7	24,070.43	1.4E-02				Yes
7439976	Mercury	2	1.27	5.0E+02	1.27	634.75		Yes
7439987	Molybdenum	1	146.61	2.0E-01				Yes
7440020	Nickel	25	7,941.51	3.6E-02	7,941.51	285.89		Yes
7440224	Silver	5	26.57	4.7E+01	26.57	1,248.88		Yes
7440280	Thallium	3	56.47	1.4E-01	56.47	7.91		
7440315	Tin	2	2,078.29	3.0E-01				Yes

Table 4-18
Summary of 1992 PCS Data

CAS	Chemical Name	Number of Facilities	Total Pollutants Discharged (lbs/yr)	Toxic Weighting Factor	Total Priority Pollutants Discharged (lbs/yr)	Total Priority Pounds-Equiv. Discharged (lbs-eq/yr)	Carcinogens in Discharges	Systemic Toxicants in Discharges
7440326	Titanium	1	10.25	2.9E-02				
7440360	Antimony	1	1.60	1.9E-01	1.60	0.30		Yes
7440382	Arsenic	5	90.05	4.0E+00	90.05	360.19	Yes	Yes
7440417	Beryllium	1	34.55	5.3E+00	34.55	183.13	Yes	Yes
7440439	Cadmium	15	237.32	5.2E+00	237.32	1,234.08	Yes	Yes
7440473	Chromium	35	23,490.04	2.7E-02	23,490.04	634.23		Yes
7440508	Copper	33	11,175.20	4.7E-01	11,175.20	5,252.34		
7440666	Zinc	71	207,582.46	5.1E-02	207,582.46	10,586.71		Yes
7664417	Ammonia	40	3,871,646.56	3.7E-03				
7782492	Selenium	4	14,313.68	1.1E+00	14,313.68	15,745.05		Yes
7782505	Chlorine	13	11,421.17	4.9E-01				Yes
16984488	Fluoride	8	317,256.35	3.5E-02				Yes
18540299	Chromium hexavalent	18	2,103.92	5.1E-01	2,103.92	1,073.00	Yes	Yes
	TOTALS:	97	6,742,231		396,124	705,528	16	34
			(lbs/day)		(lbs/day)	(lbs-eq/day)		
	TOTALS PER DAY (assuming 365 days/year):		18,472		1,085	1,933		
	AVERAGE PER FACILITY:				11.19	19.93		

