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A PRACTICAL GUIDE TO POLLUTION PREVENTION PLANNING FOR THE IRON AND STEEL INDUSTRIES

A pollution prevention program is dynamic. Like an engine that needs tinkering and attention, your program will need periodic review and updating as new options are developed or identified. Any cost savings associated with a particular option will go unaccounted if an evaluation is not performed.

There is only one final message to convey once you have completed your first successful waste reduction project.

LET OTHERS KNOW OF YOUR SUCCESS

and then tell them again. As stated in Step 1, pollution prevention requires some in-house marketing. **BE SURE TO DO IT!**

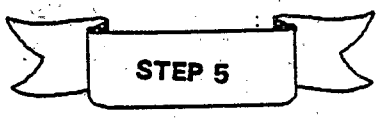
POLLUTION PREVENTION PAYS

Such a final report is necessary. It helps to focus subsequent pollution prevention efforts and will be useful as a record of what aspects of the mill have been examined for pollution prevention opportunities.

WRITE A FINAL ASSESSMENT REPORT!

The assessment teams should consider report review a top priority before the report is issued in final form. Managers and other experienced people in the production units that will be affected by the proposed projects should be asked to review the report. Their review will help to ensure that the projects proposed are well-defined and feasible from their perspectives. While they probably were involved in the site reviews and other early efforts of the task force, they may spot inaccuracies or misunderstandings on the part of the assessment teams that were not apparent before.

STEP 5: IMPLEMENT THE POLLUTION PREVENTION PROGRAM



Implementation of waste reduction options that your audit team has determined are feasible and which management has approved is a turning point in the assessment process. Here you can put into practice those recommendations that make the most economical and technical sense into practice. The process of implementation involves four steps:

1. Justify the Project Using all Collected Technical and Economic Data
2. Obtain Funding
3. Install Equipment/Implement Procedure
4. Evaluate Performance

If you adhere to this model, recommended waste reduction options will be easier to implement because the appropriate data will be available to properly evaluate the project and to ultimately judge its effectiveness.

Cost competitive issues make cost a primary concern for iron and steel. Therefore, implement low-cost, low-tech waste reduction options first. Generally, these options can be put in place almost immediately. Their effect can be readily seen. Move on to more capital-intensive options after careful evaluation. Examples of low-cost options which do not require major capital investments and have an immediate payback include:

- Good housekeeping to prevent waste through spills.
- Use of quality resealable containers to prevent loss from spills and evaporation.
- Rigid inventory control to insures that you use only what material you need.
- Segregation of wastes to enhance recycling (for example, keep solvents out of used oil) or segregate waste streams as previously noted for EAF's.
- Employee education about waste reduction and hazardous materials control.
- Locating another business to use your waste as a recycled material.

Evaluate your success by formally reviewing your waste reduction efforts. It is important to document your waste reduction efforts and keep track of costs of various options (raw material consumption, waste generation decreases, etc.). This information will be useful when evaluating the success of your program.

Efforts to reduce waste at the source go against the grain of traditional pollution control practice, which emphasizes "end-of-the-pipe" or "top-of-the-stack" control. It may take time for employees to get used to this new way of thinking. Pollution prevention options, even low-tech ones, should be implemented carefully, building consensus among workers and management to generate support for the changes. Moreover, options may result in procedural changes within the mill, which may require an orientation period.

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A PRACTICAL GUIDE TO POLLUTION PREVENTION PLANNING

by

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

AIPP
AMERICAN INSTITUTE FOR POLLUTION PREVENTION

Steel the recycled material

October 14-15, 1992

Embassy Suites Hotel
Chicago, Illinois

FOREWORD

Until recently, businesses and industries throughout the United States did not generally concern themselves with the concept of preventing, reducing, or minimizing the generation of industrial pollutants. It was a widely accepted notion that the generation of unusable material in large quantities was, in some cases, an inevitable part of doing business. When regulations required it, companies installed some mechanical device on the end of a pipe or stack, or paid to have the unusable material buried or burned.

