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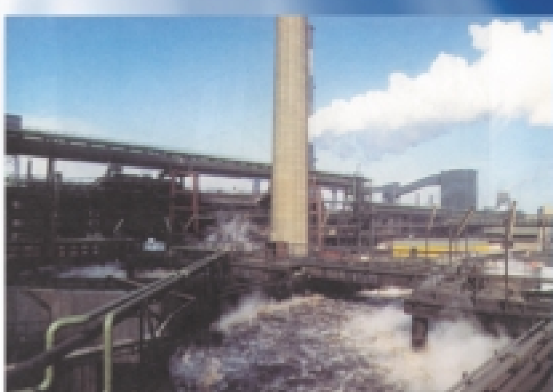
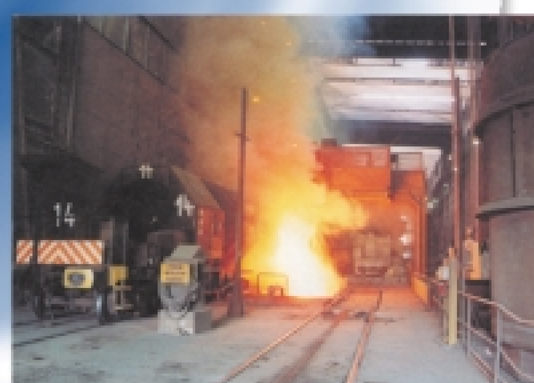
Environmental Code of Practice for Integrated Steel Mills

CEPA 1999 Code of Practice





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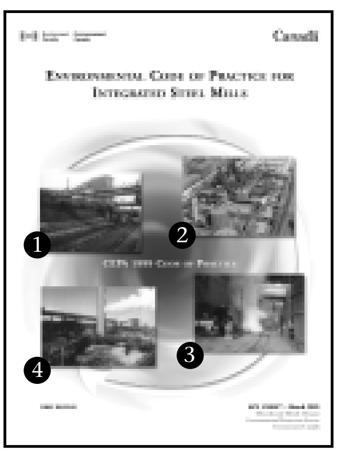

1) Coke oven battery
2) Aerial view of blast furnaces with slag pits and gas holders in foreground
3) Case study of improving emissions from a hot metal torpedo ladle with CO_2 blanketing
4) Water treatment facilities

READERS' COMMENTS

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ABSTRACT

This Environmental Code of Practice for Integrated Steel Mills outlines environmental concerns associated with the integrated mills segment of the steel manufacturing sector and advances recommendations aimed at preserving and enhancing the quality of the environment that is affected by these mills. Environmental performance standards are included for atmospheric emissions, water and wastewater, wastes, and environmental management practices. These recommended practices may be used by the steel sector, regulatory agencies, and the general public as sources of technical and policy guidance but do not negate any regulatory requirements.

The Code identifies minimum environmental performance standards for new integrated steel mills and provides a set of environmental performance goals that existing mills can strive to achieve through continual improvement over time.

More information on steel manufacturing sector is available on Environment Canada's Green Lane at www.ec.gc.ca/nopp/metals/index.cfm .

Résumé

Ce code de pratiques écologiques se rapportant aux aciéries intégrées expose les préoccupations environnementales liées au segment des aciéries intégrées du secteur de la fabrication de l'acier et formule des recommandations visant à préserver et à améliorer les milieux naturels sur lesquels ces aciéries produisent des effets. De plus, il présente des normes de performance environnementale concernant les émissions atmosphériques, les ressources en eau, les eaux usées et les matières solides, ainsi que des pratiques de gestion de l'environnement. Ces pratiques recommandées peuvent être utilisées par l'industrie sidérurgique, des organismes de réglementation et le grand public en tant que sources d'orientation technique et stratégique, mais elles ne se substituent pas aux exigences réglementaires.

Le présent code de pratiques énonce les normes minimales de performance environnementale concernant les nouvelles aciéries intégrées; ces normes constituent un ensemble d'objectifs de performance environnementale que les aciéries existantes peuvent s'efforcer d'atteindre par l'amélioration continue de leurs procédés.

De plus amples renseignements au sujet du secteur de la fabrication de l'acier sont disponibles sur la Voie verte d'Environnement Canada au www.ec.gc.ca/nopp/metals/index.cfm .

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SUMMARY

Various substances that are released, produced, or used by the steel manufacturing sector have been declared toxic under the *Canadian Environmental Protection Act* (CEPA) (For further information: www.ec.gc.ca/CEPARegistry/the_act/). A multi-stakeholder Strategic Options Process (SOP) was launched in April 1995 to address the management of these substances. The SOP culminated in the development of a Strategic Options Report (SOR) in December 1997.

The SOR recommended among other things that Environmental Codes of Practice be developed for integrated steel mills. The integrated mills segment of the steel manufacturing sector includes all facilities that use coal and iron ore or agglomerated iron ore as raw materials to produce primary steel products. Primary steel production processes include iron sintering, cokemaking, iron and steelmaking, hot and cold forming, coating operations, and associated production processes and facilities. They do not include pipe or tube making or steel fabricating facilities. There are currently four integrated steel mills in Canada.

This Code of Practice outlines environmental concerns and alternative methods, technologies, designs, and procedures that will minimize the adverse environmental effects associated with integrated steel mills. Simplified flowsheets are presented in Figures S.1 and S.2 showing the major feeds to and environmental releases from integrated steel mills. Operational activities addressed in the Code include:

- raw materials handling and storage;
- cokemaking;
- sintering;
- ironmaking;
- steelmaking;
- continuous casting;
- hot forming;
- cold forming;
- pickling and cleaning; and
- coating.

The Code advances recommendations aimed at preserving and enhancing the quality of the environment that is affected by these mills. Environmental performance standards are included for atmospheric emissions, water and wastewater, waste management, and environmental management practices. These recommended practices may be used by the steel sector, regulatory agencies, and the general public as sources of technical and policy guidance in the development and implementation of site-specific environmental protection practices and requirements.

The overall objective of the Code is to identify minimum environmental performance standards for new integrated steel mills and to provide a set of environmental performance goals for existing mills to achieve through continual improvements over time. However, all municipal, provincial, and federal legal requirements must be met, and a commitment by companies to be consistent with Code recommendations does not remove obligations to comply with all regulatory requirements.

The Code was developed by Environment Canada in consultation with provincial environmental agencies, industry representatives, and other stakeholders. Federal, provincial, and international environmental guidelines and standards of relevance to the operation of integrated steel mills were considered in the development of Code recommendations, as were the environmental management practices recommended by various national and international organizations.

This Code of Practice will be adopted by Environment Canada and others as a guidance document that delineates appropriate environmental protection standards and practices for integrated steel mills. Some elements of the Code may be adopted under the Federal–Provincial/Territorial Environmental Harmonization Accord and associated sub-agreements such as Canada-Wide Standards. Some elements of the Code may be used in the development of initiatives or programs

to achieve the objectives of cooperative agreements including the Canada-Ontario Agreement and St. Lawrence Vision 2000.

The Code may be adopted on a voluntary basis by individual steel sector corporations and facilities and by the Canadian Steel Producers Association (CSPA) and its members. It may be included as commitment to Code recommendations in Environmental Performance Agreements among Environment Canada, provincial environment departments, and steel companies or facilities. It may also be adopted in whole or in part by regulatory agencies. CSPA members who operate integrated mills have initiated a program to monitor Polycyclic Aromatic Hydrocarbons (PAHs) and benzene emissions consistent with Code standards and audited by an independent third party.

The Code may be used for benchmarking best practices to achieve continual improvement in the environmental performance of integrated steel mills in Canada and other countries. Code recommendations may also be used as benchmark criteria for the conduct of audits aimed at assessing the environmental performance of sector facilities or companies.

A summary of the recommendations is presented in Table S.1. The full text of the recommendations, presented in Section 4, should be consulted for details.

Figure S.1 Coke and Iron Production Simplified Flowsheet

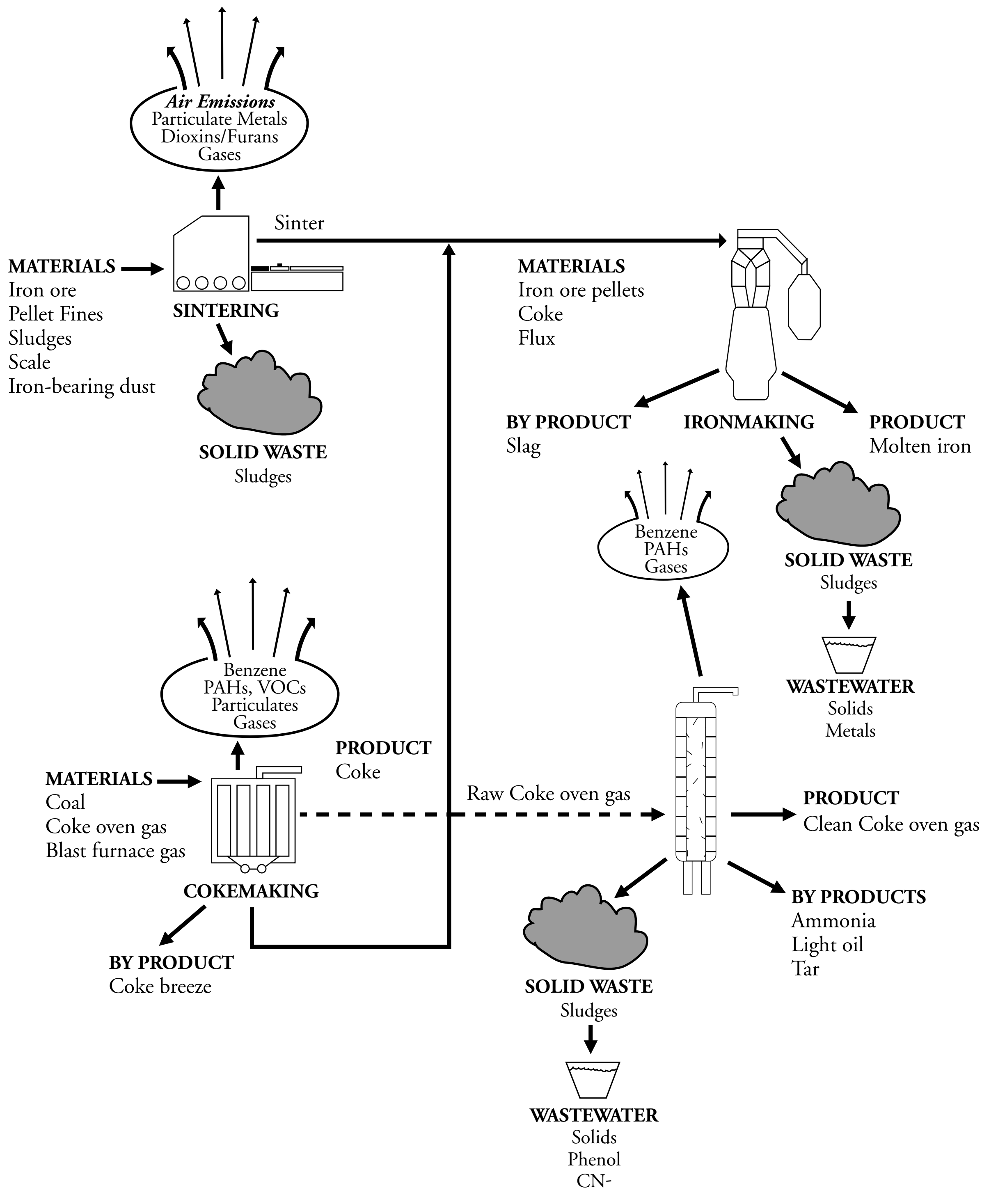


Figure S.2 Integrated Plant Steelmaking Simplified Flowsheet

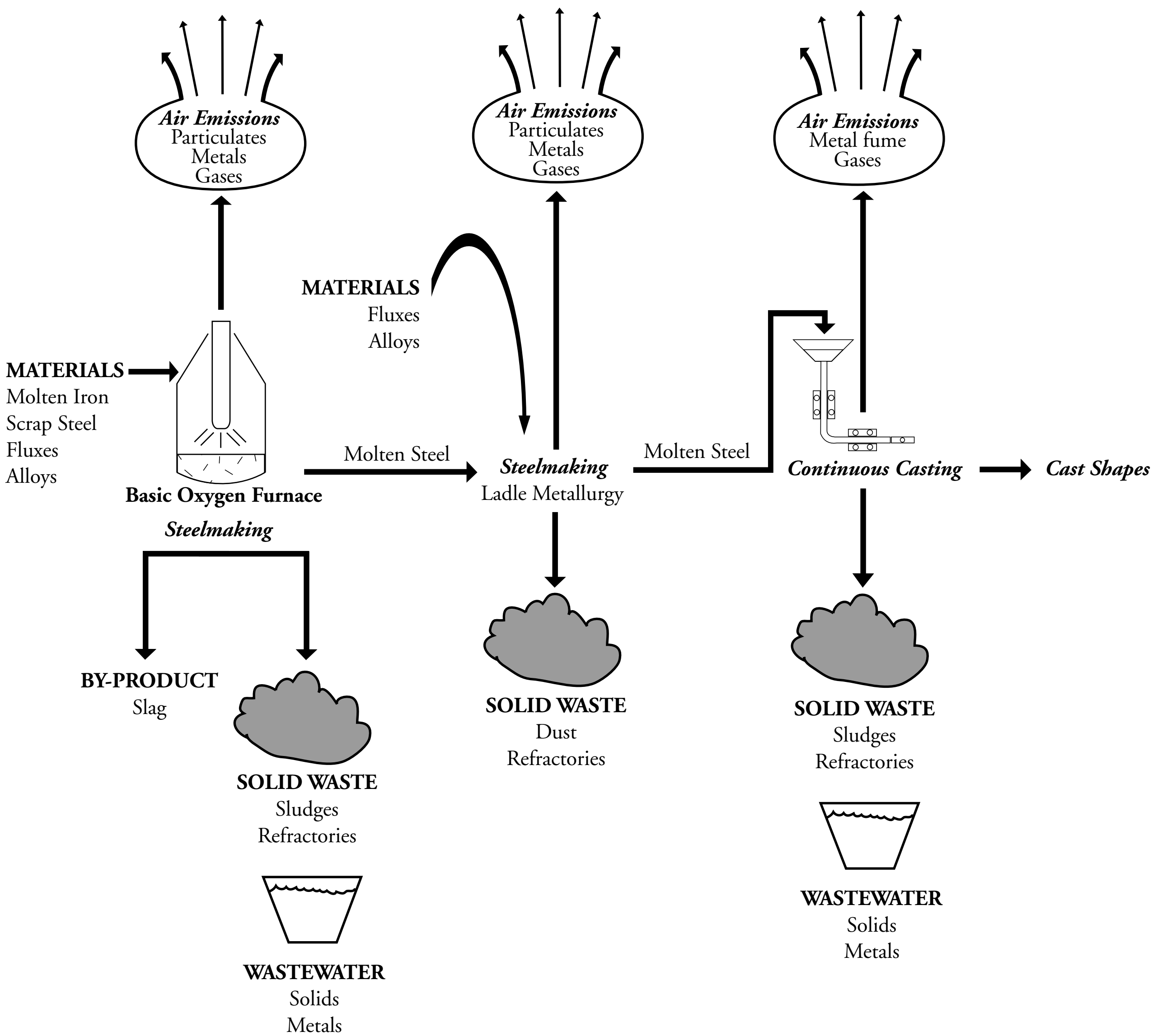


Table S.1 Summary of Recommendations

Number	Subject	Summary of Recommendation
Atmospheric Emission Management		
RI101	Targets and Schedules for Release Reductions of PAHs and Benzene	**PAH releases from coke ovens and coke by-product plants** should be reduced in accordance with the following: (i) to an industry production-based average of 13.2 g/tonne of coke produced in 2000; (ii) to a maximum for any coke oven battery of 9.8 g/tonne of coke produced in 2005; (iii) to a maximum for any coke oven battery of 8.2 g/tonne of coke produced in 2015 or later. **Benzene releases from coke ovens and coke by-product plants** should be reduced in accordance with the following: (i) to an industry production-based average of 120 g/tonne of coke produced in 2000; (ii) to a maximum of 71.7 g/tonne of coke produced in 2005; (iii) to a maximum of 62.7 g/tonne of coke produced in 2015 and later.
RI102	Release Guidelines for Particulate Matter	Each facility should target on achieving the following emission guidelines for particulate matter after the emission control device: (i) sinter plants: 50 mg/Nm^3; (ii) blast furnaces: 50 mg/Nm^3; (iii) basic oxygen furnaces: 50 mg/Nm^3; (iv) electric arc furnaces: 20 mg/Nm^3.
RI103	Environmental Performance Indicators	Each facility should target on limiting particulate emissions in accordance with the following: (i) sinter plants: less than 200 grams per tonne of sinter produced; (ii) blast furnaces: less than 100 grams per tonne of liquid iron produced; (iii) basic oxygen furnaces: less than 100 grams per tonne of raw steel produced; (iv) electric arc furnaces: less than 150 grams per tonne of raw steel produced.
RI104	Collection of Furnace Emissions	Adequately sized facilities should be engineered and installed, and documented operating and maintenance procedures should be developed for the collection of emissions associated with: ironmaking, primary steelmaking, and secondary steelmaking.
RI105	Control of Fugitive Emissions	Adequately sized facilities should be engineered and installed, and documented operating and maintenance procedures should be developed for the control of emissions associated with: ironmaking, primary steelmaking, and secondary steelmaking.
RI106	Solvent Degreasing	Documented procedures for the control or elimination of chlorinated solvent emissions from degreasing operations should be developed and implemented in accordance with the multi-stakeholder *Solvent Degreasing Strategic Options Report* (www.ec.gc.ca/degrease/degrease.htm) and the associated regulations that may be promulgated from time to time.