Figure 4-1

Mill Performance vs Effluent Limitations Guidelines

Cokemaking: Long-Term Average Data

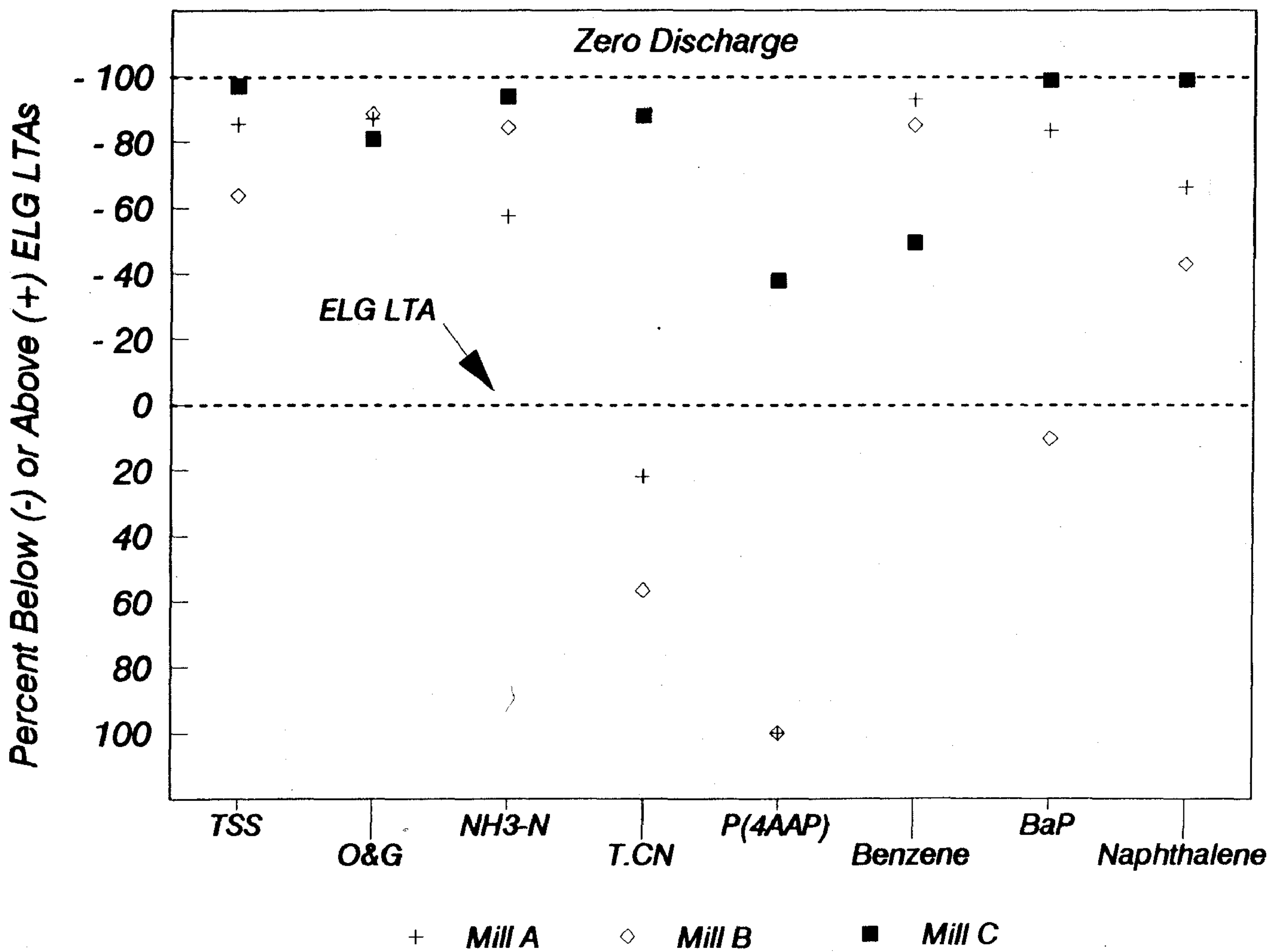


Figure 4-2

