

## New environmental guidelines for IFC projects

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### Introduction

The International Finance Corporation (IFC)—the private sector investment arm of the World Bank—and the World Bank<sup>1</sup> use environmental guidelines when financing projects in developing countries. Guidelines were written in 1982-'83 and published in 1984, and were republished in 1988 but with no substantial changes. Other guidelines were written by IFC in the early '90s because by that point in time IFC felt that the 1984/88 guidelines were out-of-date and did not meet the needs of the private sector projects in which it was investing—essentially the 1984/88 guidelines were based on late '70s and early '80s production and environmental control technologies, and reflected the command-and-control regulatory approach. A commitment was made in 1993 to start the process of writing new environmental guidelines that would eventually replace both the 1988 guidelines which are still used by the Bank, and the series of guidelines that IFC had written for its projects, and which continue to be used by IFC. When completed, the new guidelines will apply to all operations of the World Bank Group.

### Methodology Used in Developing the Guidelines

The guidelines specify the maximum emission values for new projects that are financed by the World Bank Group. In developing these maximum emission levels it was agreed that the following factors would be considered: the protection of human health; acceptable mass loadings to the environment; the use of commercially available/proven technologies (production and control); regulatory trends; cost effectiveness of pollution prevention and control systems; and the use of Good Industrial Practices. Brief comments on each of these follow:

- **The Protection of Human Health:** The guidelines are designed to protect human health to the extent that current technology allows. In some cases emissions levels selected for the guidelines were derived by back-calculating from target ambient

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<sup>1</sup> The World Bank consists of the International Bank for Reconstruction and Development (IBRD) and the International Development Agency (IDA), however IBRD is commonly referred to as the World Bank or the Bank. IBRD, IDA, IFC and MIGA (the Multilateral Investment Guarantee Agency) together constitute the World Bank Group.

levels recommended by internationally recognized organizations such as the World Health Organization (WHO). Extensive literature on Good Industrial Practice was reviewed to determine maximum emission levels which are considered acceptable to protect human health. In addition, it was recognized that site-specific conditions may warrant a lowering of the maximum emission numbers in order to protect human health—the environmental assessment for the project would address this situation. In cases where short term exposure is of concern, the guidelines recommend actions that can be taken. For example, short term effects from sulfur dioxide might be controlled by the burning of cleaner fuel at a power plant.

- **Acceptable Levels of Mass Loadings to the Environment:** The World Health Organization's publication "Management and Control of the Environment", the US EPA's "Compilation of Air Pollutants Emissions Factors (AP-42)", the European Union's "Atmospheric Emission Inventory Guidebook", and other sources were used to develop an emissions inventory of the major pollutants of concern. The guidelines stress good environmental management programs which, at a minimum, will maintain loading rates in the air and water sheds below the removal rates for these major pollutants.
- **Commercially Proven Technologies:** The guidelines recommend production and control technologies which are commercially available, which are resource and energy efficient, and which minimize the type and quantity of pollutants generated. In situations where pollutant release levels are greater than acceptable health based levels then best demonstrated technology may be required.
- **Current Regulatory Trends:** In developing the guidelines the regulatory trends of OECD member countries and developing countries were reviewed to determine levels of pollutant releases in air emissions, liquid effluents, and solid/hazardous wastes which are considered acceptable by these regulators.
- **Cost Effectiveness:** Pollution prevention and control systems were reviewed to determine levels of control which promote productivity and optimize resource utilization to achieve sustainable development. Pollution prevention is stressed in the guidelines as a means of cost-effective environmental management.
- **Good Industrial Practices:** For each of the industrial sectors covered in the guidelines, documents from several organizations were reviewed to determine those Good Industrial Practices which prevent pollution and which promote energy efficiency.

### **Who Will Use the Guidelines?**

At the outset, the guidelines were intended to inform the staff of the World Bank Group, and consultants to the Bank, what level of emissions and discharges are acceptable for new projects. This is still the primary audience. However, interest in the guidelines from outside

the World Bank Group has surfaced and has grown dramatically during the time of their preparation. It is now the case that the following stakeholders have indicated interest in referring to the guidelines:

- Other multilateral financial institutions (e.g. Asian Development Bank, African Development Bank)
- Commercial banks and on-lending institutions
- Industry associations
- Equipment manufacturers and suppliers

Representatives of the NGO community have commented that the guidelines are expected to draw a global audience. Moreover, developing countries that may be in the process of establishing, or improving on, their own regulatory requirements are expected to consider the requirements of the Bank's guidelines. With the global interest in the guidelines the Bank is perceived to be assuming leadership in establishing emission requirements for projects in developing countries.