Table S.1 Summary of Recommendations (continued)

Number	Subject	Summary of Recommendation
RI107	Ambient Air Quality Monitoring	An ambient air quality monitoring program should be developed and implemented by each facility in consultation with the appropriate regulatory authorities. This program should include monitoring of particulate matter (total, PM_{10}, and $PM_{2.5}$), benzene, and PAHs, taking into account: (i) the location of emission sources under the control of the facility operator; and (ii) local meteorological conditions.
Cokemaking: Coke Ovens		
RI108	Charging Operations	Documented procedures should be developed and implemented for the control of coke oven charging operations.
RI109	Coke Oven Doors	Documented procedures should be developed and implemented for the control of emissions from coke oven doors.
RI110	Topside Port Lids	Documented procedures should be developed and implemented for the control of emissions from topside port lids.
RI111	Offtake Systems	Documented procedures should be developed and implemented for the control of emissions from offtake system(s).
RI112	Coke Pushing	Documented procedures should be developed and implemented for the control of emissions from coke pushing and coke transfer to the quench station.
RI113	Coke Wet Quenching	Documented procedures should be developed and implemented for the control of atmospheric emissions and wastewater discharges from coke quenching.
RI114	Bypass/Bleeder Stacks	Documented procedures should be developed and implemented for the control of atmospheric emissions from coke oven gas flaring.
Cokemaking: Coke By-Product Plant		
RI115	Storage Tanks	The recommendations advanced in the Canadian Council of Ministers of the Environment's (CCME's) *Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks* should be applied to light oil and wash oil storage tanks.
RI116	Fugitive Emissions	The recommendations advanced in the CCME's *Environmental Code of Practice for the Measurement and Control of Fugitive VOC Emissions from Equipment Leaks* should be followed.
RI117	Benzene Transfer Operations	A vapour collection system should be used to contain benzene vapours during the transfer of benzene-containing liquids to tank trucks or rail cars.
RI118	Process Cooling Water	All process cooling should be by the use of indirect cooling, with no water in contact with process liquids or gases unless properly treated prior to discharge.
RI119	Open Trenches and Sumps	All process trenches and sumps should be enclosed and the vapours collected for treatment.
RI120	Containment of Process Pumps and Tanks	All process pumps and tanks should be installed on impervious pads with containment dykes and drainage to wastewater treatment facilities to contain spills.

Table S.1 Summary of Recommendations (continued)

Number	Subject	Summary of Recommendation
Water and Wastewater Management		
RI121	Effluent Guidelines	All wastewater treatment facilities approved for construction and operation after the publication of this Code of Practice should be designed, constructed, and operated to achieve the following effluent quality prior to release to cooling water or to local receiving water body: **On a continuous basis:** pH 6.0–9.5 **On a monthly average basis:** Total suspended solids (TSS) 30 mg/l Chemical oxygen demand (COD) 200 mg/l Oil and grease 10 mg/l Cadmium 0.1 mg/l Chromium (total) 0.5 mg/l Lead 0.2 mg/l Mercury 0.01 mg/l Nickel (total) 0.5 mg/l Zinc 0.5 mg/l Toxicity No more than 50% mortality in 100% effluent Wastewater treatment facilities approved prior to the publication of this Code of Practice should be so operated that effluent quality is as close to satisfying the above-listed criteria as is practicably possible.
RI122	Environmental Performance Indicator	Each facility should target on limiting total suspended solids discharges from wastewater to less than 100 grams per tonne of raw steel produced.
RI123	Wastewater Collection	All wastewater streams that exceed the effluent criteria should be directed to an approved treatment facility prior to discharge.
RI124	Water Use/Reuse	Water use should be minimized through the reuse or recycling of water and the cascading of cooling water and wastewater between production processes. Facilities should target on achieving 90% reuse of water.
RI125	Wastewater Containment Sizing	Wastewater collection and containment facilities constructed after the publication of this Code of Practice should be designed to contain the maximum volume of liquid that could reasonably be expected to be in storage prior to any of the following events, and: (i) the maximum volume of wastewater that would be generated during the time required to shut down wastewater generating processes, plus 50%; (ii) 110% of the volume that could enter the containment facility in the event of a leak or spill; or (iii) the accumulated precipitation from a 50-year return period, 24-hour precipitation event that is collected in an outdoor containment (e.g. rain that falls on the open surface or inside the containment berm).
RI126	Environmental Effects Monitoring	An environmental effects monitoring program should be developed and implemented where appropriate by each facility in consultation with the appropriate regulatory authorities.

Table S.1 Summary of Recommendations (continued)

Number	Subject	Summary of Recommendation
Waste Management		
RI127	Location and Construction of Waste Disposal Sites	Expansions to existing waste disposal sites and construction of new sites should be undertaken so as to ensure that: (i) the site plan is updated to show clearly the location and dimensions of the new or expanded site; (ii) the perimeter of the disposal area is far enough away from all watercourses to prevent contamination by runoff, seepage, or fugitive emissions; (iii) the surface drainage from off-site areas is diverted around the disposal area; (iv) the expanded area is hidden from view by fences, berms, or buffer zones to the extent practicable; and (v) the beneficial uses of the site after closure have been considered.
RI128	Development of Solid Waste Disposal Sites	Solid waste disposal sites should be developed in accordance with the following practices: (i) the disposal area should be developed in modules or cells; (ii) all wastes should be so placed that they have physical and chemical stability suitable for land reuse; (iii) contouring, capping, and reclamation of cells should be undertaken throughout the operating life of the site; and (iv) all disposal sites should be reclaimed for beneficial uses before final closure.
RI129	Management of Waste Disposal Sites	All waste disposal sites should be managed in accordance with documented, site-specific waste management plans approved by the appropriate regulatory authority so that: (i) solid, liquid, and hazardous wastes are disposed of only in facilities specifically designed, approved, and operated for that purpose; (ii) access to the site is controlled and disposal activities are supervised by trained personnel; and (iii) records are maintained of the types, approximate quantities, and point of origin of the wastes.
RI130	Monitoring of Waste Disposal Sites	A groundwater monitoring program should be developed, to the extent that is feasible, for all waste disposal sites in accordance with the following guidelines: (i) a permanent system of appropriately located piezometers and wells should be provided; (ii) a program of pre-operational monitoring of groundwater regimes should be initiated; (iii) groundwater samples should be collected at least quarterly; and (iv) each groundwater sample should be analyzed for pH, total dissolved solids, and other appropriate (site-specific) parameters.
RI131	Liquid Storage and Containment	Liquid storage and containment facilities should be designed and constructed to meet the requirements of the appropriate standards, regulations, and guidelines of the pertinent regulatory agency.
RI132	Reduction, Reuse, and Recycling	Each corporate entity responsible for the operation of an integrated steel mill should develop, implement, and maintain a reduction, reuse, and recycling program.

Table S.1 Summary of Recommendations (continued)

Number	Subject	Summary of Recommendation
Best Environmental Management Practices		
RI133	Implementation of an Environmental Management System (EMS)	Each facility should develop, implement, and maintain an EMS that is consistent with the requirements of a recognized national standard such as ISO 14001.
RI134	Environmental Policy Statement	Each facility should develop and implement an environmental policy statement.
RI135	Environmental Assessment	The development of new facilities and changes to existing facilities that could significantly increase releases to the environment should be subjected to an internal environmental assessment process.
RI136	Emergency Planning	Each facility should develop and implement an Emergency Plan aimed at ensuring that facility management meet all legal requirements in developing, maintaining, exercising, and reporting emergency preparedness and resource activities.
RI137	Pollution Prevention Planning	Each facility should develop and implement a Pollution Prevention Plan aimed at avoiding or minimizing discharges to the environment.
RI138	Decommissioning Planning	Planning for decommissioning should begin in the design stage for new facilities and as early as possible in the operating stage for existing facilities. All site closures should be undertaken in accordance with the CCME's *National Guidelines for the Decommissioning of Industrial Sites*.
RI139	Environmental Training	Each facility should establish and maintain procedures to identify its environmental training needs and ensure that all personnel whose work may create a significant impact upon the environment have received appropriate training.
RI140	Environmental Facility Inspection	Each facility should develop and implement an Environmental Inspection Plan.
RI141	Monitoring and Reporting	Documented procedures for the monitoring and reporting of environmental performance data should be developed and implemented.
RI142	Environmental Auditing	Each facility should conduct periodic internal environmental audits throughout the operating life of the facility.
RI143	Environmental Performance Indicators	Each facility should develop a set of environmental performance indicators that provides an overall measure of the facility's environmental performance.
RI144	Life Cycle Management	Each corporate entity should develop and implement a Life Cycle Management (LCM) Program aimed at minimizing the environmental burdens associated with the products used and produced by its steelmaking facilities over the product life cycle.
RI145	Community Advisory Panel	Each facility should establish a Community Advisory Panel to provide a forum for the review and discussion of facility operations, environmental concerns, emergency preparedness, community involvement, and other issues that the Panel may decide are important.

SECTION 1 INTRODUCTION

Environment Canada and Health Canada have joint responsibility for the management of toxic substances under the *Canadian Environmental Protection Act* (CEPA), (For further information: www.ec.gc.ca/CEPARegistry/the_act/) which provides for actions, including regulations, relating to the quantity or concentration of a toxic substance that may be released to the environment.

Responsibilities under the Act include identifying substances that may be toxic, assessing them to determine whether they are toxic as defined in CEPA1999 Part 5 and, for substances that are found to be toxic, establishing and applying controls to prevent harm to human health or the environment. The *CEPA Schedule 1 List of Toxic Substances* is available on Environment Canada's website at www.ec.gc.ca/CEPARegistry/subslist/Toxicupdate.cfm .

Sixteen substances that are released, produced, or used by the Canadian steel manufacturing sector were assessed as toxic under Section 11 of CEPA (1988). Those substances are: benzene, polycyclic aromatic hydrocarbons (PAHs), inorganic arsenic compounds, inorganic cadmium compounds, hexavalent chromium compounds, lead, mercury, oxidic, sulphidic and soluble, inorganic nickel compounds, inorganic fluorides, dichloromethane, tetrachloroethylene, 1,1,1-trichloroethane, trichloroethylene, polychlorinated biphenyls, polychlorinated dibenzodioxins (dioxins), and polychlorinated dibenzofurans (furans). Dioxins and furans have been identified as substances targeted for virtual elimination (www.ec.gc.ca/toxics/toxic1_e.html#track1).

A Strategic Options Process (SOP) was launched in April 1995 to assess potential options for the management of these substances in the steel sector. A multi-stakeholder *Issue Table* was established under the SOP for the sector, with representatives from various government and non-government organizations. Eight meetings of the *Issue Table* were held starting July 24-25, 1995, and ending November 25-26, 1996.

The SOP culminated in the development of a Strategic Options Report (SOR) (www.ec.gc.ca/sop/download/steel_e.pdf). Recommendations advanced by the SOR for the steel sector included: the development of an Environmental Code of Practice for Integrated Steel Mills, the development of pollution prevention plans, and the conduct of environmental audits. It was also recommended that the Code of Practice address best management practices for cokemaking facilities and achieving continual improvement in the design, operation, and maintenance of air and water pollution control systems. The Environmental Code of Practice for Integrated Steel Mills was developed in response to these recommendations.

A second group of substances, the CEPA Priority Substances List (PSL) 2, is being assessed by Environment Canada and Health Canada (www.ec.gc.ca/CEPARegistry/subs_list/psl2.cfm).

The Code identifies good environmental protection practices for various production processes and operations of an integrated steel plant, with air emission and water effluent considerations as the highest priorities. It also includes multimedia and other considerations consistent with a comprehensive and life cycle approach to environmental protection.

1.1 Sector Description

The Canadian steel sector comprises the 17 facilities listed in Table 1.1 and shown in Figure 1.1. The sector consists of five integrated mills, including QIT-Fer et Titane Inc., and 12 non-integrated mills (10 mini-mills and two specialty steel mills).

Table 1.1 Canadian Steel Plant Shipments (1996)

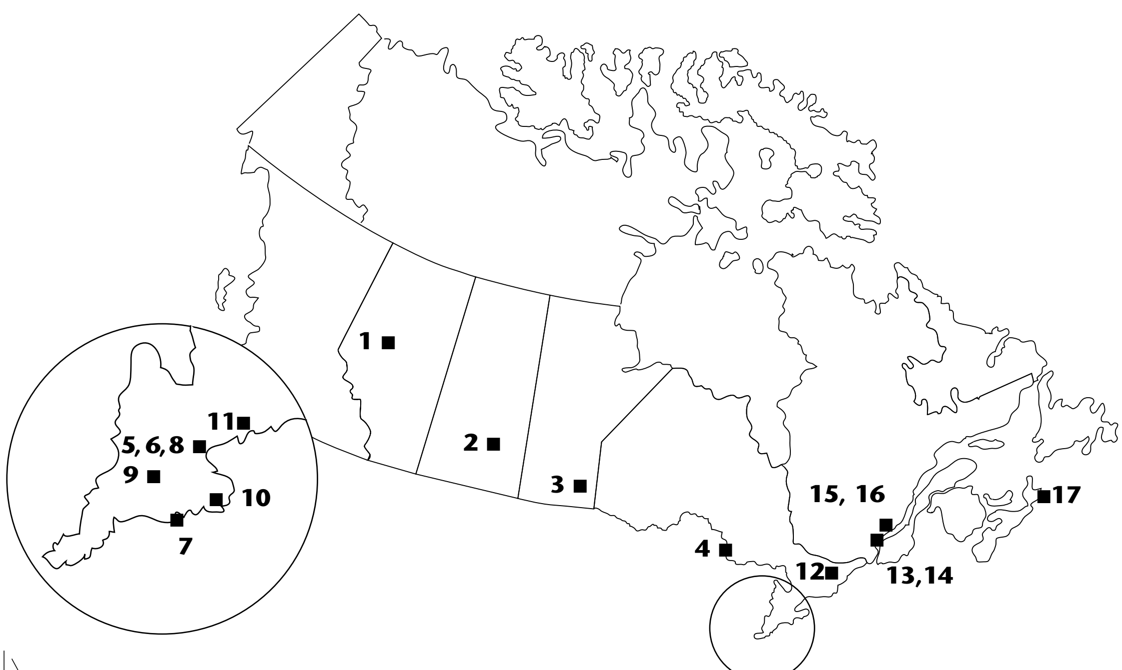
Plant No.	Plant Company/Name	Location	Manufacturing Process	Steel Shipments [1] (tonnes)
1	AltaSteel Ltd.	Edmonton, AB	MM	225,000 [2]
2	IPSCO Inc.	Regina, SK	MM	800,000 e
3	Gerdau MRM Steel Inc.	Selkirk, MB	MM	254,000
4	Algoma Steel Inc.	Sault Ste. Marie, ON	IM	1,907,000
5	Dofasco Inc.	Hamilton, ON	IEM	3,400,000 [3]
6	Stelco Inc., Hilton Works	Hamilton, ON	IM	2,672,000 [4]
7	Lake Erie Steel Co. (Stelco)	Nanticoke, ON	IM	1,485,000 [5]
8	Slater Steels, Specialty Bar Division	Hamilton, ON	MM	306,000
9	Gerdau Courtice Steel Inc.	Cambridge, ON	MM	250,000
10	Atlas Specialty Steels	Welland, ON	SS	200,000 e
11	Co-Steel Lasco	Whitby, ON	MM	672,000
12	Ivaco Inc.	L'Orignal, ON	MM	525,000 e
13	Ispat Sidbec Inc.	Contrecoeur, QC	DRM	1,367,000
14	Stelco-McMaster Ltée	Contrecoeur, QC	MM	417,000 [6]
15	Atlas Stainless Steels	Tracy, QC	SS	73,000
16	QIT-Fer et Titane Inc.	Sorel, QC	IM	350,000 e
17	Sydney Steel Corporation	Sydney, NS	MM	137,000

Legend:

e	estimated
IM	Integrated Mill
IEM	Integrated and Electric Arc Furnace Mill
MM	Mini-Mill
DRM	Direct Reduction Mini-Mill
SS	Specialty Steel Mill

Plant Numbers refer to locations on Figure 1.1

Figure 1.1 Steel Plant Location by Province (1997)



Nine of these facilities, including four integrated mills, are located in Ontario. There are four mills in Quebec and one each in Alberta, Saskatchewan, Manitoba, and Nova Scotia. Ontario accounts for about 70% of Canadian steel capacity. Plant locations are shown in Figure 1.1.