Significant progress has been made by the iron and steel industry over the last several decades for improving environmental conditions through the implementation of end-of-the-pipe, top-of-the-stack, and land ban regulations. The pollution control laws, with their associated pollution control equipment and EPA enforcement, were aimed at specific media (air, land, and water). Such laws have limitations, however.

In 1990, the United States Congress established "pollution prevention" as a top priority by passing the Pollution Prevention Act of 1990. This act cuts across the former media divisions of air, land, and water and declares that a broad-based look at all pollution generation is necessary. By taking this preventive approach, industry and individuals can minimize air pollution, solid and hazardous wastes, waste water discharges, reduce the consumption of valuable resources, such as energy and water, lower their potential liability, and save money.

NOTICE

This manual was produced by engineers at Blasland, Bouck and Lee, under a cooperative grant from the U.S. Environmental Protection Agency (EPA) to the University of Cincinnati, Department of Civil and Environmental Engineering. It has been subject to review by staff from EPA Region V, a steering committee of member companies of the American Iron and Steel Institute (AISI), and others. Review does not signify that the contents necessarily reflect the views and policies of the EPA, nor does the mention of any specific products constitute recommendation or endorsement of such a product.

This manual supplements a Conference held October 14-15, 1992, in Chicago, Illinois. The conference, entitled *Pollution Prevention for the Iron and Steel Industry*, was co-sponsored by the EPA, AISI, and the American Institute for Pollution Prevention (AIPP). The aim of the conference was to provide an opportunity for individuals from industry, federal and state government, non-profit organizations, and consulting firms to exchange information on technical and policy issues related to pollution prevention for the iron and steel industry.

The objective of this manual and associated computer aids is to assist in the education of individuals within the iron and steel community on the concepts of pollution prevention, why pollution prevention is important, and how to develop a facility-specific pollution prevention plan. References for valuable guidance documents and additional information are also provided at the end of this document to aid in the preparation of a pollution prevention plan.

ACKNOWLEDGEMENTS

Documents are never prepared without the aid of a great many individuals, many of whom do not receive credit on the title page. This manual is no exception. Numerous individuals have contributed to the revision and update of this document from all over the country; some through direct conversation, some through the contributions of their written works on pollution prevention, and others simply by their helpfulness and support of this project.

Specific thanks go to the organizers and backers of this conference:

Linda Glass
EPA Headquarters

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EPA Region V

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EPA Region V

Karen Martin
EPA Region V

Bruce Steiner
AISI

Gary Allie
AISI

Tom Hauser
University of Cincinnati

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Barbara Bachman
Bethlehem Steel

Anthony Spinola
USX

John Heintz
National Steel

Lawrence Szuhay
LTV Steel

A great number of phone calls were made to solicit speakers for the conference and obtain current pollution prevention information for the iron and steel industry. This manual and the conference would not have been completed without the help of:

- Tom Hauser, Department of Civil and Environmental Engineering at the University of Cincinnati, who served as the director of the cooperative grant with EPA.
- David Thomas of the Hazardous Waste Research and Information Center, who provided us with many contacts for speakers and case study information.
- The people at the Waste Reduction Institute for Training Application Research (WRITAR), especially Terry Foecke, Al Innes, and Bob Styles.
- Employees of U.S. EPA's Pollution Prevention Staff, Theresa Harten at RREL (ORD, EPA Cincinnati, Everett Moten at the 33/50 program, and numerous others whose names have escaped us at the moment.
- Peter Wieczorowski at the Steel Manufacturers Association.
- Speakers at the Pollution Prevention Conference for the Iron & Steel Industry

ABSTRACT

Blasland, Bouck & Lee developed this Practical Guide to Pollution Prevention Planning for individuals from the iron and steel industry who are interested in pollution prevention. Its aim is to provide an overview of just what pollution prevention is, and provide specific ideas for pollution prevention planning within the industry.

The guide presents a six step approach to undertake pollution prevention planning. The steps describe specific and detailed tasks such as how to obtain company-wide support, how to organize a pollution prevention task force, how to undertake the necessary audits and assessments, and how to implement the developed plan. Reference materials and useful worksheets are provided in the Appendices.