### **The Pollution Prevention and Abatement Handbook**

The industry specific guidelines are included in a forthcoming Bank publication—the Pollution Prevention and Abatement Handbook. This Handbook has three parts:

- **Part I—Pollution Management: Key Policy Issues:** This part is aimed at government decision makers and other policy makers in developing countries. It will guide decision makers in adopting appropriate policies by providing lessons learned from previous development experience. It outlines the incentives needed to promote pollution prevention and control with greater emphasis on pollution and adoption of Good Industrial Practices which in turn lead to sound environmental management.
- **Part II—Implementing Policies in Practice:** Part II identifies the basics of good environmental management, including the use of indicators for pollution management, implementing the environmental assessment process, and use of sound environmental standards. A methodology for setting the right priorities is also presented. Other subjects covered include air, water, and solid/hazardous waste management, environmental audits and monitoring, global and transboundary environmental issues, and financial incentives/disincentives needed to promote good environmental management.
- **Part III—Project Requirements:** Part III focuses on the requirements for industrial projects financed by the World Bank Group. This part of the Handbook includes discussions of the characteristics of major pollutants and their environmental and health effects, as well as technologies for their control. Included are papers on sulfur

oxides, nitrogen oxides, particulate matter, arsenic, cadmium, lead, mercury and ground level ozone. And finally, Part III contains the Industry Sector Guidelines.

A table of contents for the Handbook is attached.

### **A Typical Industry Sector Guideline**

An attempt was made to include in each industry sector guideline contained in Part III of the Handbook sections on: industry description, waste characteristics, pollution prevention and control measures, pollution reduction targets, emissions requirements, monitoring and reporting requirements, and key issues. Not every guideline includes every one of these sections. A description of the contents of each section follows:

- **Industry Description and Practices:** The major manufacturing processes and the energy consumption associated with each of the processes are described in this section. If there are processes which increase productivity and energy efficiency together with minimizing environmental impacts, then these are recommended. Raw materials used in the process and manufactured products are discussed to assist in evaluating the processes for their potential environmental impacts.
- **Waste Characteristics:** Here the major pollutants associated with the manufacturing process, their range of concentrations, and their loading levels in air emissions, liquid effluents, and solid/hazardous wastes are described. Information on the quantities of wastewater and solid/hazardous waste generated together with the quantity of pollutant per unit of output are presented for the major processes.
- **Pollution Prevention and Control:** Measures which reduce or eliminate pollutant loads are described in this section—these are measures that, if implemented, minimize pollutants at source.
- **Target Pollution Loads:** The levels achievable through adopting pollution prevention and control measures and Good Industrial Practices are specified. management would be able to achieve these before the addition of any add-on pollution control devices or treatment systems. In some cases one can argue, for example, that a fabric filter for capturing particulate matter is part of the process or is an add-on pollution control device. In cement production a fabric filter would be argued as part of the process in order to capture valuable product that would otherwise be lost, rather than a pollution control device.
- **Emissions Guidelines:** Although this section has “guidelines” in its title the Bank requires projects to discharge not more than the maximum values given in this section of each guideline unless an environmental assessment fully justifies a variance from the values and the variance(s) is/are approved by Bank management. Values are normally expressed as concentrations to facilitate monitoring and in many of the guidelines these concentrations are accompanied with values expressed as units of

pollutant per unit of production. These maximum values are based on the level of pollutant reduction that is achievable through inclusion of cleaner production processes and appropriate pollution prevention and control technologies.

- **Monitoring and Reporting:** The frequency of sampling for each parameter is specified—sampling and testing methodologies are not included here since a separate document elsewhere in the Handbook addresses this. Reporting requirements are also specified in this section of the guideline.
- **Key Issues:** This section captures the key points and recommendations that are embedded in the various sections of the guideline—adopting these will help management meet the requirements of the guideline.

One of the new guidelines (Iron and Steel Manufacturing) has been attached to this paper to illustrate the content of the above described sections.