In 1998, the 17 plants shipped 15.5 million tonnes of steel with a sales value of $11.2 billion and employed approximately 34,500 people.[7]

Canada plays a major role in the international steel trade, exporting 5.2 million tonnes and importing 7.4 million tonnes in 1998. The United States, Canada's traditional major trade partner in steel, accounted for 88% of Canada's exports and 42% of imports in 1998.[8] International competitiveness is a significant issue for the industry.

Steel making is a very complex, capital and energy intensive operation involving a progression of manufacturing processes that transform raw materials into iron and steel products. Figure 1.2 illustrates the iron and steel manufacturing processes.

Steel is produced in Canada by two main steelmaking processes: basic oxygen furnaces (58.5% in 1998) and electric arc furnaces (41.5% in 1998).[9] The basic oxygen furnace is used in integrated mills in conjunction with cokemaking, sintering, and blast furnace ironmaking operations. The integrated mills, which smelt iron ore and melt scrap, produce the greatest diversity of products including bars, rods, structural shapes, plates, sheets, pipes and tubes, and wire rod. The integrated mills are gradually changing their product mix towards a greater concentration in flat-rolled products. While electric arc furnace technology is gaining importance, it is usually used in non-integrated mills (mini-mills or specialty steel mills) fed by scrap or direct reduced iron (DRI) to produce a wide product range of carbon and alloy steels. Dofasco Inc. operates the only integrated steel plant in Canada that produces part of its steel by the electric arc furnace process. Ispat Sidbec Inc. operates the only Canadian steel mill that produces and uses DRI as part of its raw material feed.

Ancillary or secondary steelmaking processes that are common to both integrated and non-integrated steelmaking include ladle metallurgy, continuous casting, hot forming, cold forming, and finishing. Three of the integrated mills have finishing operations, which may include acid pickling, pickle acid regeneration, annealing, and coating. Lake Erie Steel Co. Ltd. produces hot-rolled flat product only. Two non-integrated mills (Ispat Sidbec Inc. and Atlas Stainless Steels) have some finishing operations (acid pickling, cold rolling, and annealing).

QIT-Fer et Titane Inc. was grouped with the integrated mills because it operates a basic oxygen furnace, a ladle metallurgy station, and a continuous casting machine for secondary steelmaking.[10] QIT-Fer et Titane Inc. also produces titanium (TiO_2) slag and high-quality pig iron from smelting calcined ilmenite ore and coal in rectangular electric arc furnaces. The iron oxide slag from the electric arc furnaces is fed to a basic oxygen furnace to produce high-quality steel billets.

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1 Canadian Steel Producers Association, *Producer Information*, www.canadiansteel.ca, downloaded Feb. 11, 1998.

2 Ibid.

3 Dofasco Inc., *Annual Report 1996*.

4 Stelco Inc, *Annual Report 1996*.

5 Ibid.

6 Ibid.

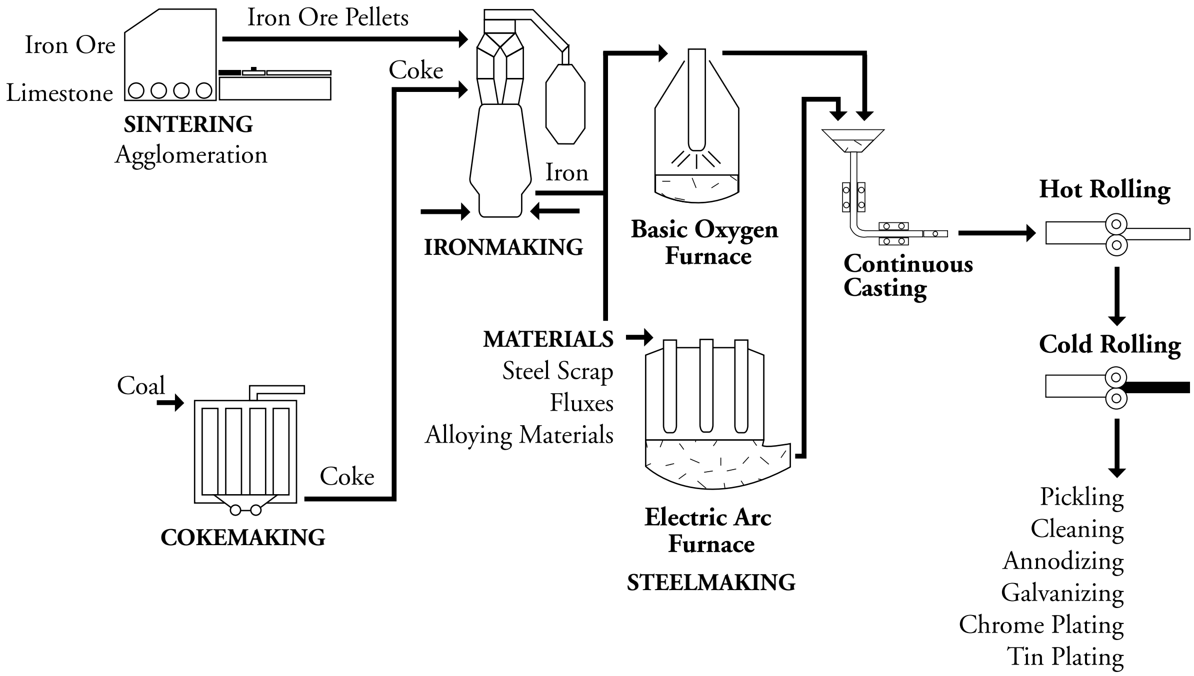
7 Canadian Steel Producers Association, *Steel Facts 1992–1998*, 29/03/99.

8 Ibid.

9 International Iron and Steel Institute, *World Steel in Figures, 1999 Edition*, Brussels, Belgium.

10 QIT-Fer et Titane Inc., corporate brochure.

Figure 1.2 Simplified Steel Manufacturing Flowsheet



1.2 Scope of the Code

The integrated mills segment of the steel sector includes all facilities that use coal and iron ore or agglomerated iron ore as raw materials to produce primary steel products. Primary steel production processes include iron sintering, cokemaking, iron and steelmaking, hot and cold forming, coating operations, and associated production and ancillary processes and facilities. It does not include pipe or tube making or steel fabricating facilities.

This Code of Practice outlines environmental concerns and alternative methods, technologies, designs, practices, and procedures that will minimize the adverse environmental effects associated with integrated steel mills. It also contains recommendations considered to be reasonable and practical measures to preserve and enhance the quality of the environment that is affected by these mills. Environmental performance standards are included for atmospheric emissions, water and wastewater, solids, and environmental management practices. These recommended practices may be used by the steel sector, regulatory agencies, and the general public as sources of technical and policy guidance in the development and implementation of site-specific environmental protection practices and requirements.

While Code recommendations are intended to be clear and specific with regard to expected results, they are not intended to discourage the use of alternative technologies and practices that can achieve an equivalent or better level of environmental protection. The Code is intended to be applied with some flexibility, recognizing that some recommendations will require interpretation to allow for site-specific conditions and concerns, particularly in the context of existing facilities. However, interpretations of Code recommendations should be undertaken in consultation with the appropriate regulatory authorities and stakeholders.

The overall objective of the Code is to identify minimum environmental performance standards for new integrated steel mills and to provide a set of environmental performance goals for existing mills to achieve through continual improvement over time. However, all municipal, provincial, and federal legal requirements must be met, and a commitment by companies to be consistent with Code recommendations does not remove obligations to comply with all regulatory requirements.

1.3 Code Development

The Code was developed by Environment Canada in consultation with provincial environmental agencies, industry representatives, and other stakeholders. Federal, provincial, and international environmental guidelines and standards of relevance to the operation of integrated steel mills were considered in the development of these recommendations, as were the environmental management practices recommended by various national and international organizations. Sources of standards-related information included environmental agencies in the United States, various countries in the European Union, Japan, the World Bank, and the United Nations Economic Commission for Europe (UNECE). Information on best management practices was drawn from various reports and literature produced by provinces, Environment Canada, the Canadian Council of Ministers of the Environment (CCME), the United States Environmental Protection Agency (U.S. EPA), the United Nations Environment Programme (UNEP), the World Bank, the International Iron and Steel Institute (IISI), steel companies, and technical journals.

1.4 Code Structure

The Code describes operational activities (Section 2) and related environmental concerns such as atmospheric emissions, wastewater discharges, and waste management (Section 3). Recommended environmental protection practices are described in Section 4.

1.5 Implementation of the Code

This Code of Practice will be adopted by Environment Canada and others as a guidance document that delineates appropriate environmental protection standards and practices for integrated steel mills. Some elements of the Code may be adopted under the Federal-Provincial/Territorial Environmental Harmonization Accord and associated sub-agreements such as Canada-Wide Standards (CWS) (www.ccme.ca/3e_priorities/3ea_harmonization/3ea2_cws_3ea2a.html).

Some elements of the Code may be used in the development of initiatives or programs to achieve the objectives of cooperative agreements including the Canada-Ontario Agreement (COA) and St. Lawrence Vision 2000. (www.on.ec.gc.ca/coa/intro.html) (www.slv2000.qc.ec.gc.ca/slv2000/bibliotheque/rapport/quin9398/rapport_accueil_a.pdf).

The Code may be adopted on a voluntary basis by individual steel sector corporations and facilities and by the Canadian Steel Producers Association (CSPA) and its members. It may be included as a commitment to Code recommendations in Environmental Performance Agreements among Environment Canada, provincial environment departments, and steel companies or facilities. It may also be adopted in whole or in part by regulatory agencies. CSPA members who operate integrated mills have initiated a program to monitor PAH and benzene emissions consistent with Code standards and audited by an independent third party.

The Code may be used for benchmarking best practices to achieve continual improvement in the environmental performance of integrated steel mills in Canada and other countries. Code recommendations may also be used as benchmark criteria for the conduct of audits aimed at assessing the environmental performance of sector facilities or companies.

SECTION 2 OPERATIONAL ACTIVITIES

This section describes the major activities involved in the operation of integrated steel mills. It is not intended to be an all-inclusive list of operational activities of potential environmental significance; nor are all activities and techniques necessarily applicable to all mills. Rather, the intent is to identify the nature and scope of the activities addressed in the Code with emphasis on those activities that relate to the environmental concerns and mitigative measures that are discussed in Sections 3 and 4.

The major activities and processes of relevance to the Code and the associated environmental releases are illustrated in Figures 2.1, 2.2, and 2.3.

2.1 Raw Materials Handling and Storage

Iron-bearing raw material, usually agglomerated in the form of pellets, is transported to the steel mill by lake carriers or, in special circumstances, by rail and blended for storage in outdoor stock piles. Coal is handled in a similar manner. Fluxing materials include limestone and dolomite for ironmaking, and burnt lime, burnt dolomite, fluorspar, and silica for steelmaking. Limestone and dolomite are usually transported by rail or truck for storage in outdoor stockpiles, while steelmaking fluxes are usually transported by truck and stored in enclosed silos.

Steel scrap may be classified as home or "revert" scrap (generated from the steel plant operations), and purchased scrap. The availability of home scrap has been decreasing as a result of the application of new technologies aimed at increasing productivity. Purchased scrap may be classified as "prompt" industrial scrap returned directly from customers, lower-grade scrap such as shredded automobiles or turnings, mixed scrap from miscellaneous sources, obsolete scrap from the demolition of buildings or other structures, stainless steel scrap, and alloy scrap. Purchased scrap is usually transported by rail or truck and is usually stored outdoors.

2.2 Cokemaking

The primary function of coke in the blast furnace is to reduce iron oxide to iron metal chemically. Coke also acts as a fuel, provides physical support and allows the free flow of gas through the furnace. Coal cannot fulfil these functions as it softens and becomes impermeable under smelting conditions; therefore, it must be converted to coke by heating to ~1300°C in an oxygen-free atmosphere for 15-21 hours. Only certain coals with the right plastic properties, for example coking or bituminous coals, can be converted to coke and, as with ores, several types may be blended to improve blast furnace productivity, extend coke battery life, etc.

A coke oven battery may contain 40 or more refractory-walled coke chambers interspaced with heating chambers referred to as "flues." Each coke chamber typically measures 0.4-0.6 metres wide, 4-7 metres high, and 12-18 metres long and is fitted at both ends with removable full-height doors. From a coal-charging car that runs along the top of the battery, coal is charged through three or four holes approximately 300 mm in diameter located above each coke chamber. Once charged, the coal is levelled, the doors and charge lids are sealed, and heating (referred to as under-firing) commences. Distillation products in the form of tar and coke oven gas (COG) driven off during the coking process are collected in mains that run the full length of the battery and are transported to the by-products plant. When the heating cycle is complete, the oven is isolated from the main, the end doors are removed, and solid coke is pushed into a "quench-car." The quench-car travels along the side of the battery to the quench tower, where fresh water or recycled water is sprayed onto the hot coke to reduce its temperature to approximately 200°C.

The coke is crushed and screened and transported to the blast furnace. The oversize coke is returned to the crusher while the undersize coke, known as coke breeze, is recycled to the coke ovens, used as fuel in a sinter plant, or sold.

The COG that is driven off during the coking process is a complex mixture containing hydrogen, methane, carbon monoxide (CO), carbon dioxide (CO_2), water vapour, oxygen, nitrogen, hydrogen sulphide, cyanide, ammonia, benzene, light oils, tar vapour, naphthalene, Polycyclic Aromatic Hydrocarbons (PAHs), many other hydrocarbons, and condensed particulate. Prior to distribution as a fuel gas, the COG is usually processed in a by-products plant where some of the components (e.g., benzene, toluene, xylene, sulphur, ammonia, and tar) are removed and collected for subsequent sale.

2.3 Sintering

Sintering involves the heating of fine iron ore with flux and coke fines or coal to produce a semi-molten mass that solidifies into porous pieces of sinter with the size and strength characteristics necessary for feeding into the blast furnace. Moistened feed is delivered as a layer onto a continuously moving grate or "strand." The surface is ignited with gas burners at the start of the strand, and air is drawn through the moving bed causing the fuel to burn. Strand velocity and gas flow are controlled to ensure that "burn through" (i.e. the point at which the burning fuel layer reaches the base of the strand) occurs just prior to the sinter being discharged. The solidified sinter is then broken into pieces in a crusher and is air-cooled. Product outside the required size range is screened out, oversize material is recrushed, and undersize material is recycled back to the process. Sinter plants that are located in a steel plant recycle iron ore fines from the raw material storage and handling operations and from waste iron oxides from steel plant operations and environmental control systems. Iron ore may also be processed in on-site sinter plants.

2.4 Ironmaking

Ironmaking is a smelting process in which iron-bearing material is reduced from the oxide form to produce liquid iron. This smelting process is carried out in a blast furnace, which is a refractory-lined shaft furnace. The blast furnace is a closed system into which iron-bearing materials (iron ore, sinter, and pellets), fluxing additives (slag formers such as limestone or dolomite), and a reducing agent (coke) are continually added to the top of the furnace shaft through a charging system that prevents the escape of blast furnace gas. A hot air blast, usually enriched with oxygen and auxiliary fuels (such as oil, natural gas, or pulverized coal), is injected from the bottom of the furnace, providing a counter-current stream of reducing gases. The air blast reacts with the coke to produce carbon monoxide (CO), which in turn reduces iron oxide to iron.

The liquid iron is collected in the hearth along with the slag, and both are tapped on a regular basis. The liquid iron flows in refractory troughs and is collected in a torpedo-shaped rail car for transport to the steelmaking shop. The liquid iron is often treated to remove part of the unwanted substances such as sulphur or phosphorus.

The remaining slag flows in other refractory troughs to the slag yard where it is either water-cooled or pelletized. After cooling, the water-cooled slag is crushed for use as a construction material. The blast furnace gas is collected at the top of the furnace and cleaned for use as a fuel for the blast furnace, coke ovens, or steam-generating boilers.

2.5 Steelmaking

The basic oxygen steelmaking process is used in Canadian integrated steel plants to produce most of their steel. Dofasco Inc. also uses an electric arc furnace to produce part of its steel.

Basic oxygen steelmaking involves the conversion of iron from the blast furnace into steel through the injection of pure oxygen into the liquid iron bath to remove carbon, silicon, and other elements. This conversion takes place in a refractory-lined, pear-shaped vessel. One-quarter to one-third of the furnace charge is steel scrap that is charged into the furnace before the liquid iron is poured from a ladle into the furnace. Fluxes such as burnt lime or dolomite are added to the bath to produce slag. Alloying materials are added to alter the composition of the steel. During the process, carbon in the iron is oxidized and released as CO and CO_2. Silicon, manganese, and phosphorus are also oxidized and captured in the slag formed by the fluxes. The reactions between silicon, carbon, and oxygen are strongly exothermic and cause the temperature in the vessel to rise. Once the final steel composition and temperature are achieved, the liquid steel is tapped into a refractory-lined ladle for transfer to the ladle metallurgy station, vacuum degassing, or the continuous casting machine.