The support for the development of this guide was provided by the U.S. Environmental Protection Agency under a cooperative grant to the Department of Civil and Environmental Engineering, University of Cincinnati.

who volunteered to participate and share valuable pollution prevention information.

Special thanks go to Elizabeth Starling and Billie Smith, in our office, for their help with word processing, page layout, production of this manual and associated computer aids.

In addition, much of the outline for this manual came from the use of valuable guidance documents, especially:

- *Facility Pollution Prevention Guide*, released by EPA in May 1992.
- *Profiting from Waste Reduction in Your Small Business*, David Wigglesworth, Alaska Health Project, 1988.
- *Industrial Processes for Pollution Prevention and Waste Minimization*, C.R. Newman, A.E. Rimer, 1991.

A PRACTICAL GUIDE TO POLLUTION PREVENTION

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Increased efficient use of raw materials, energy, water, and other resources is one method of implementing pollution prevention. Conservation of natural resources is another method.

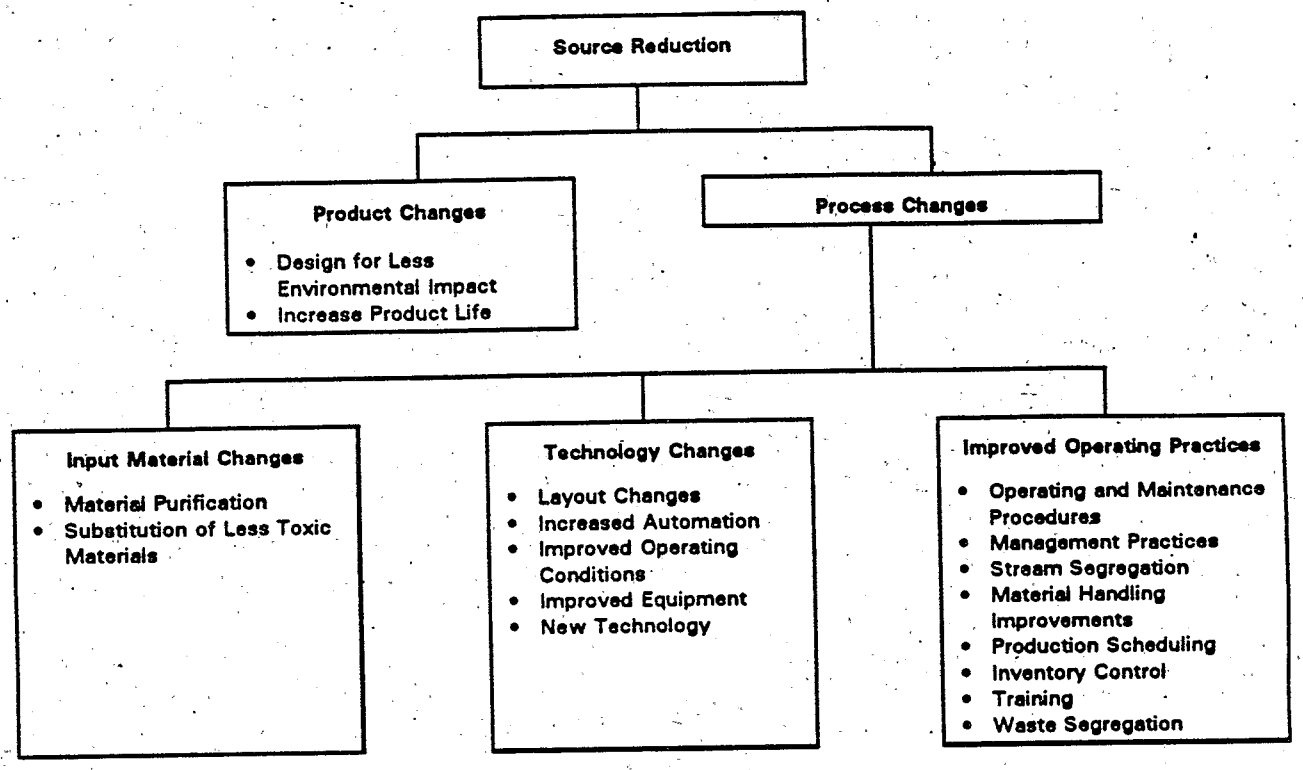


Figure 1.1 Typical Source Reduction Examples
(Adapted from EPA *Facilities Pollution Prevention Guide*, May 1992)