Mill Performance vs Effluent Limitations Guidelines

Sintering - Long Term Average Data

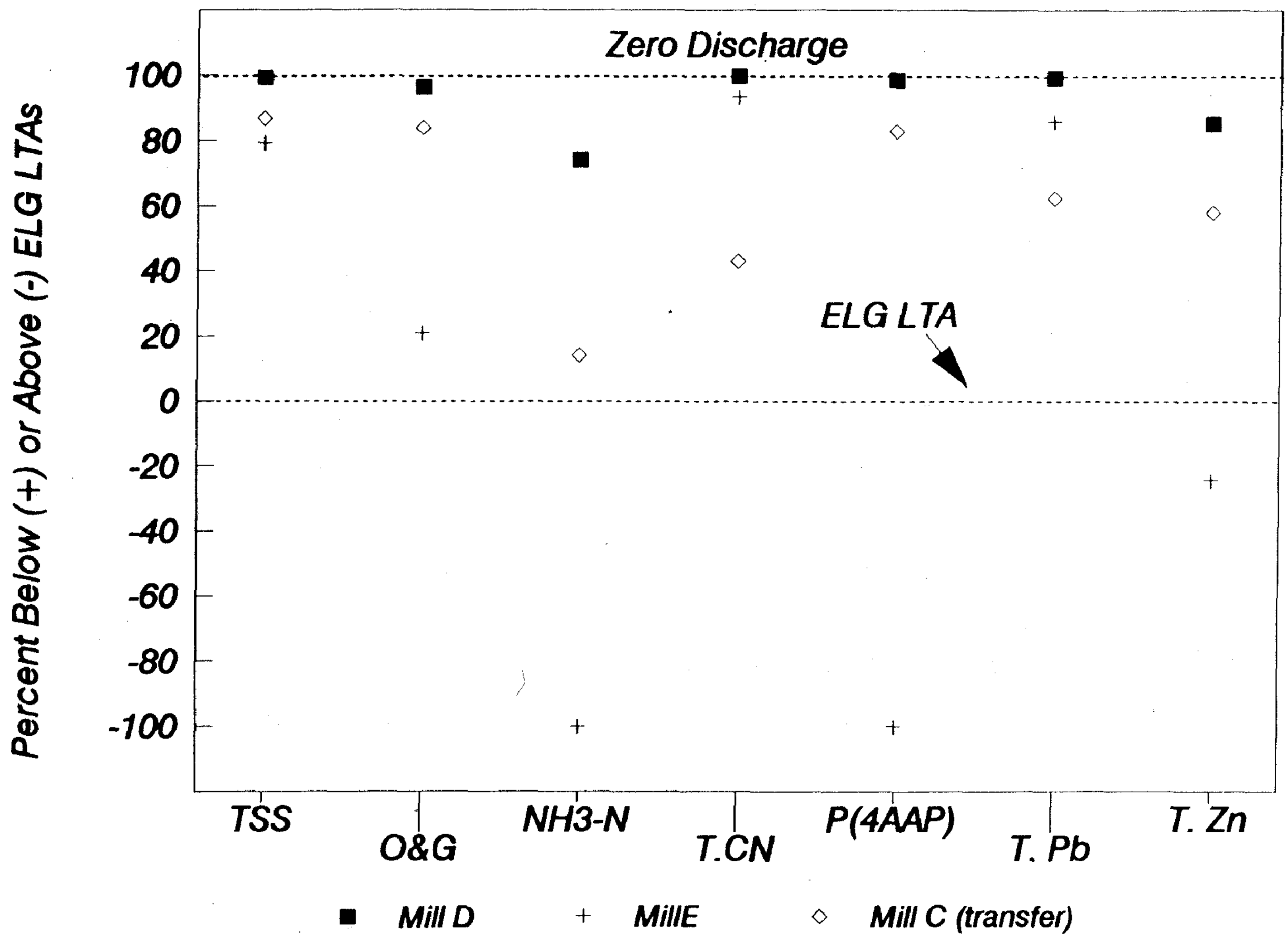


Figure 4-3