The slag is tapped into a slag pot, air-cooled, and transported to the slag yard. After cooling, the solid slag is removed from the slag pot and broken into pieces. A magnet removes steel that is present in the slag, and the slag is crushed and screened. The steel is recycled to steelmaking, and the slag is sold as construction material.

Most modern steel plants increase productivity by using the basic oxygen furnace for the melting phase and a ladle metallurgy facility for the final refining and alloying phase. In some cases the steel ladle is taken to a vacuum degassing station where the gas content of the molten steel is reduced for quality requirements.

2.6 Continuous Casting

Over 97% of Canadian steel production is continuously cast into semi-finished products including slabs, blooms, billets, or beam blanks depending on the finished product and metallurgical and rolling requirements; the balance is cast into moulds to produce ingots.

In the continuous casting process, a ladle containing liquid steel is positioned over a refractory-lined vessel called a tundish into which steel is tapped to a predefined level. The steel flow can be shrouded by refractory tubes to minimize contact with air. Stoppers or sliding gates in the base of the tundish are opened to control the flow of the liquid steel into one or more water-cooled oscillating copper moulds. A solid shell forms around the steel in contact with the mould and the shell. The molten core is withdrawn through the bottom of the mould and carried through guiding rollers where solidification is completed with the help of water sprays. The solidified steel is subsequently cut to length with either mechanical shears or a flame-cutting torch depending on the thickness of the steel.

2.7 Hot Forming

In many modern plants the continuous cast product is transported hot to a reheat furnace to ensure that it is at the uniform temperature required to meet the hot forming specification. Prior to hot forming, surface imperfections may be removed by scarfing the surface with an oxy-fuel flame or by mechanical means. Modern steelmaking practices aim to minimize surface imperfections and eliminate this operation. Hot forming changes the shape and metallurgical properties of the steel slab, bloom, billet, or beam blank by compressing the hot metal between electrically powered rolls. The rolls for bar, wire rod, or structural shapes (long products) have indentations to change the shape of the steel progressively to the final desired form. The rolls for sheet, strip, and plate (flat-rolled) products are flat or have a small contour to form the flat surface of the final product.

Following the hot forming operation the product may be processed in finishing operations. These include roller straightening and cut-to-length operations for long products, sheet products and plate products, and edge trimming and coiling for strip. Some of the strip in coil form is sent to cold forming for further processing.

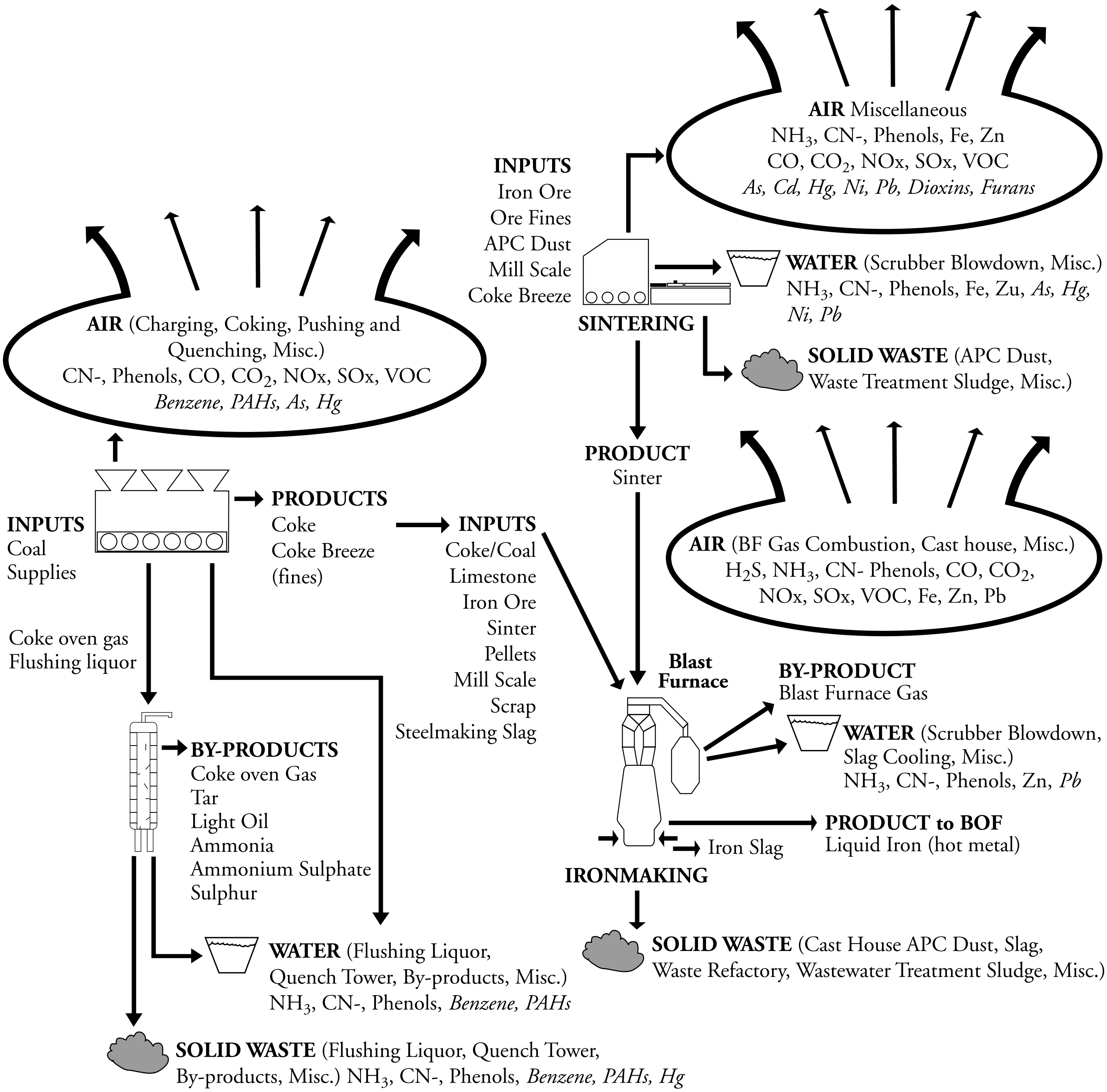
2.8 Cold Forming

Some hot-formed products, primarily flat-rolled products (steel strip or sheet), undergo further processing by cold forming. The first process is acid pickling to remove the oxide coating that forms during hot forming. The steel strip or sheet is then cold reduced by compression between rolls to the required thickness and specifications. The material may have its metallurgical properties altered by annealing. Some flat-rolled products have a final pass in a temper mill to meet flatness and surface hardness specifications.

2.9 Pickling and Cleaning

The oxide coating on the surface of hot-formed flat-rolled product is removed by passing the steel strip through an acid pickling operation followed by a rinse operation to remove any trace of acid. Hydrochloric acid is the most

Figure 2.1 Cokemaking and Blast Furnace Ironmaking and Related Environmental Releases



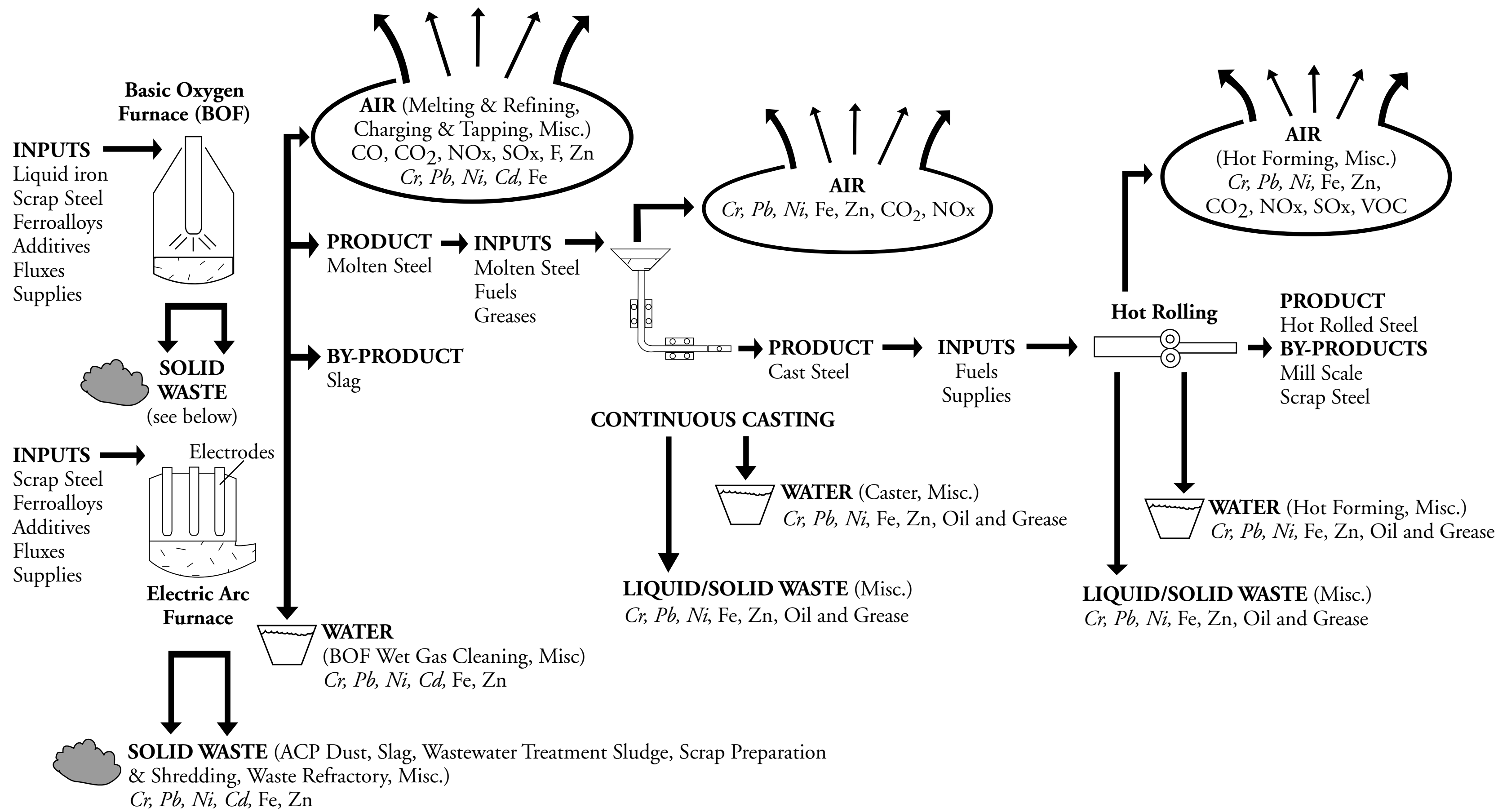
Notes: CEPA-toxic substances are in *italics*
APC: Air Pollution Control

common acid used; however, some plants use sulphuric acid.

Waste acid pickling liquor is processed in an acid regeneration plant to regenerate the acid for reuse and to recover iron oxide for recycling or sale.

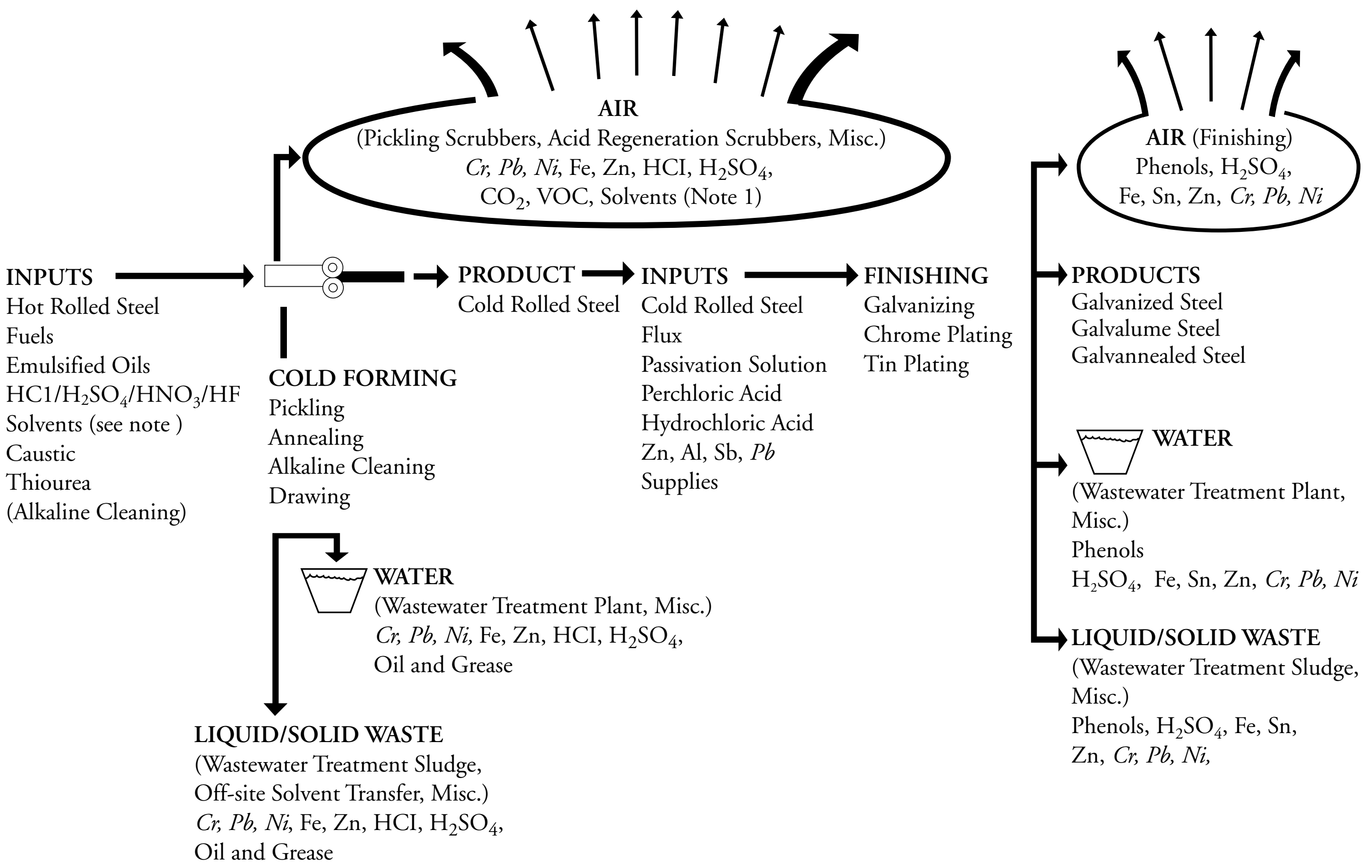
Alkali or solvent cleaning is used to remove oil that remains on the product from the cold forming operation prior to annealing or coating to prevent surface staining or contamination.

Figure 2.2 Steelmaking and Hot Forming and Related Environmental Releases



Notes: CEPA-toxic substances are in *italics*
APC: Air Pollution Control

Figure 2.3 Cold Forming and Finishing and Related Environmental Releases



Notes: Trichloroethane, Trichloroethylene, Tetrachloroethylene, Dichloromethane
CEPA-toxic substances are in *italics*

2.10 Coating

Coatings are applied to the steel strip for protection and decoration. They may be metallic including zinc, tin, nickel, aluminum, lead, zinc/aluminum alloys, and chromium, or non-metallic including paints, polymers, varnish, and lacquer. Metallic coatings are applied by hot dipping the strip or sheet into a molten bath of coating metal, in the case of zinc and zinc/aluminum alloy coatings, or by electro-deposition using the product as an electrode, in the case of zinc, nickel, tin, and copper coatings. Non-metallic coatings are normally organic compounds in the form of powders, paints, films, and liquids and are applied by brushing, rolling, spraying, or immersion.

SECTION 3 ENVIRONMENTAL CONCERNS

The major activities and processes of relevance to this Code of Practice and the associated environmental releases are illustrated in Figures 2.1, 2.2, and 2.3.

3.1 Raw Materials Handling and Storage

The main environmental issue relating to raw materials handling and storage is the fugitive emission of particulate material arising from material transfers, truck traffic, and wind erosion of raw material storage piles. A secondary issue is the suspended solids and, in some cases, oil, contained in the runoff water from the storage areas.

Fugitive emissions of particulate are usually controlled by spraying stockpiles with water or crusting agents and ensuring that roadways and vehicle wheels are kept clean. The water runoff is usually directed to a wastewater treatment plant.

3.2 Cokemaking

Coke oven emissions may be intermittent or continuous. The combustion stack emissions resulting from the under-firing process are continuous and include CO, CO_2, oxides of sulphur (SO_X), NO_X, and particulate matter. The levels of each will depend on the fuel used and the performance of the combustion control system. Intermittent emissions arise from a multitude of sources including the oven charging operation, coke pushing, transport and quenching operations, and process leaks from coke oven doors, topside lids, offtakes, and collector mains. Intermittent emissions include particulate and a wide range of hydrocarbons including benzene and PAH. Coke ovens are the major source of PAH emissions in the steel manufacturing sector and one of the major sources of PAH emissions from Canadian industry.