### **Status of the Handbook and the Guidelines**

IFC and Bank staff have agreed that the Handbook will be a “living” document. As such, other guidelines will be added from time-to-time. At present about 35 industry sector guidelines have reached final draft stage, although it is expected that additional comments will be received after its release to the public and these comments will be reviewed for their potential inclusion. An additional 15 guidelines are in various stages of drafting and are expected to reach final draft status by mid-June, 1997. The Handbook will be available for wide distribution by the first of July. There are also plans to eventually make the complete Handbook available through the Internet.

### **Use of the Guidelines by IFC**

As stated earlier, IFC is the private sector investment arm of the World Bank Group. When considering a loan to a private sector project or investment in a project in a developing country, IFC uses four criteria for making an investment: (1) the project must be in the private sector and it must be profitable; (2) the project must contribute to the national economy; (3) the project must be technically feasible; and (4) the project must be environmentally sound.

IFC’s Environment Division staff review the project for environmental issues, including the results of the environmental assessment, and approve the project when they are satisfied that environmental issues are being appropriately addressed. The industry sector guidelines in the Handbook are critical to IFC’s involvement in a project—the legal agreement between IFC and the project sponsor will specify that the project must meet the maximum emissions numbers in the guideline, and exceptions or variations to these numbers would only be made in rare and compelling circumstances and on approval by IFC’s management.

IFC further requires that project sponsors provide to IFC an annual performance report summarizing emissions information. As well, IFC monitors the environmental performance of

its investments through visits to the project site—large heavy industry projects might warrant an annual visit while smaller less polluting projects might warrant a supervision/monitoring visit from an IFC environmental specialist on a less frequent basis, perhaps once every two years. The guidelines and the maximum emission values are criteria that the environmental specialist would refer to during his/her visit.

### **In Closing**

Industry is moving forward with inclusion of cleaner production processes that use less resources, that are energy efficient, and that emit fewer pollutants. As well, new management practices such as those found in ISO 14000 are quickly falling into place, including in projects in developing countries. Older World Bank Group environmental guidelines were based on late 1970s and early 1980s production and control technologies and the command-and-control approach. The new guidelines are justified and timely and are based on a sound approach. This approach has been described and includes: recommending cleaner production processes and pollution prevention methods which minimize pollutants at source and which are energy efficient, coupled with, as necessary, additional treatment and control systems to meet specified maximum emission levels that are attainable and which take into account the impact on human health and the environment.

IFC believes that the pollution prevention approach taken in developing the guidelines is correct for its investments. A recent case study by IFC confirmed this—a heavily polluting cement plant was modernized with IFC investment to substantially reduce the discharge of air emissions and IFC followed up with a study of the benefits of the modernization. The results are published in: “Cost Benefit Analysis of Private Sector Environmental Investments—A Case Study of the Kunda Cement Plant”. Here is a summary of the findings:

- The investment to reduce air pollution resulted in significant net economic benefits—the economic rate of return has been calculated at 24.7%, and sensitivity analysis confirmed that even if benefits are significantly reduced the economic rate of return is more than 16%.
- The significant environmental benefits that were identified include:
  - reduced global effects of SO<sub>x</sub> and NO<sub>x</sub> emissions
  - better health and health-related costs
  - reduced soiling and material damage
  - increased tourism income
  - greater real estate values
  - increased forestry and agricultural yields

The advantages and benefits of pollution prevention are clear in this example. It is interesting to note that the approach taken in the study and the findings that came out of the study have many applications in the private sector. They include: (a) improved project investment analysis; (b) clearer demonstration of the development impact of environmental investments; (c) help in developing investment plans, by estimating the returns to specific environmental

investments; (d) improved corporate image and public relations; and (e) higher environmental awareness.

IFC identified as well that an environmental cost-benefit analysis can also help public policy makers with respect to: (a) funding investments; (b) providing incentives; (c) justifying environmental regulations; and (d) establishing penalties for non-compliance of regulations.

IFC's environmental staff have been a full partner with the Bank's environmental staff in developing the guidelines. The guidelines respond to IFC's project needs and will be used by IFC as they are released—expected to be in mid 1997.