Mill Performance vs Effluent Limitations Guidelines

Ironmaking: Long-Term Average Data

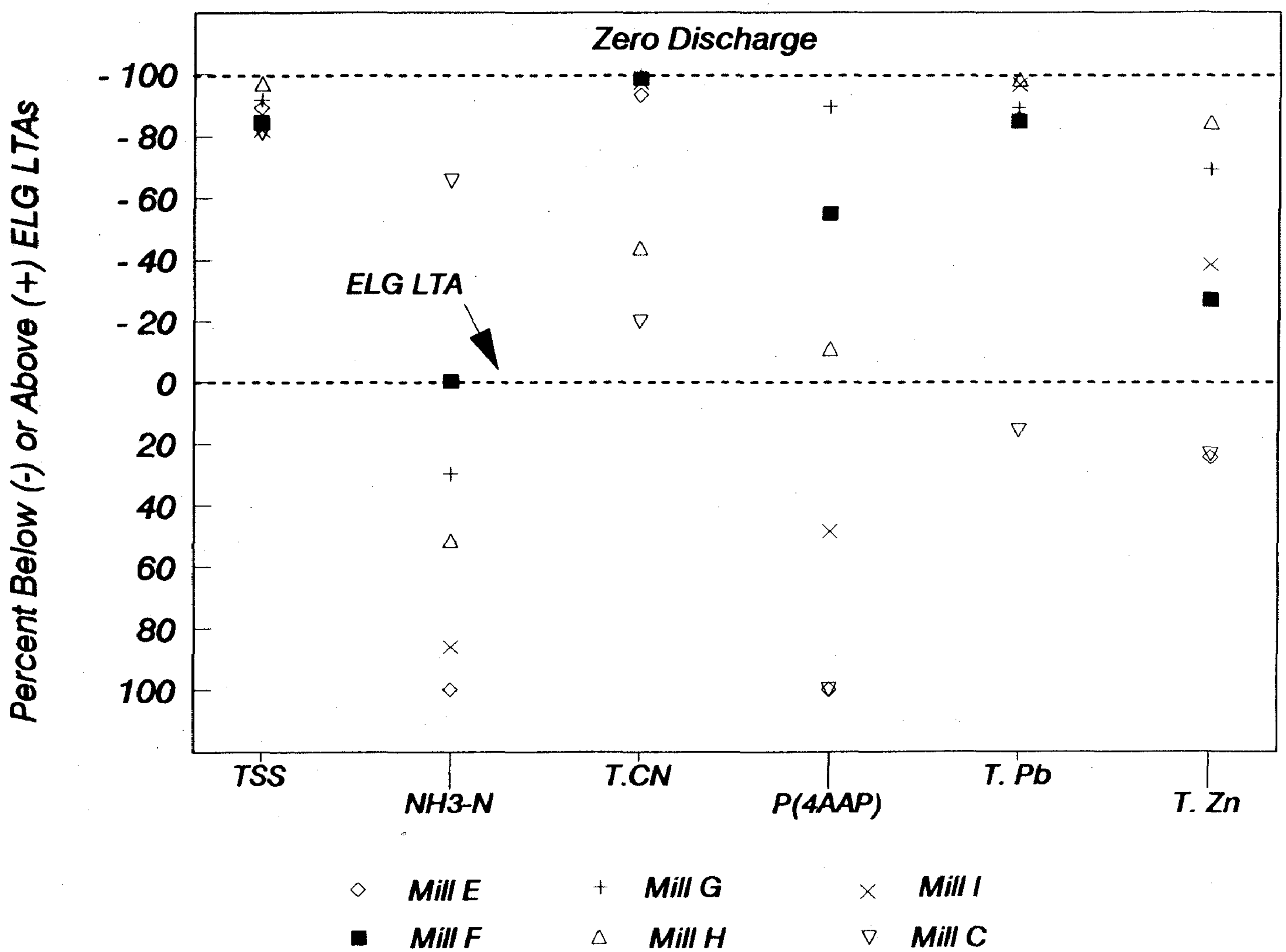


Figure 4-4