Potential sources of benzene emissions include leaks from process pumps, valves, vents, storage tanks, and associated equipment and the handling of light oil (a mixture of benzene, toluene, xylene, and other hydrocarbons) recovered from the COG. Cooling towers used for process cooling water may also be a significant source of benzene emissions if there are leaks in the heat exchangers. The coke by-products plants are the major source of benzene emissions in the steel manufacturing sector and one of the major sources of benzene emissions from Canadian industry.

3.3 Sintering

Emissions from the sintering process arise primarily from materials-handling operations, which result in airborne dust, and from the combustion reaction on the strand. Combustion gases from the latter source contain dust entrained directly from the strand along with products of combustion such as CO, CO_2, SO_X, NO_X, and particulate matter. The concentrations of these substances vary with the quality of the fuel and raw materials used and combustion conditions. Atmospheric emissions also include volatile organic compounds (VOCs) formed from volatile material in the coke breeze, oily mill scale, etc., and dioxins and furans, formed from organic material under certain operating conditions. Metals are volatilized from the raw materials used, and acid vapours are formed from the halides present in the raw materials.

Combustion gases are most often cleaned in electrostatic precipitators (ESPs), which significantly reduce dust emissions but have minimal effect on the gaseous emissions. Water scrubbers, which are sometimes used for sinter plants, may have lower particulate collection efficiency than ESPs but higher collection efficiency for gaseous emissions. Significant amounts of oil in the raw material feed may create explosive conditions in the ESP. Sinter crushing and screening emissions are usually controlled by ESPs or fabric filters. Wastewater discharges, including runoff from the materials storage areas, are treated in a wastewater treatment plant that may also be used to treat blast furnace wastewater.

Solid wastes include refractories and sludge generated by the treatment of emission control system water in cases where a wet emission control system is used. Undersize sinter is recycled to the sinter strand.

3.4 Ironmaking

The main emissions from the blast furnace occur during tapping operations and are primarily iron oxide particulates. These are usually controlled by local hooding within the cast house to direct the emissions to a fabric filter. Variable quantities of hydrogen sulphide and sulphur dioxide are emitted from slag cooling and treatment. The control of these emissions is usually through process change or operating practices. Some emissions, including particulate matter, sulphur oxides, and other gases, are generated on an intermittent basis when de-sulphurization is practised. Emission control is usually by fabric filter. Some fugitive emissions, including iron oxides and graphite flakes, occur during hot metal transport to the steel melt shop.

Wastewater effluents arise from blast furnace gas cleaning and slag cooling and processing operations. Recirculation is used and the bleed stream is treated to remove solids, metals, and oil prior to discharge.

Slag is the main solid by-product. It can be processed in a variety of ways including granulating and pelletizing or cooled, crushed, and screened. The slag is sold as a by-product, primarily to the cement and construction industries. Sludge from the gas cleaning system may be recycled to a sinter plant or sent to a solid waste disposal site.

3.5 Steelmaking

Primary emissions of gas and particulate matter are collected in a hood above the mouth of the basic oxygen furnace (BOF) during oxygen blowing. These emissions include carbon monoxide, iron oxides, and other metal oxides. Fugitive emissions emerge from the mouth of the BOF during oxygen blowing but are minimized in modern plants by the use of a close-fitting hood. The primary emissions are usually controlled by a wet scrubbing system, although a few plants, including Stelco Inc., Hilton Works, use an electrostatic precipitator.

The fugitive emissions from hot metal transfer, scrap charging, oxygen blowing, tapping, and slag handling are usually collected by local hooding and cleaned in fabric filters.

Minor emissions of particulates arise from ladle metallurgy processes and vacuum degassing. These are usually collected and cleaned by fabric filters. Some wastewater effluent may be generated by the degassing process and is treated with other wastewater effluents.

The wastewater effluent from gas scrubbing is recycled and the bleed stream is treated to remove suspended solids and oil and to control pH.

The main solid wastes include steel skulls, slag, and waste refractories. Other solid wastes include the wastewater treatment sludge and dust from dry dust collectors. The steel skulls are recycled, the slag is crushed and screened for recycle or sale, and other solid wastes are recycled, where appropriate, or disposed to a landfill site.

3.6 Continuous Casting

Air emissions of particulate matter and metals arise from the transfer of molten steel to the mould and from the cutting to length of the product by oxy-fuel torches.

Wastewater effluents are generated during the cooling of the hot metal and include scale particles and oil.

Solid waste is generated from the cutting of the steel but is minor in amount and is recycled within the plant.

3.7 Hot Forming

Air emissions from hot forming include gases generated by the combustion of fuel in the heating furnaces and VOCs from rolling and lubrication oils.

Wastewater effluents are generated from the high-pressure water descaling of the hot steel and include suspended solids, oil, and grease.

Solid waste is primarily waste iron oxides recovered from the descaling and wastewater treatment operations and includes oil and grease.

3.8 Cold Forming

Air emissions from cold forming are primarily VOCs from rolling and lubrication oils. Some minor emissions result from the combustion of annealing furnace fuel.

Wastewater effluents are generated from rolling oil-filtering systems, leaks, and spills and include oil and minor amounts of suspended solids.

3.9 Pickling and Cleaning

The major air emissions are acid aerosols from the acid pickling operations and the acid regeneration plant, if acid regeneration is used.

The major sources of wastewater effluents are the acid pickling rinse water and acid fume scrubber, acid regeneration plant scrubber, and alkaline cleaning. Acid pickling rinse water discharges can be minimized by counter flow cascading and, in some cases, recycling to the acid regeneration plant. The wastewater effluents contain suspended solids, oil and grease, metals and acids. Wastewater effluent from alkaline cleaning is treated in a wastewater treatment facility.

The major sources of solid wastes are iron oxide from the acid regeneration process and sludge from wastewater treatment facilities.

3.10 Coating

Emissions from the coating process include VOCs (solvents), metal fumes, acid aerosols (electrolytic coating), particulate, and combustion products. These emissions are usually controlled by local hooding and fabric filters or wet scrubbers.

Wastewater effluents include wet scrubber discharge and electrolytic coating process wastewater and rinse water. These effluents contain suspended solids, metals, and acids and are treated in a wastewater treatment plant before discharge. Wastewater effluent and rinse water that contain Cr^6 from chromium coating facilities are treated by an ion exchange process, and the chromic acid is recycled.

Solid wastes include zinc dross, tin oxide, tank sludges, and water treatment sludges. The zinc dross and tin oxide are sold, and other solid wastes disposed to landfill.

3.11 Environmental Release Inventories

The National Pollutant Release Inventory (NPRI) is a federal government regulatory initiative designed to collect annual, comprehensive, national data on releases to air, water, and land, and transfers for disposal or recycling of specified substances. The NPRI data support a wide range of environmental initiatives, including toxic substance assessment and pollution prevention and abatement. NPRI data are accessible by the public and provide information on all sectors – industrial, government, commercial, and others (www.ec.gc.ca/pdb/npri/npri_home_e.cfm).

The Accelerated Reduction/Elimination of Toxics (ARET) is an initiative dedicated to decreasing the adverse effects of toxic substances on human health and the environment. ARET especially targets toxic substances that persist in the environment and bioaccumulate in living organisms. Through voluntary action, organizations that use, generate, or release toxic substances strive to reduce or eliminate their emissions of these substances. According to the 1998 ARET report, 14 of the 17 steel plants participated in ARET for the 1997 calendar year (www.ec.gc.ca/aret/reports.html). The substances reported by integrated mills in 1997 are identified in the ARET list of substances.

SECTION 4 RECOMMENDED ENVIRONMENTAL PROTECTION PRACTICES

This section presents recommended mitigative measures for activities of potential environmental concern. These recommendations were derived from regulatory and non-regulatory standards, in particular on environmental practices, published by various agencies and organizations.

The overall objective of the Code is to identify minimum environmental performance standards for new integrated steel mills and to provide a set of environmental performance goals for existing mills to achieve through continual improvement over time.

Application of the recommendations to individual mills may involve practices that are not mentioned in this Code of Practice but achieve an equivalent or better level of environmental protection.

Site-specific municipal, provincial, federal, legal, and non-legal requirements must be met where they exist.

The Strategic Options Report (SOR) recognized that the measurement or calculation of some emissions is particularly difficult, for example for benzene and PAHs, and that the data reported and the ARET commitments made by individual facilities vary. SOR recommendations concerning benzene and PAHs included the development of standardized emission measuring, monitoring, and reporting practices. The CSPA has developed such practices. The targets for release reductions presented in Recommendation RI101 reflect the results of this development.

4.1 Atmospheric Emissions Management

The targets and schedules recommended for benzene and PAH releases are based on the recommendations advanced by the SOR for the steel sector. The guidelines recommended for particulate matter are based on the application of demonstrated control technologies and are generally considered technically and economically feasible for application to integrated steel mills. These guidelines are consistent with standards and practices currently in place in Canada, the United States, Europe, and other jurisdictions. More stringent criteria may be required by local regulatory authorities where deemed appropriate to the circumstances.

The effective control of benzene, PAH, and particulate emissions, in combination with the management practices recommended in RI104, RI105, and RI106, will significantly reduce the overall environmental impact associated with air releases of CEPA toxics by the steel sector.

4.1.1 Targets and Schedules for Release Reductions

RECOMMENDATION RI101 All by-product coke oven plants should implement plans to achieve the SOR targets and schedules for:

PAH releases from coke ovens and coke by-product plants should be reduced in accordance with the following:

(i) to an industry production-based average of 13.2 g/tonne of coke produced in 2000;
(ii) to a maximum for any coke oven battery of 9.8 g/tonne of coke produced in 2005;
(iii) to a maximum for any coke oven battery of 8.2 g/tonne of coke produced in 2015 or later.

The measurement and calculation of PAH releases should be undertaken in accordance with the CSPA PAH Measurement Protocol contained in *Environmental Best Practice Manual* *for Coke Producers – Controlling and Reducing Emissions of Polycyclic Aromatic Hydrocarbons (PAH) from Metallurgical Coke Production in the Province of Ontario.* [11]

Benzene releases from coke ovens and coke by-product plants should be reduced in accordance with the following:

(i) to an industry production-based average of 120 g/tonne of coke produced in 2000;
(ii) to a maximum of 71.7 g/tonne of coke produced in 2005;
(iii) to a maximum of 62.7 g/tonne of coke produced in 2015 and later.

The measurement and calculation of benzene releases should be undertaken in accordance with the CSPA Benzene Measurement Protocol contained in *Benzene Environmental Best Practice Manual for Coke Producers in Ontario – Controlling and Reducing Fugitive Benzene Emissions from Coke Production By-Product Process*. [12]

Benzene and PAH emission data for the 1993 base line, 1997 reported emissions, and ARET commitments for 2000 are contained in Appendix A.

4.1.2 Release Guidelines for Particulate Matter

RECOMMENDATION RI102 Each facility should target on achieving the following emission guidelines for particulate matter after the emission control device:

(i) sinter plants:	50 mg/Nm^3;
(ii) blast furnaces:	50 mg/Nm^3;
(iii) basic oxygen furnaces:	50 mg/Nm^3;
(iv) electric arc furnaces:	20 mg/Nm^3.

Emission testing should be carried out on an annual basis in a manner that is consistent with Environment Canada's *Reference Methods for Source Testing: Measurement of Releases of Particulate from Stationary Sources*, [13] as amended from time to time. In cases where the emission control system does not have a stack, emission testing should be carried out in a manner that is consistent with the U.S. Environmental Protection Agency *Method 5D – Determination of Particulate Matter Emissions from Positive Pressure Fabric Filters*. [14] It is recognized that particulate emission estimates for facilities without stacks are typically less accurate than emission estimates for facilities equipped with stacks and that relative accuracy must be taken into account in assessing the results of tests conducted in accordance with Method 5D.

More stringent criteria may be required by local regulatory authorities where deemed appropriate to the circumstances.

4.1.3 Environmental Performance Indicators

RECOMMENDATION RI103 Each facility should target on limiting particulate emissions in accordance with the following:

(i) sinter plants: less than 200 grams per tonne of sinter produced;

The calculation of this Environmental Performance Indicator should be undertaken in accordance with the methodology outlined in Section B.1 of Appendix B.

(ii) blast furnaces: less than 100 grams per tonne of liquid iron produced;

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[11] Canadian Steel Producers Association, *Environmental Best Practice Manual for Coke Producers – Controlling and Reducing Emissions of Polycyclic Aromatic Hydrocarbons (PAHs) from Metallurgical Coke Production in the Province of Ontario*, prepared by CSPA/Environmental Committee Task Group on PAHs Emissions for CSPA/EC, final edition June 2000.

[12] Canadian Steel Producers Association, *Benzene Environmental Best Practice Manual for Coke Producers in Ontario – Controlling and Reducing Fugitive Benzene Emissions from Coke Production By-Product Process*, prepared by CSPA/EC Task Group on Benzene Emissions for CSPA/Environmental Committee, Rev. 2, final report, December 1999.

[13] Environment Canada, *Reference Methods for Source Testing: Measurement of Releases of Particulate from Stationary Sources, Reference Method*, Report EPS 1/RM/8, December 1993.

[14] U.S. Environmental Protection Agency, Method 5D – *Determination of Particulate Matter Emissions from Positive Pressure Fabric Filters*, Federal Register, CFR 40 Part 60, Appendix A, pp. 647-651, 07/01/96.

The calculation of this Environmental Performance Indicator should be undertaken in accordance with the methodology outlined in Section B.2 of Appendix B.

(iii) basic oxygen furnaces: less than 100 grams per tonne of raw steel produced;

The calculation of this Environmental Performance Indicator should be undertaken in accordance with Section B.3 of Appendix B.

(iv) electric arc furnaces: less than 150 grams per tonne of raw steel produced.

The calculation of this Environmental Performance Indicator should be undertaken in accordance with Section B.4 of Appendix B.

4.1.4 Collection of Furnace Emissions

RECOMMENDATION RI104 Adequately sized facilities should be engineered and installed, and documented operating and maintenance procedures should be developed for the collection of emissions associated with:

(i) ironmaking including cokemaking, furnace operations, tapping and slagging operations, hot metal transfer operations, hot metal and slag runners, and hot metal desulphurization;
(ii) primary steelmaking, including furnace operations, scrap and hot metal charging, and tapping and slagging operations;
(iii) secondary steelmaking, including furnace operations, and continuous casting.

4.1.5 Control of Fugitive Emissions

RECOMMENDATION RI105 Adequately sized facilities should be engineered and installed, and documented operating and maintenance procedures should be developed for the control of emissions associated with:

(i) ironmaking, including materials handling and storage operations, the crushing and screening of coal and coke, cokemaking, the disposal of by-products and wastes including coke breeze, and the cooling and processing of slag;
(ii) primary steelmaking operations, including materials handling and storage operations, hot metal transfer, and processing of slag; and
(iii) secondary steelmaking operations, including transfer of hot metal and continuous casting operations.

These facilities and procedures should include:

(i) enclosure and/or hooding with emission controls, where appropriate, of those operations that are potential sources of fugitive emissions;
(ii) operating practices that minimize fugitive emissions from those operations that are not amenable to enclosure or hooding; and
(iii) criteria for building, working, and maintaining bulk-material storage piles.

4.1.6 Chlorinated Solvents Used in Solvent Degreasing

RECOMMENDATION RI106 Documented procedures for the control or elimination of chlorinated solvent emissions from degreasing operations should be developed and implemented in accordance with the multi-stakeholder Strategic Options Report and the associated regulations that may be promulgated from time to time (www.ec.gc.ca/degrease/degrease.htm).

4.1.7 Ambient Air Quality Monitoring

RECOMMENDATION RI107 An ambient air quality monitoring program should be developed and implemented by each facility, in consultation with the appropriate regulatory authorities, with the objective of enabling the facility to demonstrate that operations are being conducted in a manner that is consistent with the *National Ambient Air Quality Objectives* *for Air Contaminants*[15] as amended from time to time. (Note that the *National Ambient Air Quality Objectives for Air Contaminants* may be superseded by Canada-Wide Standards in the future.) This program should include monitoring of particulate matter (total, PM_{10}, and $PM_{2.5}$), benzene, and PAHs, taking into account:

(i) the location of emission sources under the control of the facility operator; and
(ii) local meteorological conditions such as the direction of prevailing winds.

4.2 Cokemaking

The recommendations in this section are intended to provide general guidance on the issues and topics that should be addressed by site-specific procedures as a means of mitigating the environmental impact of cokemaking and associated operations. Individual coke plants have developed Standard Operating Practices (SOPs) for coke oven and coke by-product plant operating, maintenance, and training activities to minimize benzene and PAH emissions. These SOPs are identified in the CSPA documents *Environmental Best Practice Manual for Coke Producers (PAHs) and Benzene Environmental Best Practice Manual for Coke Producers in Ontario*.