**Appendix 1**  
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**SUMMARY OF ENVIRONMENTAL GUIDELINES/CHARTERS OF INDUSTRY ASSOCIATIONS****GLOSSARY**



## Pollution Prevention and Abatement Handbook - Part III

# Iron and Steel Manufacturing

### Industry Description and Practices

Steel is manufactured by reducing iron ore using an integrated steel manufacturing process or a direct reduction process. In the conventional integrated steel manufacturing process, the pig iron from the blast furnace is converted to steel in the basic oxygen furnace (BOF). Steel can also be made in an electric arc furnace (EAF) from scrap steel and in some cases, from direct reduced iron. BOF is typically used in high tonnage production of carbon steels, while EAF is used to produce carbon steels and low tonnage specialty steels. An emerging technology, direct steel manufacturing, produces steel directly from iron ore. **This document only addresses integrated iron and steel manufacturing; a separate document on mini mills addresses the electric arc steel process and steel finishing processes. Steel manufacturing and finishing processes which are discussed in the document on Mini Steel Mills are also employed at integrated steel plants.** The manufacturing of coke is also dealt within a separate document.

When making steel using a BOF, coke making and iron making precede steel making; these steps are not necessary with an EAF. Pig iron is manufactured from sintered, pelletized, or lump iron ores using coke and limestone in a blast furnace. It is then fed to a BOF in molten form along with scrap metal, fluxes, alloys and high-purity oxygen to manufacture steel. In some integrated steel mills, sintering (heating without melting) is used to agglomerate fines so as to recycle iron-rich material, such as mill scale.

### Waste Characteristics

Sintering operations can emit significant dust levels of about 20 kg/ton of steel. Pelletizing operations can emit dust levels of about 15 kg/t of steel. Air emissions from pig iron manufacturing in a blast furnace include: particulate matter (PM - ranging from less than 10 to 40 kg/t of steel manufactured), sulfur oxides (SO<sub>x</sub> - which are mostly from sintering or pelletizing operations) (1.5 kg/ton of steel), nitrogen oxides (NO<sub>x</sub> - which are mainly from sintering and heating) (0.5 kg/ton of steel), hydrocarbons, carbon monoxide, in some cases, dioxins (mostly from sintering operations), and hydrogen fluoride.

Air emissions from steel manufacturing using BOF may include PM (ranging from less than 15 to 30 kg/ton of steel), chromium (0.8 mg/Nm<sup>3</sup>), cadmium (0.08 mg/Nm<sup>3</sup>), lead (0.02 mg/Nm<sup>3</sup>), and nickel (0.3 mg/Nm<sup>3</sup>). In the desulfurization step between the blast furnace and the BOF, the particulate matter emissions are about 10 kg/ton of steel manufactured.

In the conventional process without recirculation, waste waters (including those from cooling operations) are generated at an average rate of 80 m<sup>3</sup> per ton of steel manufactured. Major pollutants present in untreated waste waters generated from pig iron manufacture include total organic carbon (typically 100 to 200 mg/l), total suspended solids (7,000 mg/l), dissolved solids, cyanide (15 mg/l), fluoride (1,000 mg/l), COD (500 mg/l), and zinc (35 mg/l).

Major pollutants in waste waters generated from steel manufacturing using the BOF include total suspended solids (up to 4,000 mg/l), lead (8 mg/l), chromium (5 mg/l), cadmium (0.4 mg/l), zinc (14 mg/l), fluoride

(20 mg/l), and oil and grease. The process generates effluents with high temperatures.

Process solid waste from the conventional process, including furnace slag and collected dust, is generated at an average ranging from 300 to 500 kg per ton of steel manufactured, of which 30 kg may be considered hazardous based on the concentration of heavy metals present.

### Pollution Prevention and Control

Where technically and economically feasible, direct reduction of iron ore for the manufacture of iron and steel is preferred because it does not require coke manufacturing and because it has fewer environmental impacts. Wherever feasible, pelletizing should be preferred over sintering for the agglomeration of iron ore. The following pollution prevention measures should be considered:

#### *Pig Iron Manufacturing*

- Improve the blast furnace efficiency by using coal and other fuels (such as oil or gas) for heating instead of coke thereby minimizing coke guidelines.
- Recover thermal energy of the blast furnace off-gas before using it as fuel.
- Increase fuel efficiency and reduce emissions by improving blast furnace charge distribution.
- Improve productivity through screening of the charge and better tap-hole practices.
- Take action to reduce dust emissions at furnaces, such as covering iron runners when tapping the blast furnace, using nitrogen blankets during tapping.
- Use pneumatic transport, enclosed conveyor belts, or self-closing conveyor belts, wind barriers, and other dust suppression measures to reduce the formation of fugitive dust.
- Use low NO<sub>x</sub> burners to reduce NO<sub>x</sub> emissions from burning fuel in ancillary operations.
- Recycle iron-rich materials such as iron ore fines, pollution control dust, and scale *sintering* in a sinter plant.
- Recover energy from sinter coolers.