The United States Environmental Protection Agency (EPA), pursuant to the "Pollution Prevention Act of 1990" and the "Pollution Prevention Strategy", established a comprehensive definition as outlined in a May 28, 1992 letter to all EPA personnel from Deputy Administrator, F. Henry Habicht II.

Under Section 6602(b) of the Pollution Prevention Act of 1990, Congress established a national policy that:

EPA Deputy Administrator Henry Habicht II outlined the official definition of Pollution Prevention in May 1992.

CHAPTER 1
POLLUTION PREVENTION

What Is Pollution Prevention?

THE NEW APPROACH TO MANAGEMENT OF POLLUTANTS--POLLUTION PREVENTION

Despite years of implementing "end-of-the-pipe" solutions and stringently regulating hazardous material disposal, substantial amounts of pollution are still being released into the environment. A new approach to environmental protection is necessary in order to maintain and improve the environment and our quality of life. This new approach will require industries to assess their production processes, to evaluate their purchasing decisions, and to improve their maintenance practices. Simply put, industries need to find new ways to prevent pollution at the source.

The concept of pollution prevention is very important in today's society. Industries are concerned with the increasing cost of raw materials. Stringent environmental control laws and regulations are restricting the way some businesses operate. Potential financial and criminal liability associated with disposal of waste materials increasingly concern industry executives. In addition, consumers dislike of industrial pollution and their strong influence on profit has caused industry officials to analyze their production processes. Pressure from foreign competition has also required that companies become very cost conscious. All of these examples should make one realize that pollution prevention planning can be beneficial. As we shall see, this may be particularly true for the iron and steel industry as it seeks to improve its competitive edge.

What exactly is pollution prevention, you may ask? Many different definitions of pollution prevention have been developed by numerous individuals and organizations over the last several years. Pollution prevention, often referred to as source reduction, includes practices that maximize the reduction or elimination of the generation of pollution. Figure 1.1 illustrates several examples of source reduction.

The term includes: equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

Under the Pollution Prevention Act, recycling, energy recovery, treatment, and disposal are not included within the definition of pollution prevention. Some practices commonly described as "in-process recycling" may qualify as pollution prevention. Recycling that is conducted in an environmentally sound manner shares many of the advantages of prevention--it can reduce the need for treatment or disposal, and conserve energy and resources.

Some "in-process recycling" may qualify as pollution prevention.

[While not directly related to the iron and steel industry, we thought it might be interesting for you to also see EPA's pollution prevention definition as it applies to other sectors, which was part of Mr. Habicht's letter. (Ed.)]

Pollution prevention approaches can be applied to all pollution-generating activity, including those found in the energy,agriculture, Federal, consumer, as well as industrial sectors. The impairment of wetlands, ground water sources, and other critical resources constitutes pollution, and prevention practices may be essential for preserving these resources. These practices may include conservation techniques and changes in management practices to prevent harm to sensitive ecosystems. Pollution prevention does not include practices that create new risks of concern.

- pollution should be prevented or reduced at the source whenever feasible;
- pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible;
- pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and
- disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

Pollution prevention means "source reduction," as defined under the Pollution Prevention Act, and other practices that reduce or eliminate the creation of pollutants through:

--increased efficiency in the use of raw materials, energy, water, or other resources, or
--protection of natural resources by conservation.

The Pollution Prevention Act defines "source reduction" to mean any practice which:

--reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and
--reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.

HIERARCHY OF PREFERRED POLLUTION PREVENTION OPTIONS:

- **Source Reduction**
- **Recycling**
- **Treatment**
- **Disposal**

Pollution prevention, source reduction, or any other terms that may apply is basically nothing more than a common sense approach to managing resources. No matter what the term, the philosophy is the same: reduce the quantity of waste at, or close to, its source. After all, wastes can be thought of as out-of-place resources. This philosophy makes good business sense.