4.2.1 Coke Ovens

4.2.1.1 Charging Operations

RECOMMENDATION RI108 Documented procedures should be developed and implemented for the control of coke oven charging operations including:

(i) the nature and frequency of equipment inspections;
(ii) replacement or repair of emission control equipment, where applicable, and the method used to audit the effectiveness of the inspection and repair program;
(iii) proper filling of larry car hoppers;
(iv) alignment of larry cars over the oven to be charged;
(v) proper filling of the ovens (e.g. procedures for staged or sequential charging);
(vi) proper leveling of coal in the ovens; and
(vii) the inspection and cleaning of offtake systems (including standpipes, standpipe caps, goosenecks, dampers, and mains), oven roofs, charging holes, topside port lids, steam supply system, and liquor sprays.

4.2.1.2 Coke Oven Doors

RECOMMENDATION RI109 Documented procedures should be developed and implemented for the control of emissions from coke oven doors including:

(i) a program for the inspection, adjustment, repair, and replacement of coke oven doors and jambs, and any other equipment used to control emissions from coke oven doors;
(ii) a defined frequency for door inspections;
(iii) the method to be used to evaluate conformance with operating specifications for each type of equipment;
(iv) the methods to be used to audit the effectiveness of the inspection and repair program;
(v) procedures for identifying leaks that indicate a failure of the emissions control technology to function properly;
(vi) a clearly defined chain of command for communicating information on leaks and procedures for corrective action;
(vii) procedures for cleaning sealing surfaces of doors and jambs which include the identification of equipment that will be used and a specified schedule or frequency for the cleaning of the sealing surfaces;
(viii) procedures for use of supplemental gasketing and luting materials, and hand luting, if the operator elects to use such procedures;
(ix) procedures for maintaining an adequate number of spare coke oven doors and jambs on-site;
(x) procedures for monitoring and controlling back pressure in the collecting main, which include corrective action if pressure control problems occur; and
(xi) a program for identifying and adopting improved coke oven door and door sealing designs.

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[15] Canada Gazette, Department of the Environment, *National Ambient Air Quality Objectives for Air Contaminants*, Part I, August 12, 1989.

4.2.1.3 Topside Port Lids

RECOMMENDATION RI110 Documented procedures should be developed and implemented for the control of emissions from topside port lids including:

(i) the inspection and replacement or repair of topside port lids and port lid mating and sealing surfaces;
(ii) the frequency of inspections;
(iii) the method to be used to evaluate conformance with operating specifications for each type of equipment;
(iv) the method to be used to audit the effectiveness of the inspection and repair program, where applicable; and
(v) procedures for sealing topside port lids after charging, for identifying topside ports that leak, and resealing.

4.2.1.4 Offtake Systems

RECOMMENDATION RI111 Documented procedures should be developed and implemented for the control of emissions from offtake system(s) including:

(i) the inspection and replacement or repair of offtake system components;
(ii) the frequency of inspections;
(iii) the method to be used to evaluate conformance with operating specifications for each type of equipment;
(iv) the method to be used to audit the effectiveness of the inspection and repair program;
(v) procedures for identifying offtake system components that leak and sealing leaks that are detected; and
(vi) procedures for dampering off ovens before a push.

4.2.1.5 Coke Pushing

RECOMMENDATION RI112 Documented procedures should be developed and implemented for the control of emissions from coke pushing and coke transfer to the quench station including:

(i) minimizing the occurrence and severity of "green" pushes;
(ii) the inspection and replacement or repair of pushing emission control system components;
(iii) the frequency of inspections;
(iv) the method to be used to evaluate conformance with operating specifications for each type of equipment, where applicable;
(v) the method to be used to audit the effectiveness of the inspection and repair program, where applicable;
(vi) minimizing emissions from the transfer of hot coke to the quench station; and
(vii) procedures for identifying pushing emissions that indicate occurrences of incomplete coking or a failure of the emissions control technology to function properly, which include a clearly defined chain of command for communicating information on such occurrences and procedures for corrective action.

4.2.1.6 Coke Wet Quenching

RECOMMENDATION RI113 Documented procedures should be developed and implemented for the control of atmospheric emissions and wastewater discharges from coke quenching including:

(i) the inspection, repair, and replacement of quench tower components;
(ii) the frequency of inspections;
(iii) the method to be used to evaluate conformance with operating specifications, where applicable;
(iv) the method to be used to audit the effectiveness of the inspection and repair program; and
(v) procedures for the quality control of quench water.

4.2.1.7 Bypass/Bleeder Stacks

RECOMMENDATION RI114 Documented procedures should be developed and implemented for the control of atmospheric emissions from coke oven gas flaring including:

(i) the method to be used to flare coke oven gas;
(ii) the inspection, repair, and replacement of flare system components;

(iii) the method to be used to evaluate conformance with operating specifications of the flare system; and
(iv) procedures for reporting and correcting malfunctions of the flare system.

4.2.2 Coke By-Product Plant

4.2.2.1 Storage Tanks

RECOMMENDATION RI115 The recommendations advanced in the Canadian Council of Ministers of the Environment's (CCME's) *Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks* [16] should be applied to light oil and wash oil storage tanks.

4.2.2.2 Fugitive Emissions

RECOMMENDATION RI116 The recommendations advanced in the CCME's *Environmental Code of Practice for the Measurement and Control of Fugitive VOC Emissions from Equipment Leaks* [17] should be followed.

4.2.2.3 Benzene Transfer Operations

RECOMMENDATION RI117 A vapour collection system should be used to contain benzene vapours during the transfer of benzene-containing liquids to tank trucks or rail cars.

4.2.2.4 Process Cooling Water

RECOMMENDATION RI118 All process cooling should be by the use of indirect cooling, with no water in contact with process liquids or gases unless properly treated prior to discharge.

4.2.2.5 Open Trenches and Sumps

RECOMMENDATION RI119 All process trenches and sumps should be enclosed and the vapours collected for treatment.

4.2.2.6 Containment of Process Pumps and Tanks

RECOMMENDATION RI120 All process pumps and tanks should be installed on impervious pads with containment dykes and drainage to wastewater treatment facilities to contain spills. Refer also to Recommendation RI125, which would also apply as appropriate.

4.3 Water and Wastewater Management

Technologies capable of achieving the criteria recommended in RI121 and RI122 have been demonstrated and are considered technically and economically feasible for application to integrated steel mills. These criteria are consistent with standards and practices currently in place in Canada, the United States, Europe, and other jurisdictions.

Although limits have not been prescribed for all parameters of potential environmental concern, the application of technologies capable of achieving the specified criteria, in combination with the water and wastewater management practices recommended in RI123 through RI126, will reduce the overall environmental impact associated with water use and wastewater discharges. More stringent criteria may be required by local regulatory authorities where deemed appropriate to the circumstances.

4.3.1 Effluent Guidelines

RECOMMENDATION RI121 All wastewater treatment facilities approved for construction and operation after the publication of this Code of Practice should be designed, constructed, and operated to achieve the following effluent criteria prior to release to cooling water or to local receiving water body:

Wastewater treatment facilities approved by the appropriate regulatory authorities prior to the publication of this Code of Practice should be

[16] Canadian Council of Ministers of the Environment, *CCME Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks*, CCME-EPC-87E, June 1995.

[17] Canadian Council of Ministers of the Environment, *CCME Environmental Code of Practice for the Measurement and Control of Fugitive VOC Emissions from Equipment Leaks*, CCME-EPC-73E, October 1993.

On a continuous basis:	
pH	6.0–9.5
On a monthly average basis:	
Total suspended solids (TSS)	30 mg/l
Chemical oxygen demand (COD)	200 mg/l
Oil and grease	10 mg/l
Cadmium	0.1 mg/l
Chromium (total)	0.5 mg/l
Lead	0.2 mg/l
Mercury	0.01mg/l
Nickel (total)	0.5 mg/l
Zinc	0.5 mg/l
Toxicity	No more than 50% mortality in 100% effluent when tested in accordance with Environment Canada Reference Methods 1/RM/13[18] and 1/RM/14.[19]

so operated that effluent quality is as close to satisfying the above-listed criteria as is practicably possible.

Wastewater testing should be carried out on a continuous basis for pH, on a daily basis for total suspended solids, and on a weekly basis for the balance of the substances. Toxicity testing should be conducted quarterly.

Wastewater sampling and analyses should be carried out in accordance with documented, performance-based standards approved by the appropriate regulatory authorities.

4.3.2 Environmental Performance Indicator

RECOMMENDATION RI122 Each facility should target on limiting total suspended solids discharges from wastewater to less than 100 grams per tonne of raw steel produced.

The calculation of this Environmental Performance Indicator should be undertaken in accordance with Section B.5 of Appendix B.

4.3.3 Wastewater Collection

RECOMMENDATION RI123 All wastewater streams that may exceed the effluent criteria specified in RI121 should be directed to an approved treatment facility prior to discharge to a local receiving water body. To the extent practicable, system designs should provide for the segregation and collection of similar wastewaters (e.g. oily, acid, cleaning, and sanitary wastes).

4.3.4 Water Use/Reuse

RECOMMENDATION RI124 Water use should be minimized through the reuse or recycling of water and the cascading of cooling water and wastewater between production processes. Facilities should target on achieving 90% reuse of water. Flow measurements should be carried out in accordance with documented, performance-based standards approved by the appropriate regulatory authorities. Engineering design data or estimates should be used where flow measurements are not feasible.

[18] Environment Canada, *Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout*, Report EPS 1/RM/13, 1990, as amended in May 1996.

[19] Environment Canada, *Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to* Daphnia magna, Report EPS 1/RM/14, 1990, as amended in May 1996.

The calculation of this Environmental Performance Indicator should be undertaken in accordance with the methodology outlined in Section B.6 of Appendix B.

4.3.5 Wastewater Containment Sizing

RECOMMENDATION RI125 Wastewater collection and containment facilities constructed after the publication of this Code of Practice should be designed to contain the maximum volume of liquid that could reasonably be expected to be in storage prior to any of the following events, and:

(i) the maximum volume of wastewater that would be generated during the time required to shut down wastewater generating processes, plus 50%;
(ii) 110% of the volume that could enter the containment facility in the event of a leak or spill; or
(iii) the accumulated precipitation from a 50 year return period, 24-hour precipitation event that is collected in an outdoor containment (e.g. rain that falls on the open surface or inside the containment berm).

4.3.6 Environmental Effects Monitoring

RECOMMENDATION RI126 An environmental effects monitoring program should be developed and implemented where appropriate by each facility in consultation with the appropriate regulatory authorities. This program should be sufficiently comprehensive to enable the facility to:

(i) measure changes in receiving water quality, aquatic sediments, and important aquatic and terrestrial organisms; and
(ii) assess the need to incorporate changes in operational activities and procedures affecting the receiving environment.

The frequency and duration of this monitoring activity should be assessed, in consultation with the appropriate regulatory authorities, on the basis of test results.

4.4 Waste Management

For the purposes of this Code "wastes" are defined as substances or objects that are disposed of, or are intended to be disposed of, or are required to be disposed of by the provisions of national, provincial, or municipal law.[20] The recommendations presented in this section are based on guidelines, practices, and procedures currently in place in Canada with regard to the management of wastes generated by industrial facilities. The nature of the waste material (e.g. hazardous, solid, liquid), local site conditions, and local regulatory requirements should be considered in the development of waste management plans and strategies. More stringent requirements may be stipulated by local regulatory authorities where deemed appropriate to the circumstances.

4.4.1 Location and Construction of Waste Disposal Sites

RECOMMENDATION RI127 Expansions to existing waste disposal sites that extend beyond the spatial bounds of areas that have been approved by the appropriate regulatory authority, before the publication of this Code of Practice, and location and construction of new sites should be undertaken so as to ensure that:

(i) the site plan is updated to show clearly the location and dimensions of the new or expanded site;
(ii) the perimeter of the disposal area is far enough away from all watercourses to prevent contamination by runoff, seepage, or fugitive emissions;
(iii) the surface drainage from off-site areas is diverted around the disposal area;
(iv) the expanded area is hidden from view by fences, berms, or buffer zones to the extent practicable; and
(v) the beneficial uses of the site after closure have been considered.

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[20] United Nations Environment Programme, *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal Adopted by the Conference of Plenipotentiaries on 22 March 1989*, www.unep.ch/basel .

4.4.2 Development of Solid Waste Disposal Sites

RECOMMENDATION RI128 Solid waste disposal sites should be developed in accordance with the following practices:

(i) the disposal area should be developed in modules or cells throughout its operational life;
(ii) all wastes should be so placed that they have physical and chemical stability suitable for land reuse;
(iii) contouring, capping, and reclamation of cells should be undertaken throughout the operating life of the site and, where feasible, should include the re-establishment of vegetation as a means of controlling fugitive emissions and the erosion of side slopes; and
(iv) all disposal sites should be reclaimed for beneficial uses before final closure.

4.4.3 Management of Waste Disposal Sites

RECOMMENDATION RI129 All waste disposal sites should be managed throughout their operational life in accordance with documented, site-specific waste management plans approved by the appropriate regulatory authority so that:

(i) solid, liquid, and hazardous wastes are disposed of only in facilities specifically designed, approved, and operated for that purpose;
(ii) access to the site is controlled and disposal activities are supervised by trained personnel; and
(iii) records are maintained of the types, approximate quantities, and point of origin of the wastes.

4.4.4 Monitoring of Waste Disposal Sites

RECOMMENDATION RI130 A groundwater monitoring program should be developed, to the extent that is feasible, for all waste disposal sites in accordance with the following guidelines:

(i) a permanent system of appropriately located piezometers and wells should be provided for monitoring the quantity, quality, and flow direction of groundwater;
(ii) a program of pre-operational monitoring of groundwater regimes that may be affected by new facilities should be initiated at least one year prior to the commencement of disposal activities;
(iii) groundwater samples should be collected at least quarterly from all monitoring wells during the first two years of well operation and at a frequency based on the results of this test program in subsequent years; and
(iv) each groundwater sample should be analyzed for pH, total dissolved solids, and other appropriate (site-specific) parameters.

4.4.5 Liquid Storage and Containment

RECOMMENDATION RI131 Liquid storage and containment facilities should be designed and constructed to meet the requirements of the appropriate standards, regulations, and guidelines of the pertinent regulatory agency. This recommendation applies to liquid fuels, acids, petroleum products, solvents, and other liquids that are combustible or potentially harmful to the environment.

4.4.6 Reduction, Reuse, and Recycling

RECOMMENDATION RI132 Each corporate entity responsible for the operation of an integrated steel mill should develop, implement, and maintain a reduction, reuse, and recycling program that:

(i) identifies opportunities for in-plant reduction, reuse, and recycling of wastes;
(ii) develops and implements plans for the evaluation and implementation of reduction, reuse, and recycling opportunities;
(iii) identifies and evaluates market opportunities for waste with a view to maximizing waste reduction, reuse, and recycling (this includes the sale of by-products such as slag that would otherwise be considered wastes); and
(iv) develops and implements a research and development program for reducing, reusing, and recycling residual wastes.

4.5 Best Environmental Management Practices

In the context of this Code of Practice, Best Environmental Management Practices (BEMPs) can be broadly defined as those activities, actions, processes, and procedures that go beyond legal and technical requirements in helping to ensure that facilities have minimal impact on the environment in which they operate. The effective development and implementation of BEMPs will also facilitate efforts to achieve continual improvement in the overall environmental performance of integrated steel mills.

The recommendations presented in this section are based on the policies, principles, and commitments advanced by Environment Canada, the CCME, provinces, the Canadian Steel Producers Association, and the International Iron and Steel Institute.

4.5.1 Implementation of an Environmental Management System

RECOMMENDATION RI133 Each facility should develop, implement, and maintain an environmental management system that is consistent with the requirements of a nationally recognized standard such as ISO 14001. [21]

4.5.2 Environmental Policy Statement

RECOMMENDATION RI134 Each facility should develop and implement an environmental policy statement. The International Iron and Steel Institute's Statement on Environment, provides a good example of the principles that should be considered in the development of the policy statement (www.worldsteel.org/environment/env_policy/index.html). The Canadian Steel Producers Association's Environmental Policy Statement is available on the website at www.canadiansteel.ca/environment/environ_statement.html .

4.5.3 Environmental Assessment

RECOMMENDATION RI135 The development of new facilities and changes to existing facilities that could significantly increase releases to the environment should be subjected to an internal environmental assessment process, with the aim of identifying potential problems and formulating cost-effective solutions that address the concerns of stakeholders. This self-assessment process should be initiated during the early stages of pre-project planning and continue as an iterative process through the project design, construction, and operations phases. Consideration should be given to potential impacts on air quality, water quality, water supply and use, land use, flora and fauna, and local infrastructure.