- Use dry sulfur oxide removal systems (such as carbon absorption for sinter plants or lime spraying in flue gases).

#### *Steel Manufacturing*

- Use dry dust collection and removal systems to avoid the generation of wastewater.
- Use BOF gas as fuel.
- Use doghouse enclosures for BOF.

#### *Other*

Use blast furnace slag in construction materials.

### Target Pollution Loads

The recommended pollution prevention and control measures can achieve the following target levels:

#### *Liquid Effluents*

Over ninety percent of the wastewater generated can be reused. Discharged waste waters should in all cases be less than 5 m<sup>3</sup> per ton of steel manufactured and preferably less than 1 m<sup>3</sup> per ton.

#### *Solid Wastes*

Blast furnace slag should be normally generated at a rate less than 320 kg/ton iron. Slag generation rates from BOF should be between 70 and 170 kg/t of steel manufactured but this will depend on the impurity content of feed materials. Approximately, 65 percent of BOF slag from steel manufacturing can be recycled in various industries such as building materials. Zinc recovery may be feasible for collected dust.

### Treatment Technologies

#### *Air Emissions*

Air emission control technologies for the removal of particulate matter include scrubbers (or semidry system), baghouses, and ESPs; the latter two technologies can achieve 99.9 percent removal efficiencies for the PM and associated toxic metals.

Sulfur oxides are removed with scrubbers with a 90 percent or better removal efficiency. However, the use of low sulfur fuels and low sulfur ores may be more cost-effective.

The acceptable levels of nitrogen oxides can be achieved by using low NO<sub>x</sub> burners and other combustion modifications.

For iron and steel manufacturing, the following emissions levels should be achieved:

#### Load Targets per Unit of Production

Parameter	Maximum value
Particulate matter (PM <sub>10</sub> )	100 g/t of product (blast furnace, basic oxygen furnace), and 300 g/t from sintering process
Sulfur oxides (SO <sub>x</sub> )	1,200 g/t (500 mg/Nm <sup>3</sup> ) (for sintering)
Nitrogen oxides (NO <sub>x</sub> )	500 g/t (200 mg/Nm <sup>3</sup> )
Fluoride	1.5 g/t (5 mg/Nm <sup>3</sup> )

#### Wastewater Treatment

Wastewater treatment systems typically include sedimentation to remove suspended solids, physical/chemical treatment such as pH adjustment to precipitate heavy metals, and filtration.

The following target levels can be achieved for steel making processes:

#### Target Load per Unit of Production

Parameter	Blast Furnace	BOF
Wastewater	0.1 m <sup>3</sup> /t steel	0.5 m <sup>3</sup> /t steel
Zinc	0.6 g/t	3 g/t
Lead	0.15 g/t	0.75g/t
Cadmium	0.08 g/t	N/A

N/A = Not applicable.

#### Solid Waste Treatment

Solid wastes containing heavy metals may have to be stabilized using chemical agents before disposal.

#### Emission Guidelines

Emission levels for the design and operation of each project must be established through the Environmental Assessment (EA) process, based on country legislation and the *Pollution Prevention and Abatement Handbook* as applied to local conditions.<sup>1</sup> The emission levels selected must be justified in the EA and acceptable to the World Bank Group.

The following guidelines present emission levels normally acceptable to the World Bank Group in making decisions regarding provision of World Bank Group assistance; any deviations from these levels must be described in the World Bank Group project documentation.

The guidelines are expressed as concentrations to facilitate monitoring. Dilution of air emissions or effluents to achieve these guidelines is unacceptable.

All of the maximum levels should be achieved for at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.