Mill Performance vs Effluent Limitations Guidlines

Steelmaking - Long Term Average Data

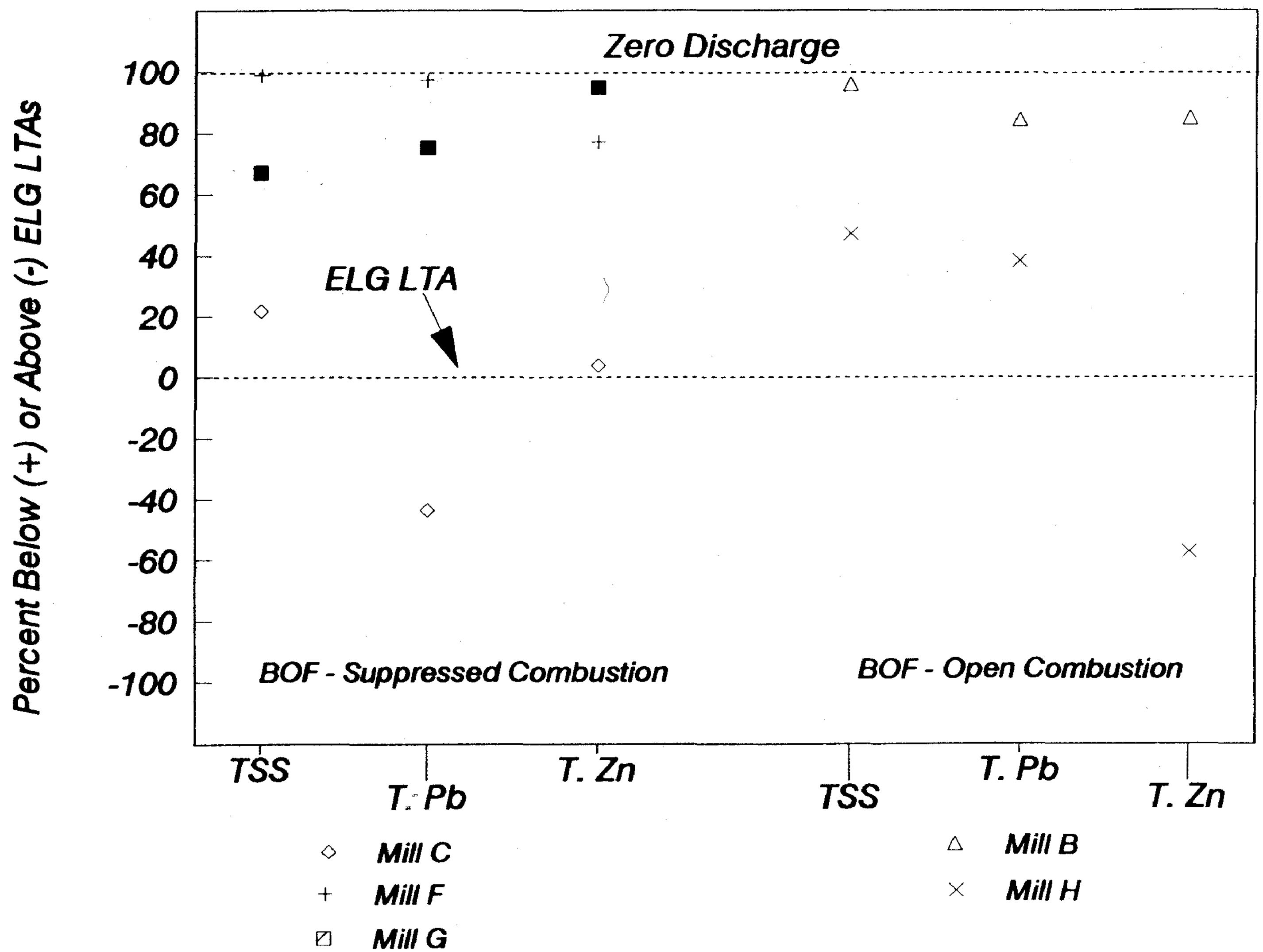


Figure 4-5

Mill Performance vs Effluent