4.5.4 Emergency Planning

RECOMMENDATION RI136 Each facility should develop and implement an Emergency Plan aimed at ensuring that facility management meets all legal requirements in developing, maintaining, exercising, and reporting emergency preparedness and resource activities. This plan should be consistent with a nationally recognized guideline such as the Canadian Standards Association's *Emergency Planning for Industry Major Industrial Emergencies*. [22] An appropriate emergency plan should:

(i) ensure the safety of workers, response personnel, and the public;
(ii) reduce the potential for the destruction of property or for actual product losses;
(iii) reduce the magnitude of environmental and other impacts;
(iv) assist response personnel in determining and performing proper remedial actions quickly;
(v) reduce recovery times and costs; and
(vi) inspire confidence in response personnel, industry, and the public.

[21] Canadian Standards Association, *Environmental Management Systems – Specification with Guidance for Use*, CAN/CSA-ISO 14001-96, 1996.

[22] Canadian Standards Association, *Emergency Planning for Industry Major Industrial Emergencies A National Standard of Canada*, CAN/CSA-Z731-95, January 1995.

4.5.5 Pollution Prevention Planning

RECOMMENDATION RI137 Each facility should develop and implement a Pollution Prevention Plan aimed at avoiding or minimizing environmental releases that is consistent with a nationally recognized guideline such as the Canadian Standards Association's *Guideline for Pollution Prevention.* [23]

4.5.6 Decommissioning Planning

RECOMMENDATION RI138 Planning for decommissioning should begin in the design stage of the project life cycle for new facilities and as early as possible in the operating stage for existing facilities. Decommissioning should be carried out in a way that ensures that limited adverse risk to the environment or human health will remain after closure. All site closures and associated decommissioning activities should be undertaken in accordance with the CCME's *National Guidelines for the Decommissioning of Industrial Sites*. [24]

4.5.7 Environmental Training

RECOMMENDATION RI139 Each facility should establish and maintain procedures to identify its environmental training needs and ensure that all personnel whose work may create a significant impact upon the environment have received appropriate training. The organization should also require that contractors working on its behalf are able to demonstrate that their employees have the requisite training. The environmental training program should include:

(i) a list by job title or classification of all personnel that require training; and
(ii) an outline of the topics to be covered, the training methods to be used, and the required frequency of refresher training for each group of personnel.

4.5.8 Environmental Facility Inspection

RECOMMENDATION RI140 Each facility should develop and implement an environmental inspection plan that includes:

(i) documented procedures for the inspection of each environmental facility including air emission control equipment; wastewater treatment facilities; liquid handling, storage, and containment facilities; waste handling, storage, and containment facilities; and air emission and wastewater monitoring and control instrumentation;
(ii) visual observations for air emission excursions and liquid leaks;
(iii) a documented schedule for inspections including timing of inspections and identification of a responsibility centre;
(iv) documented procedures for the reporting of inspection results to both internal management and external agencies; and
(v) documented procedures for follow-up to inspection reports.

4.5.9 Monitoring and Reporting

RECOMMENDATION RI141 Documented procedures should be developed and implemented for the monitoring and reporting of environmental performance data including:

(i) the identification of all parameters to be monitored and the associated sampling frequency;
(ii) definition of the procedures and protocols to be followed in sample collection, preservation, handling, shipment, and analysis;
(iii) action(s) to be undertaken when prescribed environmental criteria have been exceeded;
(iv) the means by which data are to be reported to government agencies and other stakeholders;
(v) quality assurance/quality control of the monitoring data;
(vi) reporting to the National Pollutant Release Inventory (NPRI) and, where applicable, the Accelerated Reduction/Elimination of Toxics (ARET) program; and

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[23] Canadian Standards Association, *Guideline for Pollution Prevention*, Z754-94, June 1994.

[24] Canadian Council of Ministers of the Environment, *National Guidelines for Decommissioning of Industrial Sites*, CCME-TS/WM-TRE013E, March 1991.

(vii) reporting on the status of implementation of this Environmental Code of Practice.

4.5.10 Environmental Auditing

RECOMMENDATION RI142 Each facility should conduct periodic internal environmental audits throughout the operating life of the facility as a means of assessing environmental risk, ensuring conformance with regulatory, appropriate non-regulatory, and corporate requirements, and identifying opportunities for improving environmental performance. The recommendations advanced in this Code of Practice should be included in the audit criteria.

4.5.11 Environmental Performance Indicators

RECOMMENDATION RI143 Each facility should develop a set of environmental performance indicators that provide an overall measure of the facility's environmental performance. These indicators would include a broad and practical set of ecological and economic elements that offer significant opportunities to link environmental performance to financial performance. An Environmental Performance Data Sheet that could be used for the development of the environmental performance indicators is contained in Appendix C.

4.5.12 Life Cycle Management

RECOMMENDATION RI144 Each corporate entity should develop and implement a Life Cycle Management (LCM) Program aimed at minimizing the environmental burdens associated with the products used and produced by its steelmaking facilities over the product life cycle. The LCM Program should include consideration of:

(i) types of materials used;
(ii) sources of supply of materials;
(iii) sources of energy used;
(iv) type and amount of packaging; and
(v) management of manufacturing by-products and wastes.

A summary of the International Iron and Steel Institute's Policy Statement on Life Cycle Assessment is available on the website at www.worldsteel.org/environment/env_life/index.html .

4.5.13 Community Advisory Panel

RECOMMENDATION RI145 Each facility should establish a Community Advisory Panel to provide a forum for the review and discussion of facility operations, environmental concerns, emergency preparedness, community involvement, and other issues that the Panel may decide are important.

The range of constituency categories could include local residents.

The Panel should be an advisory group and not a decision-making body.

4.5.14 Other

Other recommendations may follow.

Glossary of Terms

Acid Neutralization	Chemical treatment of water to eliminate acidity and remove iron compounds from solution.
Annealing	Controlled heating of steel to relieve cooling stresses induced by cold or hot working and to soften the steel to improve its machinability or formability.
Baghouse	An air pollution control device used to trap particulates by filtering gas streams through large fabric bags, usually made of glass fibres.
Blowdown	Refers to the controlled discharge of spent waters to limit the build-up of dissolved solids and other pollutants.
Carbon Steel	A kind of steel with various percentages of carbon and little or no other alloying elements; also known as straight carbon steel or plain carbon steel.
Clarifier Thickener	A settling tank that is used to remove settleable solids by plain gravity or colloidal solids by coagulation following chemical flocculation; will also remove floating oil and scum through skimming.
CO	Carbon monoxide is a normal product of incomplete fossil fuel combustion. CO is itself a fuel as it can be oxidized to form CO_2.
CO_2	Carbon dioxide is a product of fossil fuel combustion. Globally it is the dominant greenhouse gas.
COD	Chemical oxygen demand is the amount of oxygen required for the chemical oxidation of organic matter in a wastewater sample.
Cooling Tower	A device that reduces the temperature of the water through contact with air.
Dolomite	A mineral ($CaMg(CO_3)_2$) consisting of a calcium magnesium carbonate found in crystals and in extensive beds as a compact limestone.
Dry Dust Catcher	A device to remove solid particles from a gas stream.
Electrostatic Precipitator	An air pollution control device that removes particulate matter by imparting an electrical charge to particles in a gas stream for mechanical collection on an electrode.
Effluent	A release of pollutants into waters.
Emission	A release of pollutants into the air.
Emission Factor	The average amount of a pollutant emitted from each type of polluting source in relation to a specific amount of material processed.
Fabric Filters	A device for removing dust and particulate matter from industrial emissions, much like a home vacuum cleaner bag. Fabric filters are generally located in a baghouse.

Flocculation — In wastewater treatment, the process of separating suspended solids by chemical creation of clumps or flocs.

Fluorspar — Fluorspar is the commercial term for fluorite, a calcium fluoride mineral (CaF_2) that is used as a flux material in electric arc furnace operations to achieve the desired slag fluidity.

Fugitive Emissions — These emissions usually result from process leakage and spills of short duration that are associated with storage, material handling, charging, and other secondary process operations. Fugitive emissions are usually uncontrolled.

Galvalume — Steel sheet with a unique coating of 55% aluminium and 45% zinc that resists corrosion. The coating is applied in a continuous hot-dipped process, which improves the steel's weather resistance. Galvalume is a trademark of BHP Steel, and the product is popular in the metal building market.

Galvanizing — The process of applying a coating of zinc to the finished cold-rolled steel; the coating is applied by dipping in molten zinc (hot dip) or by the electrolytic method.

Hexavalent Chromium (Cr^{+6}) — Chromium in its hexavalent state.

ISO 14000 — The International Organization for Standardization (ISO) is an international federation of over 100 national standards bodies that since 1993 has been developing a series of integrated environmental management systems (EMS) standards, known as the ISO 14000 series.

Life Cycle Management — An integrated approach to minimizing the environmental impacts associated with a product or service through all stages of the life cycle.

Metalization — Refers to that portion of the total iron present as metallic iron.

Multiple-Cyclone Separator — An air pollution control device that separates particulate matter from a gas by spinning the gas in a vortex fashion. It consists of a number of small-diameter cyclones operating in parallel with a common gas inlet and outlet. The gas enters the collecting tube and has a swirling action imparted to it by a stationary vane.

New Facility — Any facility whose construction or reconstruction was not approved by the appropriate regulatory authority(ies) prior to the date of publication of this Code of Practice. Reconstruction means the replacement of components of an existing facility to such an extent that the fixed capital cost of the new components is a significant proportion (in excess of 50%) of the fixed capital cost of the facility.

Nm^3 — Refers to volume of gas at Normal conditions of 101.325 kPa and 25°C.

NO_X — Refers collectively to nitric oxide (NO) and nitrogen dioxide (NO_2) expressed as nitrogen dioxide equivalent.

Particulates — Particulates are any finely divided solid or liquid particles in the air or in an emission. Particulates include dust, smoke, fumes, and mist.

Scale	An iron oxide that forms on the surface of the hot steel.
Scale Pit	A settling basin for removing solid materials from water used on rolling mills. These solids are mostly mill scale, the flakes and particles of iron oxide that form on steel during heating. The solids sink to the bottom of the basin, from which they can be dredged for recycling. Oil rising to the surface of the basin can be skimmed off and reprocessed.
Scrubber	An air pollution control device that uses a liquid spray to remove pollutants from a gas stream by absorption or chemical reaction. Scrubbers also reduce the temperature of the gas stream.
Sedimentation	In wastewater treatment the settling out of solids by gravity.
Shaft Furnace	A refractory-lined vertical cylinder where iron pellets are fed into the top of the shaft furnace through a large number of distributor pipes, which reduce the possibility of size separation and gas channelling.
SO_2	Sulphur dioxide, formed primarily by the combustion of sulphur-containing fuels.
Stormwater	Any water from a precipitation event that is not considered to have been contaminated as defined by the appropriate regulatory agency.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Tempering	A special rolling procedure that adds hardness to the steel, usually applied after annealing.
Vacuum Degassing	Vacuum degassing is used as a refining operation to reduce the hydrogen content in the molten steel for rolling operations in order to prevent the formation of flakes or internal cracks.
Venturi Scrubber	An air pollution control device in which the liquid injected at the throat of a venturi is used to scrub particulate matter from the gas flowing through the venturi.
U.S. EPA	The environmental protection agency in the United States that is the U.S. equivalent to Environment Canada.
VOCs	Volatile organic compounds are also known as reactive organic gases (ROG) or non-methane volatile organic compounds (N-MVOC). Volatile organic compounds refer only to photochemically reactive hydrocarbons and therefore exclude compounds such as methane, ethane, and several chlorinated organics.
Wastes	Solid or liquid materials that are generated by production processes, maintenance, and demolition activities that have no further use and have to be disposed to appropriate disposal sites. Some wastes are classified as hazardous wastes. Recycled materials, by-products, and co-products that are sold or reused are not considered to be wastes.

Wastewater Any water that is known to contain a deleterious substance that originates in and is discharged from the plant. This includes the discharge of water used for direct cooling or cleaning, blowdown from water treatment systems, and water that has been contaminated by process leaks. This does not include water used for indirect cooling or stormwater.

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APPENDIX A POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) AND BENZENE EMISSION REDUCTIONS

The PAH and benzene emission inventories for the base year 1993, 1997, and 2000 industry commitments are shown in Table I.1 together with the percent reductions in emissions. The emission inventory for the base year was calculated for the SOR based on the best information available at that time. The 1997 emission inventory and the 2000 industry commitments are abstracted from the 1997 companies' submissions to ARET. Since naphthalene is not included in ARET, the naphthalene emissions for 1997 are taken from 1996 NPRI data[25], which are presumed to be similar to the 1997 emissions. The naphthalene emissions for the 2000 commitments are estimated from the 1996 NPRI data and the companies' commitments for the other PAH species. The benzene emissions are taken from the companies' ARET submissions for 1997 and their 2000 commitments. The emission inventories for both PAHs and benzene include emissions from both the coke ovens and the by-product plants.

Table I.1 PAH and Benzene Emission Reductions

Year and Subject	PAH emissions		Benzene emissions	
	Tonnes	Percent reduction	Tonnes	Percent reduction
1993 Baseline (SOR)[26]	186.4	N/A	1,237.1	N/A
1997 ARET 3 Report[27,28,29]	109.2	41	780.8	37
2000 Commitments (ARET 3 Report)	78.3	58	353.4	71
2000 SOR Targets	104.4	44	532.0	57

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APPENDIX B METHODOLOGIES FOR THE CALCULATION OF ENVIRONMENTAL PERFORMANCE INDICATORS

B.1 Methodology for Calculation of Particulate Emissions from Sinter Plants (Recommendation RI103)

- The Indicator should be based on sinter produced.
- The following particulate sources should be included in the Indicator:
  - particulate emissions from the sinter plant stack;
  - particulate emissions from the cooling, crushing and screening, handling and transport of sinter product, and the handling and transport of raw materials and waste materials; and
  - fugitive particulate emissions that are not collected by the emission control systems.
- All emission testing should be carried out downstream of the emission control devices.
- Measurement of the particulate emissions from the sinter plant stack and other emission control device(s) should be carried out in a manner that is consistent with the emission testing methodology referred to in Recommendation RI102.
- Testing should be carried out during normal operations, i.e., upset or malfunction conditions should be excluded.
- The particulate emission discharge from the emission control devices should be calculated in accordance with the formula:

$$(SPs \times Fp \times \Delta t) + \Sigma(Eo \times Fo \times \Delta t) = Ed$$

where: **SPs** is the sinter plant stack particulate concentration;
Fp is the sinter plant stack gas flow at standard conditions;
Eo is the other emission control system particulate emission concentrations (as applicable);
Fo is the other emission control system gas flows at standard conditions;
Δt is the duration of the selected production period;
Σ(Eo x Fo x Δt) is the sum of the discharges of other emission control devices; and
Ed is the total particulate emissions discharged from the control devices for the selected production period.

- The calculation of fugitive particulate emissions from sintering operations and sinter cooling, crushing, and handling operations should be based on fugitive emission factors that are widely used in the industry (e.g., EPA AP 42) for each of the sinter plant operations and the estimated capture efficiency of the emission collection systems. Fugitive particulate emissions should be calculated in accordance with the formula:

$$\Sigma\ [Ef \times (1 - Sc)] \times \Delta t = Fep$$

where: **Ef** is the fugitive particulate emission factor for the operation;
Sc is the emission control system estimated capture efficiency;
Δt is the duration of the selected production period; and
Fep is the fugitive particulate emission discharge to the atmosphere for the duration of the selected production period.

- The mass emission factor should be calculated for the selected production period in accordance with the formula:

$$(Ed + Fep) / Sp = MEF$$

where: **Sp** is the sinter production; and
MEF is the mass emission factor for the selected production period.

- The Environmental Performance Indicator is the average of the mass emission factors for three selected production periods.

B.2 Methodology for Calculation of Particulate Emissions from Blast Furnaces (Recommendation RI103)

- The Indicator should be based on liquid iron produced (iron tapped into hot metal car and pig casting).

- The following particulate sources should be included in the Indicator:

    - particulate emissions from the cast house including iron tapping, slag tapping, and iron and slag runners;
    - particulate emissions from hot metal treatment at the blast furnace (e.g., de-sulphurization);
    - particulate emissions from slag crushing, screening, granulating, and pelletizing; and
    - fugitive emissions from the above ironmaking operations.

- All emission testing should be carried out downstream of the emission control devices.

- Measurement of the particulate emissions from the emission control device(s) should be carried out in a manner that is consistent with the emission testing methodology referred to in Recommendation RI102.

- Emission testing should be carried out during normal operations, i.e., upset or malfunction conditions should be excluded.

- The particulate emission discharge from the emission control devices should be calculated in accordance with the formula:

$$\Sigma\ (P \times Fp \times \Delta t) = Ed$$

where: **P** is the emission control system particulate emission concentration;
Fp is the emission control system gas flow at standard conditions;
Δt is the duration of the selected production period;
Σ (P x Fp x Δt) is the sum of the discharges from the emission control systems;

and
Ed is the total particulate emissions discharged from the control devices for the selected production period.

- The calculation of fugitive particulate emissions from the ironmaking operations should be based on fugitive emission factors that are widely used in the industry (e.g., EPA AP 42) for each phase of the operations and the estimated capture efficiency of the emission collection systems. Fugitive particulate emissions should be calculated in accordance with the formula:

$$\Sigma [Ef \times (1 - Sc)] \times \Delta t = Fep$$

where: **Ef** is the fugitive particulate emission factors for the various ironmaking operations;
Sc is the emission collection system estimated capture efficiency;
Δt is the duration of the selected production period; and
Fep is the fugitive particulate emission discharge to the atmosphere.