#### Air Emissions

For integrated iron and steel manufacturing plants, the following emission levels should be achieved:

#### Air Emissions from Integrated Iron and Steel Manufacturing

Parameter	Maximum value
Particulate matter (PM)	50 mg/Nm <sup>3</sup>
Sulfur oxides (SO <sub>x</sub> )	500 mg/Nm <sup>3</sup> (sintering)
Nitrogen oxides (NO <sub>x</sub> )	750 mg/ Nm <sup>3</sup>
Fluorides	5 mg/Nm <sup>3</sup>

#### Liquid Effluents

The following effluent levels should be achieved:

<sup>1</sup> For reference, see the Tables in the Statement of Principles (first section of Part III of the Handbook).

### Effluents from the Integrated Iron and Steel Manufacturing

Parameter	Maximum value
pH	6 - 9
Total suspended solids	50 mg/l
Oil and grease	10 mg/l
COD	250 mg/l
Phenol	0.5 mg/l
Cadmium	0.1 mg/l
Chromium (total)	0.5 mg/l
Lead	0.2 mg/l
Mercury	0.01 mg/l
Zinc	2 mg/l
Cyanides (free)	0.1 mg/l
Cyanides (total)	1 mg/l
Temperature increase	less than or equal to 3°C <sup>1</sup>

<sup>1</sup> The effluent should result in a temperature increase of no more than 3 degrees Celsius at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters from the point of discharge

Note: Effluent requirements are for direct discharge to surface waters. Discharge to an **offsite wastewater treatment plant** should meet applicable pretreatment requirements.

#### Sludges

Sludges should be disposed of in a secure landfill after the stabilization of heavy metals to ensure that heavy metal concentration in the leachates do not exceed the levels presented for liquid effluents.

#### Ambient Noise

Noise abatement measures should achieve the following levels, measured at noise receptors located outside the project property boundary, with an increase in existing ambient level of  $L_{dn}$  10 dB(A) or less where background levels are less than  $L_{dn}$  55 dB(A), and with an increase in existing level of  $L_{dn}$  3 dB(A) or less where background levels are above  $L_{dn}$  55 dB(A).

#### Ambient Noise

Receptor	Maximum dB(A)
Residential; institutional; educational	$L_{dn}$ 55
Industrial; commercial	$L_{eq}$ (24) 70

The emission requirements given here can be consistently achieved by well-designed, well-operated and well-maintained pollution control systems.

#### Monitoring and Reporting

Air emissions should be monitored continuously after the air pollution control device for particulate matter on (or alternatively opacity level of less than 10 percent) and annually for sulfur oxides, nitrogen oxides (with regular monitoring of sulfur in the ores), and fluoride. Wastewater discharges should be monitored daily for the listed parameters, except for metals, which should be monitored at least on a quarterly basis. Frequent sampling may be required during start-up and upset conditions.

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be kept in an acceptable format. These should be reported to the responsible authorities and relevant parties, as required.

#### Key Issues

The following box summarizes the key production and control practices that will lead to compliance with emissions guidelines:

- Prefer direct steel manufacturing process where technically and economically feasible.
- Use pelletized feed instead of sintered feed where appropriate.
- Substitute a portion of the coke used in the blast furnace by injecting pulverized coal or by using natural gas, or oil.
- Achieve high energy efficiency by using blast furnace and basic oxygen furnace off-gas as fuels.
- Implement measures (such as encapsulation) to reduce the formation of dust (including iron oxide dust) and where possible, recycle collected dust to a sintering plant.
- Recirculate waste waters. Use dry air pollution control systems where feasible. Otherwise treat waste waters.
- Use slag in construction materials to the extent feasible.

### Further Information

The following are suggested as sources of additional information (these sources are provided for guidance and are not intended to be comprehensive):

British Steel Consultants. 1993. Research Study, International Steel Industry. Prepared for the International Finance Corporation.

The Government of The Netherlands. 1991. "Progress Report on the Study of the Primary Iron and Steel Industry." Third Meeting of the Working Group on Industrial Sectors. Stockholm: January 22-24.

Paris Commission. 1991. *Secondary Iron and Steel Production An Overview of Technologies and Emission Standards Used in the PARCOM Countries.*

World Bank. Environment Department. 1996. "Pollution Prevention and Abatement: Iron and Steel Manufacturing". Technical Background Document.