Limitations Guidelines

Vacuum Degassing - Long Term Average Data

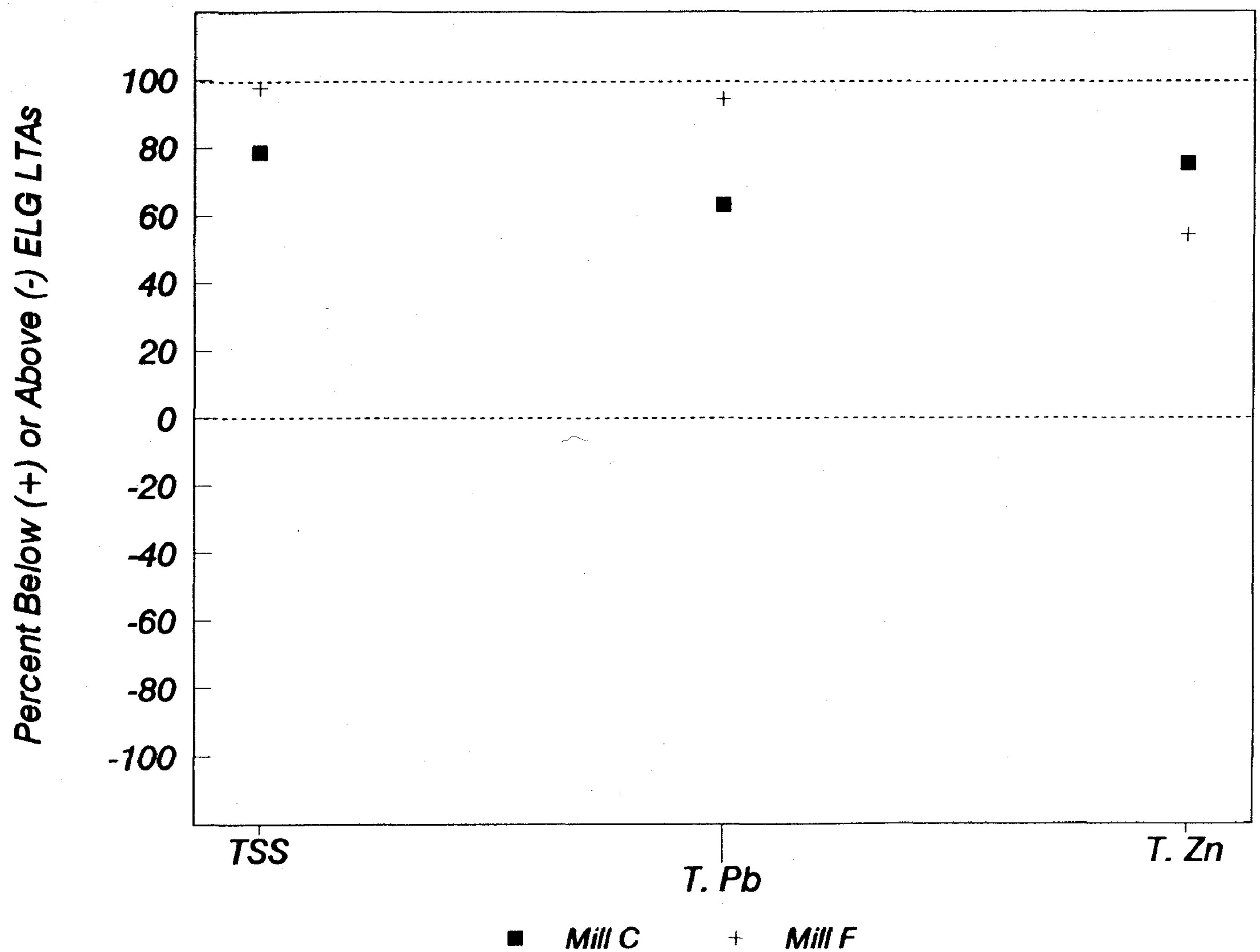


Figure 4-6

Mill Performance vs Effluent