- The mass emission factor should be calculated for the duration of the selected production period in accordance with the formula:

$$(Ed + Fep) / Sp = MEF$$

where: **Sp** is the liquid iron production; and
MEF is the mass emission factor for the selected production period.

- The Environmental Performance Indicator is the average of the mass emission factors for three selected production periods.

B.3 Methodology for Calculation of Particulate Emissions from Basic Oxygen Furnaces (Recommendation RI103)

- The Indicator should be based on liquid steel produced (steel tapped into ladle, not including liquid heel).

- The following particulate sources should be included in the Indicator:

  - primary particulate emissions from the BOF operations including charging, melting, and refining;
  - fugitive particulate emissions from the BOF operations that are collected by the secondary emission control system;
  - fugitive particulate emissions that are not collected by the secondary emission control system, including tapping and slagging;
  - particulate emissions from the hot metal (iron) transfer, ladle metallurgy, vacuum degassing, and continuous casting; and
  - particulate emissions from the flux handling and injection systems.

- All emission testing should be carried out downstream of the emission control devices.

- Measurement of the particulate emissions from the emission control device(s) should be carried out in a manner that is consistent with the emission testing methodology referred to in Recommendation RI102.

- Emission testing should be carried out during normal operations, i.e., upset or malfunction conditions should be excluded.

- The particulate emission discharge from the emission control device(s) for the primary and secondary systems for one production cycle (one heat of steel) should be calculated in accordance with the formula:

$$(P \times Fp + S \times Fs) \times \Delta t = Ed$$

where: **P** is the primary emission control system particulate emission concentration;
Fp is the primary emission control system gas flow at standard conditions;
S is the secondary emission control system particulate emission concentration where applicable;
Fs is the secondary emission control system gas flow at standard conditions;
Δt is the duration of the selected production period, and
Ed is the total particulate emissions discharged from the control devices for the selected production period.

- The calculation of fugitive particulate emissions from the BOF operations should be based on a fugitive emission factor that is widely used in the industry (e.g., EPA AP 42) for each phase of the operations and the estimated capture efficiency of the secondary emission collection system. Fugitive particulate emissions should be calculated in accordance with the formula:

$$[Ef \times (1 - Sc)] \times \Delta t = Fe$$

where: **Ef** is the fugitive particulate emission factor for the BOF operation;
Sc is the secondary emission collection system estimated capture efficiency;
Δt is the duration of one production cycle (one heat of steel); and
Fe is the fugitive particulate emission discharge to the atmosphere.

- The calculation of particulate emissions from the particulate emission control devices for other operations should be based on testing of the emission control devices. The formula that should be used is:

$$\Sigma(Flp \times Ffl \times \Delta t) = Fle$$

where: **Flp** is the control device particulate concentration;
Ffl is the control device gas flow at standard conditions;
Δt is the duration of the production cycle;
Σ(Flp x Ffl x Δt) is the sum of the particulate discharges from the emission control devices; and
Fle is the total particulate emissions discharged from the emission control devices for one production cycle (one heat of steel).

- The mass emission factor for a heat of steel should be calculated for one production cycle (one heat of steel) in accordance with the formula:

$$(Ed + Fe + Fle) / Sp = MEF$$

where: **Sp** is the liquid steel production; and
MEF is the mass emission factor for one heat.

The Environmental Performance Indicator is the average of the mass emission factors for three production cycles.

B.4 Methodology for Calculation of Particulate Emissions from Electric Arc Furnaces (Recommendation RI103)

- The Indicator should be based on liquid steel produced (steel tapped into ladle, not including liquid heel).

- The following particulate sources should be included in the Indicator:

  - primary particulate emissions from the electric arc furnace operations including charging, melting, and refining;
  - fugitive particulate emissions from the above electric arc furnace operations that are collected by the secondary emission control system;
  - fugitive particulate emissions that are not collected by the secondary emission control system, including tapping and slagging;
  - particulate emissions from ladle metallurgy, vacuum degassing, and continuous casting; and
  - particulate emissions from the flux handling and injection systems.

- All emission testing should be carried out downstream of the emission control devices.

- Measurement of the particulate emissions from the electric arc furnace emission control device(s) should be carried out in a manner that is consistent with the emission testing methodology referred to in Recommendation RN101.

- Testing should be carried out during normal operations, i.e., upset or malfunction conditions should be excluded.

- The particulate emission discharge from the emission control device(s) for the primary and secondary systems for one production cycle (one heat of steel) should be calculated in accordance with the formula:

$$(P \times Fp + S \times Fs) \times \Delta t = Ed$$

where: **P** is the primary emission control system particulate emission concentration;
Fp is the primary emission control system gas flow at standard conditions;
S is the secondary emission control system emission particulate concentration where applicable;
Fs is the secondary emission control system gas flow at standard conditions;
Δt is the duration of the production heat cycle; and
Ed is the total particulate emissions discharged from the control devices for the production heat cycle.

- The calculation of fugitive particulate emissions from the electric arc furnace operations should be based on a fugitive emission factor that is widely used in the industry (e.g., EPA AP 42) for each phase of the operations and the estimated capture efficiency of the secondary emission collection system. Fugitive particulate emissions should be calculated in accordance with the formula:

$$[Ef \times (1 - Sc)] \times \Delta t = Fe$$

where: **Ef** is the fugitive particulate emission factor for the electric arc furnace operation;
Sc is the secondary emission collection system estimated capture efficiency;

Δ**t** is the duration of the production heat cycle; and
Fe is the fugitive particulate emission discharge to the atmosphere.

- The calculation of particulate emissions from the particulate emission control devices for other operations should be based on testing of the emission control devices. The formula that should be used is:

$$\Sigma(\mathbf{Flp} \times \mathbf{Ffl} \times \Delta \mathbf{t}) = \mathbf{Fle}$$

where: **Flp** is the control device particulate concentration;
Ffl is the control device gas flow at standard conditions;
Δ**t** is the duration of the production cycle;
Σ(Flp x Ffl x Δt) is the sum of the particulate discharges from the emission control devices; and
Fle is the total particulate emissions discharged from the flux emission control devices for the duration of the production heat cycle.

- The mass emission factor for a heat of steel should be calculated for a complete production cycle of a heat of steel in accordance with the formula:

$$(\mathbf{Ed} + \mathbf{Fe} + \mathbf{Fle}) / \mathbf{Sp} = \mathbf{MEF}$$

where: **Sp** is the liquid steel production; and
MEF is the mass emission factor for the production of one heat of steel.

- The Environmental Performance Indicator is the average of the mass emission factors for three production cycles.

B.5 Methodology for Calculation of Total Suspended Solids Discharges from Integrated Steel Mills (Recommendation RI122)

- The Indicator should be based on liquid steel produced (steel tapped into ladle, not including liquid heel).

- Wastewater from the following discharge sources should be included in the Indicator:

  - Sinter plant operations;
  - cokemaking operations including by-product plant;
  - ironmaking operations;
  - steelmaking operations including ladle metallurgy operations, vacuum degassing and continuous casting;
  - hot forming operations;
  - cold forming and finishing operations including cleaning, pickling, and coating;
  - direct cooling;
  - environmental control operations; and
  - service activities (e.g., maintenance and steam generation);.

- All wastewater discharges to receiving water bodies should be included (non-contact cooling water not included). Wastewater discharges to municipal treatment facilities that meet the municipal wastewater quality requirements should not be included.

- Wastewater sampling and analyses should be carried out in a manner that is consistent with the methodology referred to in Recommendation RI121 and is downstream of the wastewater treatment facilities where applicable.

- Wastewater flow measurement should be carried out in a manner that is consistent with the methodology referred to in Recommendation RI124 and is downstream of the wastewater treatment facilities where applicable.

- The total suspended solids measurement for the Indicator should be based on a 30-day average.

- The total suspended solids discharge should be calculated by the formula:

$$\Sigma(\mathbf{TSS} \times \mathbf{Fw} \times \Delta \mathbf{t}) / \mathbf{Sp} = \mathbf{Ti}$$

where: **TSS** is the total suspended solids concentration;
Fw is the flow of each wastewater discharge;
Δt is the elapsed time of the measurement period (e.g., 30 days);
Σ(TSS x Fw x Δt) is the sum of the total suspended solids discharges;
Sp is the liquid steel production for the measurement period; and
Ti is the total suspended solids Environmental Performance Indicator.

B.6 Methodology for Calculation of Water Use/Recycle for Integrated Steel Mills (Recommendation RI124)

- Sources of wastewater discharges should include those resulting from direct-contact cooling, environmental control operations, all production operations including sintering, cokemaking, ironmaking, steelmaking, hot forming, cold forming, finishing, and service activities (e.g., maintenance and steam generation).

- Wastewater discharges should include discharges to receiving water bodies and to municipal treatment facilities.

- Water use on the basis of a once-through system should be calculated based on flow measurements or engineering calculations for all uses.

- Wastewater discharge on the basis of actual cascading and re-circulation should be calculated based on discharge flow measurements, engineering calculations, or engineering estimates.

- Flow measurements should be carried out in a manner that is consistent with the methodology referred to in Recommendation RI124 for the operating units and downstream of the wastewater treatment facilities.

- The recycle rate should be calculated in accordance with the following general principles and formula:

  Once-through flow is measured, calculated, or estimated for the following activities:

  Direct-contact cooling flow + process water flow + potable water flow = total once-through water flow or **TWF**.

Actual water discharge flow is measured, calculated, or estimated for the following activities:

Direct-contact cooling discharge flow + process water discharge flow + potable water discharge flow = total wastewater discharge flow or **TWD**.

The recycle rate is then:

$$\mathbf{(TWF - TWD)\ /\ TWF = Wr}$$

where: **Wr** is the water recycle rate.

APPENDIX C ENVIRONMENTAL PERFORMANCE DATA SHEET

Environmental Performance Profile Data Sheet (EPPDS)

Minerals and Metals Sectors **Steel Manufacturing Sector**

Identification: **NPRI Identification No.:** ____________________

Manufacturer
Company: ____________________
Address: ____________________
____
Website: ____________________
Contact person: ____________________
Tel: ____________________
Fax: ____________________
E-mail: ____________________

Product and By-product Information**

	1999	1998	1997	1996	1995
Steel Shipped					
Production (tonnes)					
Liquid Steel					
Iron					
Coke					
By-products (tonnes)					
Coke Breeze					
Light Oil					
Slag					
Other (specify)					

****Definition** A by-product is a material that is produced and sold during the production of another material (or other materials) whose production and sales form(s) the economic basis of the operation. The operation would be economically viable even if the by-products were not produced or, in the case of wastes, were disposed of rather than sold.

Prepared by: ____________________

Date: ____________________

Environmental Management Systems, Policy, Plans, Participation

	Yes/No	Other Comments (e.g. date of issue, developed with public involvement, publicly available)
Environmental Policy Statement		
Commitment to:		
Environmental Assessment		
Emergency Planning		
Pollution Prevention Planning		
Decommissioning Planning		
Environmental Training		
Environmental Facility Inspection		
Monitoring and Reporting		
Environmental Performance Indicators		
Life Cycle Management		
Environmental Reporting		
Part of Corporate Report		
Separate Environmental Report		
Sustainable Development Report		
Environmental Management System		
EMS in place		
Registered to ISO 14001		
Commitment to ISO 14001		
Environmental Auditing		
Environmental Management Agreement		
With Federal Government		
With Provincial Government		
With Local Government		
Virtual Elimination Plans		
Community Advisory Panel		
Participation		
In NPRI		
In ARET		
Other (specify)		
Compliance (most recent year – specify)		
% Compliance		
Number of Exceedences – Ambient Air		
Number of Exceedences – Effluent		
Number of Notices of Violations		
Number of Fines		
Number of Prosecutions		

Sources

Raw Materials Sources	
From mines and quarries (specify source(s), type, tonne/yr)	
From recycled sources (specify source(s), type, tonnes/yr)	
From other sources (specify source(s), type, tonnes/yr)	
Energy Use/Sources	
Efficiency (Gj/product unit)	
Hydroelectric (% of total)	
Fossil fuels (%)	
Nuclear (%)	
Biomass/land fill gas (%)	
Cogeneration (%)	
Other sources (%)	
Water Use	
Process water (m^3/product unit)	
Cooling water – direct	
Cooling water – indirect	

Release Attributes

Air Emissions	
Regulations (Federal, Provincial)	
Voluntary (ARET, Management)	
Agreement, Environment Canada Codes, other)	
Total Particulate Matter (TPM)	
Maximum Concentrations (mg/m^3)	
Annual Release (tonnes/yr)	
Loading (kg TPM/tonne product)	
PM_{10} (% of total)	
$PM_{2.5}$ (% of total)	
Maximum Ambient Concentrations	
CEPA Toxics (specify)	
Annual Release (tonnes/yr)	
Loading (kg /tonne product)	
Maximum Ambient Concentrations	
Dioxins and Furans	
Tests conducted?	
Annual Release (gr ITEQ/yr)	
Loading (nanogr/tonne product)	
Hexachlorobenzene	
Tests conducted?	
Annual Release (gr ITEQ/yr)	
Loading (nanogr/tonne product)	
Others (specify)	
Sulphur Dioxide	
Annual Release (tonnes/yr)	
Loading (kg/tonne product)	
Maximum Ambient Concentrations	
Nitrogen Oxides	
Annual Release (tonnes/yr)	
Loading (kg/tonne product)	
Volatile Organic Compounds (VOC)	
Annual Release (tonnes/yr)	
Loading (kg/tonne product)	

Carbon Monoxide	
Annual Release (tonne/yr)	
Loading (kg tonne product)	
Greenhouse Gases	
CO_2 (kg/tonne product)	
N_2O (kg/tonne product)	
CH_4 (kg/tonne product)	
(Other (e.g. HFC, PFC))	
Annual Release (kg/yr)	
Liquid Effluents	
Regulations (Federal, Provincial)	
Voluntary (ARET, other)	
Total Suspended Solids (TSS)	
Maximum Concentrations (mg/L)	
Annual Release (kg/yr)	
Loading (kg TSS/tonne product)	
CEPA Toxics	
Metals (e.g. As, Cd, Cr^6, Pb, Ni, Hg, other)	
Maximum Concentrations (mg/L)	
Annual Release (kg/yr)	
Loading (kg/tonne product)	
Other (e.g. solvents)	
Maximum Concentrations (mg/L)	
Annual Release (kg/yr)	
Loading (kg/tonne product)	
Other Metals (e.g. Cu, Zn)	
Maximum Concentrations (mg/L)	
Annual Release (kg/yr)	
Loading (kg/tonne product)	
Maximum/Minimum Ph	
Acute lethal toxicity	
(Rainbow Trout and *Daphnia magna*)	
Environmental Effects Monitoring	
Waste Materials	
Regulations (Federal, Provincial)	
Voluntary (ARET, other)	
Annual Release (tonne/yr)	
Loading (kg/tonne product)	
On site, type of treatment	
Off site, type of treatment	

Releases – Historic and Commitments (tonnes/year)

Substance	Commitment			Historic						
	2015	2005	2000	1999	1998	1997	1996	1995	1994	1993
Arsenic, Inorganic Compounds										
Air										
Water										
Waste										
Benzene										
Air										
Water										
Waste										
Cadmium, Inorganic Compounds										
Air										
Water										
Waste										
Chromium, Hexavalent Compounds										
Air										
Water										
Waste										
Dioxins/Furans **										
Air										
Water										
Waste										
Fluorides, Inorganic										
Air										
Water										
Waste										
Lead										
Air										
Water										
Waste										
Mercury *										
Air										
Water										
Waste										
Nickel, Oxidic, Sulphidic, and Soluble										
Air										
Water										
Waste										
Polychlorinated Biphenyls (PCBs) *										
Air										
Water										
Waste										
Polycyclic Aromatic Hydrocarbons (PAHs)										
Air										
Water										
Waste										
Tetrachloroethylene										
Air										
Water										
Waste										
1,1,1-trichloroethane										
Air										
Water										
Waste										
Trichloroethylene										
Air										
Water										
Waste										

Releases – Historic and Commitments (tonnes/year) (continued)

Notes * kilograms per year
** grams per year

Please attach reference documents as appropriate.

The Environmental Performance Profile Program is being developed under the auspices of Environment Canada, Minerals and Metals Division and associated mineral and metals sectors associations and corporations.

In calculating loadings, particular stressors and metrics were chosen to allow for the presentation of site-specific data. The data contained within this EPPDS are based on annual values and thus represent average conditions that apply to the production of the product.

The system boundary used in this quantification starts with raw materials and ends at the facility gate. This boundary includes the energy used for the transportation and processing of all raw materials and the on-site or off-site treatment of liquid effluent. It excludes the energy used for transportation of raw materials other than that to the facility and any potential downstream effects after the product has left the facility.