Management of pollutants has most often been viewed as a bottom line issue, a cost incurred after everything else is paid for. When viewed as a cost associated with a particular product or production line, these costs can more adequately be identified and reduced, and thus are less of a drain on a company's financial resources. To put this in perspective, you might, in round numbers, consider how much your operation actually spends on pollution management.

For an individual process, when each line is filled in, the results can be quite surprising.

• Wasted Raw Materials	
• Wasted Energy	$_____
• Pollution Control Equipment Costs (for Air, Water, Solid Wastes)	$_____
• Debt Service for Capital Equipment	$_____
• Wastewater Treatment/Air Pollution Control Process Operating Costs	$_____
• Hazardous Waste Transportation and Disposal Costs	$_____
• Environmental Management Costs	$_____
TOTAL	$_____ *More than you think*

When considering even one individual process, when each of the blanks above are filled with an estimate of pollution control costs and the total is computed, the results can be quite surprising. This is particularly true in the iron and steel industry, as we shall see in Chapter 6 Case Studies. Pollution prevention helps to focus on putting misplaced resources back where they belong; towards more profitable production rather than down the drain or into the atmosphere.

In the agricultural sector, pollution prevention approaches include:

--reducing the use of water and chemical inputs;
--adoption of less environmentally harmful pesticides or cultivation of crop strains with natural resistance to pests; and
--protection of sensitive areas.

In the energy sector, pollution prevention can reduce environmental damages from extraction, processing, transport, and combustion of fuels. Pollution prevention approaches include:

--increasing efficiency in energy use;
--substituting environmentally benign fuel sources; and
--design changes that reduce the demand for energy.

What Pollution Prevention Is Not

As Ed Wailer of the Office of Pollution Prevention (OPP) indicated in an interview with *Water Environment and Technology*, hierarchical policy makes a clear distinction between pollution prevention and measures that are applied after wastes are generated. He noted that the official EPA definition of pollution prevention does not include any practice that "alters the physical, chemical, or biological characteristic or the volume of a hazardous substance, pollutant or contaminant. Thus, off-site recycling, waste treatment, concentration, or dilution of waste streams, and the transfer of pollutants from one environmental medium to another are not considered pollution prevention measures because they are actions taken after wastes have been generated.

Environmentally sound recycling is preferred over other treatment options and disposal should be used only as a last resort.

Recycling energy recovery, treatment and disposal are not pollution prevention.

While it is important to list all of these groups within a company who impact on pollution prevention, it is important that we do not lose sight of the fact that a company is made up of individual workers. Pollution prevention can not happen if individuals do not take the initiative to make something happen.

When developing a pollution prevention plan, a multi-disciplinary task force should be assembled that includes individuals from any group or department in the company that has a role in the generation of pollution or an interest in the outcome of the pollution prevention program. This pollution prevention task force typically is responsible for:

Responsibilities of a Pollution Prevention Task Force

- Obtaining a commitment and a statement of policy from corporate management
- Establishing overall pollution prevention goals (measurable)
- Prioritizing the wastestreams, facility areas or functional areas for assessment
- Selecting assessment teams
- Conducting (or supervising) a pollution prevention assessment
- Conducting (or monitoring) technical and economic feasibility analyses of favorable options
- Selecting and justifying feasible options for implementation
- Obtaining funding and establishing a schedule for implementation
- Establishing a system to measure progress towards pollution prevention goals
- Monitoring (and/or directing) implementation progress
- Communicating pollution prevention success throughout the organization

What This Manual Is All About

The successful implementation of a pollution prevention program should result in a consistent set of procedures for projects ranging from waste materials management and overall waste reduction to the implementation of

What You Can Do

A pollution prevention program affects a variety of manufacturing and management groups within a company. In fact, almost everyone within an organization can, in some measure, impact the generation of pollution:

- **Upper Management** sets a corporate pollution prevention philosophy
- **Engineering** designs the process operations
- **Operations** runs the process
- **Maintenance** keeps the equipment in good repair
- **Material Control** determines and organizes material resources
- **Purchasing** purchases materials
- **Receiving** accepts/rejects production materials
- **Warehousing** stores and distributes production materials
- **Facilities Management** provides the appropriate production environment
- **Quality control** ensures customer satisfaction
- **Accounting** watches the bottom line
- **Human Resources** provides a trained work force
- **Health and Safety** assures a safe work place
- **Research and Development** develops new products and ideas
- **Legal** reads and interprets regulations
- **Environmental Management** picks up the pieces

ALL EMPLOYEES OF THE CORPORATION SHOULD BE INVOLVED IN POLLUTION PREVENTION

The overall goals of the manual are to help the reader to:

- Promote the understanding of pollution prevention concepts
- Understand regulatory requirements for pollution prevention
- Recognize that pollution prevention, when applied correctly, will result in a positive economic impact on the manufacturing process
- Understand the multidisciplinary and multi-media nature of pollution prevention
- Understand and be able to identify areas amenable to pollution prevention
- Understand and be able to develop and evaluate specific options for pollution prevention
- Be able to develop and implement a plan for pollution prevention

HOW IS THIS MANUAL ORGANIZED?

This manual is organized in chapters:

CHAPTER 2 describes HOW TO DEVELOP A POLLUTION PREVENTION PROGRAM;

CHAPTER 3 lists the ELEMENTS OF A POLLUTION PREVENTION PROGRAM;

CHAPTER 4 discusses methods to MEASURE PROGRESS AND MAINTAIN POLLUTION PREVENTION Programs;

CHAPTER 5 discusses the ECONOMIC ANALYSES of a pollution prevention program; and,

CHAPTER 6 provides CASE STUDY examples.

The APPENDICES provide information on implementation materials, additional references, an overview of existing industrial and state waste minimization programs, a description of the Pollution Prevention Information Exchange System (PIES), the EPA Source Reduction Review Project and other relevant background materials.

management programs. To meet this goal, this manual has been written as an aid in the development of a facility-specific pollution prevention plan that can be applied, with modifications, to your mill. Inherent in this plan and set of procedures are protocols for identifying and evaluating options for pollution prevention. Figure 1-2 illustrates the development of a workplace waste reduction program in a simple, easy to understand format.