Limitations Guidelines

Continuous Casting - Long Term Average Data

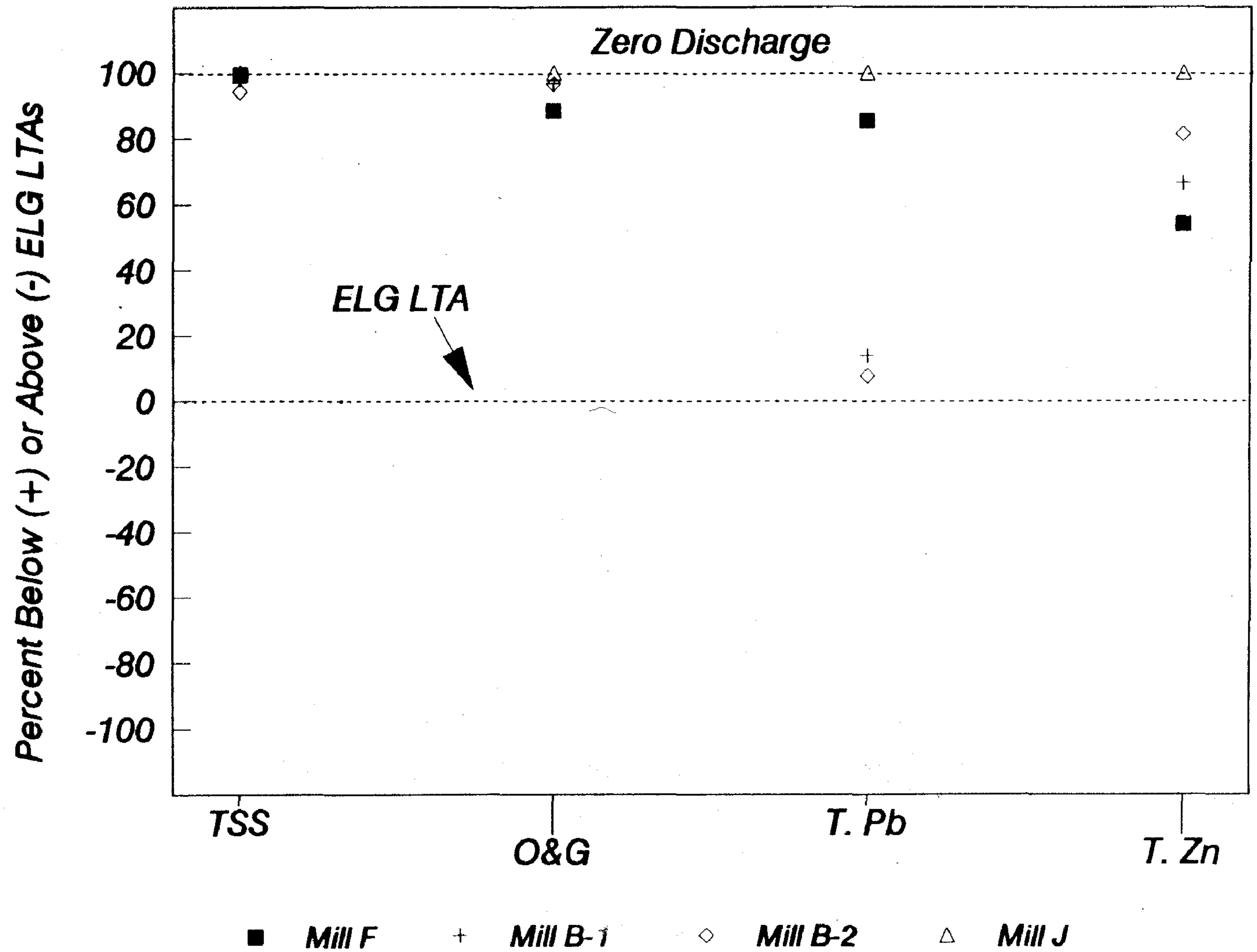
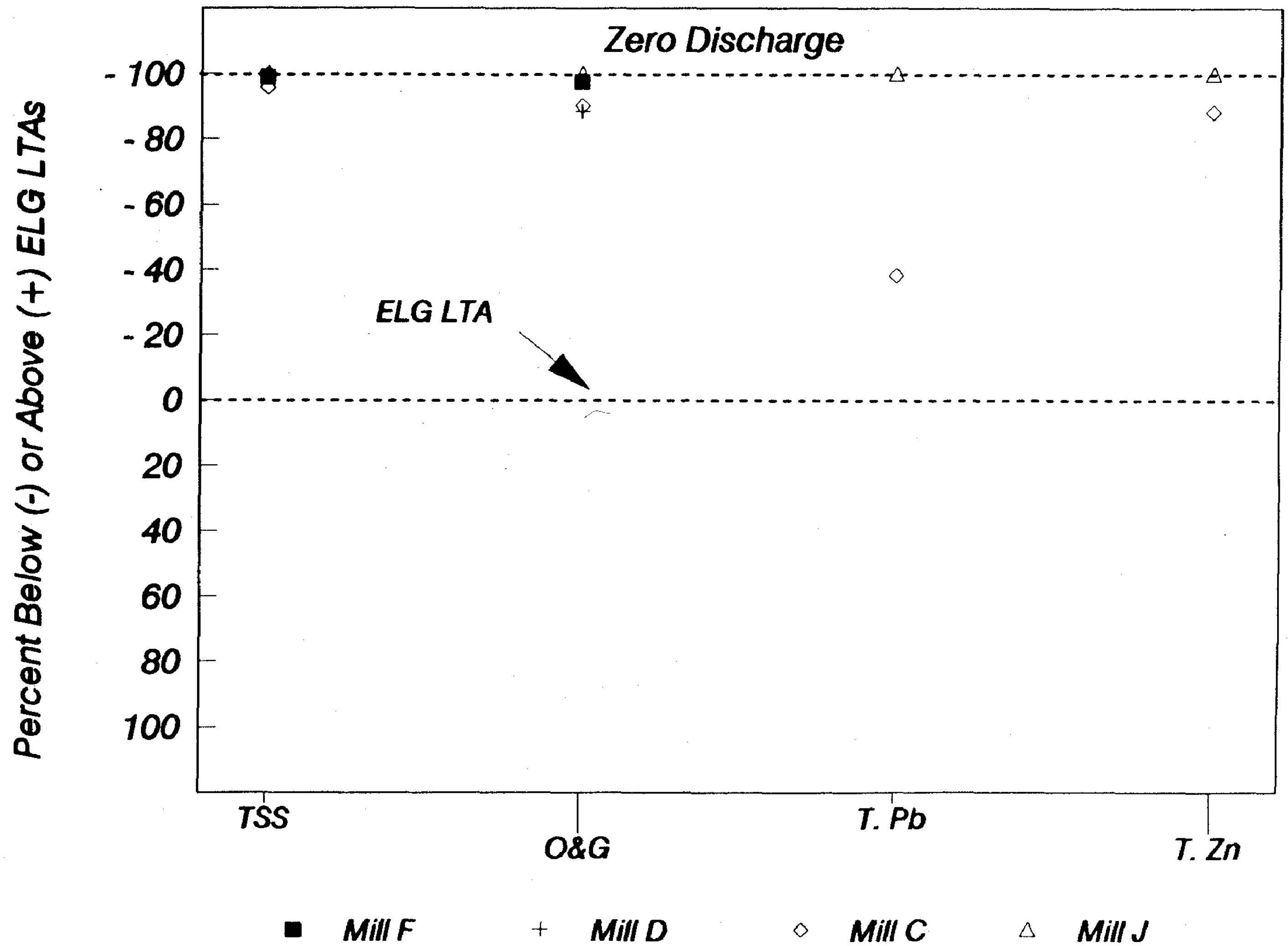


Figure 4-7

Mill Performance vs Effluent Limitations Guidelines

Hot Strip Mill: Long-Term Average Data



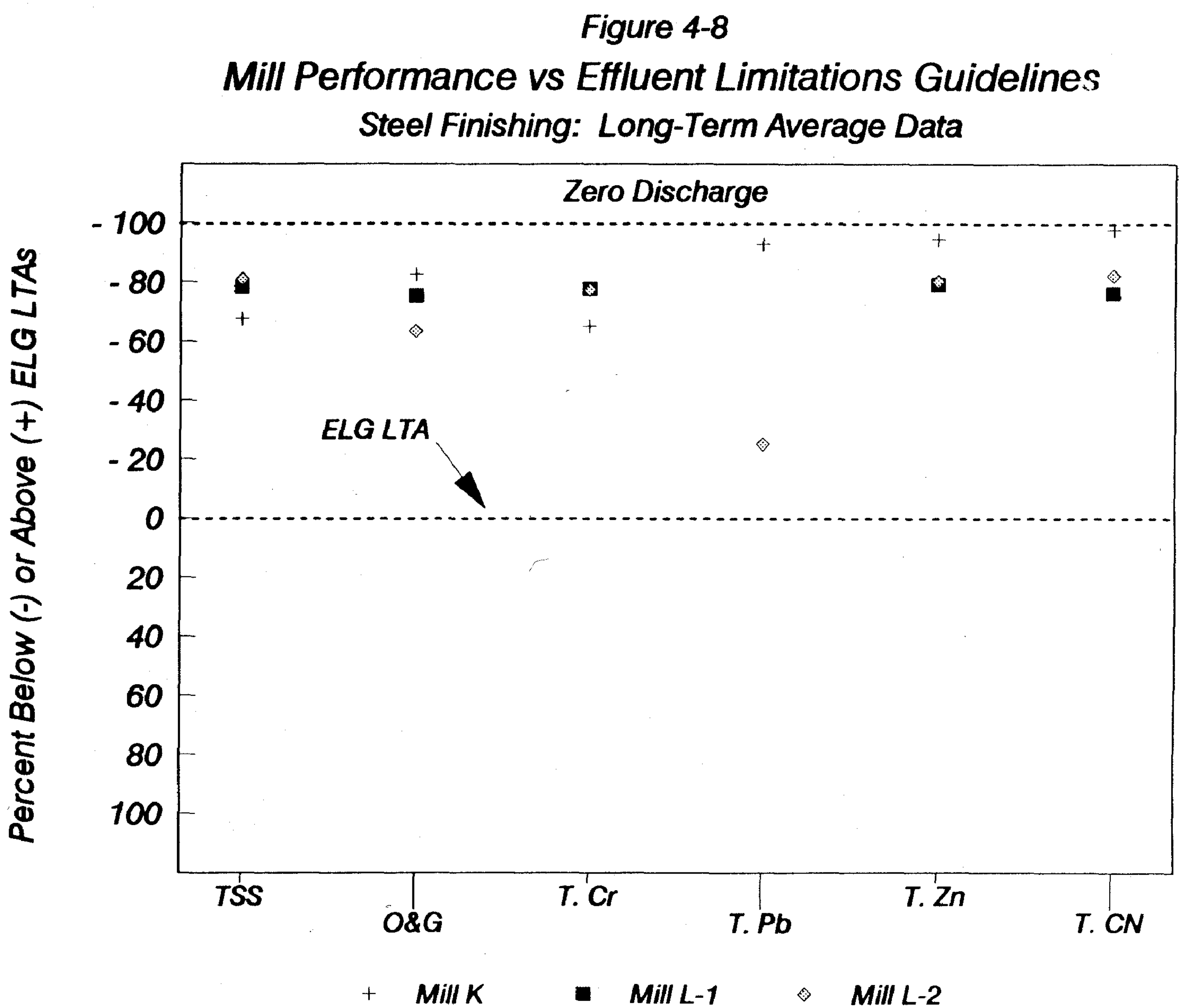


Figure 4-8
Mill Performance vs Effluent Limitations Guidelines
Steel Finishing: Long-Term Average Data
Zero Discharge
ELG LTA
Percent Below (-) or Above (+) ELG LTAs
- 100
- 80
- 60
- 40
- 20
0
20
40
60
80
100
TSS
O&G
T. Cr
T. Pb
T. Zn
T. CN
Mill K
Mill L-1
Mill L-2

Figure 4-9

Metal Finishing vs Steel Finishing Performance

Comparison of LTA Treated Effluent Concentrations