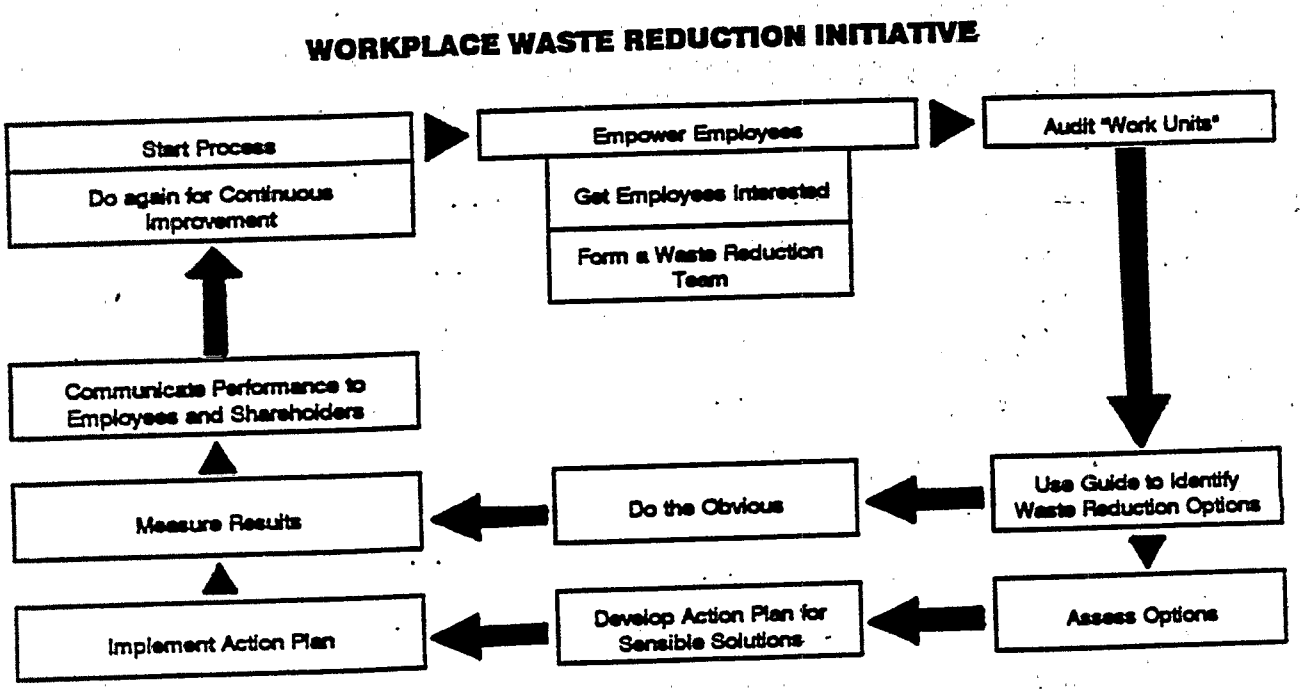


Figure 1.2 Workplace Waste Reduction Initiative
(adapted from President's Commission on Environmental Quality Pamphlet, Summer 1992)

This manual supplements and complements the Iron and Steel Conference held in Chicago, October 14, 15, 1992. Members of the industry, and those who serve it (consultants, vendors, etc.), gathered to explore the experiences of others in the industry who have applied pollution prevention in their facilities. This manual seeks to provide basic information and management tools needed to initiate or formalize a process and facility-specific pollution prevention program.

These steps can easily be modified to fit the needs of each individual mill and/or process. Steps 1 and 2 address the concept of how to develop a pollution prevention plan and are addressed in this chapter. Steps 3 through 5 deal with the elements of a pollution prevention plan and are presented in Chapter 3. Chapter 6 covers Step 6, getting the word out on your pollution prevention success stories. These steps have been adapted from the EPA *Facility Pollution Prevention Guide*, May 1992. Figure 2.1 illustrates an overview of the six step process.

In order to begin the ambitious task of developing a pollution prevention program, one must first understand the way in which a facility works. Intuitively, it is clear that the industrial processes must be understood before they can be evaluated for pollution prevention opportunities. However, unless management, research and development, purchasing, and shipping, for example, are included in a facility assessment, many opportunities for pollution prevention activities may be otherwise overlooked.

POLLUTION PREVENTION IDEAS CAN START ANYWHERE IN A COMPANY

It does not matter from where the first rumblings of a pollution prevention program come. Lower level managers, process employees, or individuals at the executive level can all act as a catalyst. It is, however, important to secure company-wide support to implement a successful pollution prevention program. Once it has been established that the development of a pollution prevention program is worthwhile, the commitment to begin such a project should be conveyed through a formal policy statement that establishes the framework for communicating, to the entire mill, the need and benefits of a pollution prevention program.

CHAPTER 2
HOW TO DEVELOP A POLLUTION PREVENTION PROGRAM

The First Steps

Successful pollution prevention has a well-conceived planning process as its foundation. The planning process is comprehensive and continual, affecting most functional areas of a company. However, it also generally has much in common with the planning for other aspects of the business. The following ideas present the basic steps necessary to undertake pollution prevention planning.

The Basic Steps of Pollution Prevention Planning

Step 1: Recognize the Need for Pollution Prevention
- Establish the Pollution Prevention Program
- Organize a Pollution Prevention Program
- Conduct a Preliminary Assessment

Step 2: Write a Pollution Prevention Program Plan
- Develop Pollution Prevention Plan Goals and Objectives
- Identify Potential Obstacles
- Define Individual Roles
- Develop schedule

Step 3: Conduct a Pollution Prevention Assessment

Step 4: Decide What Steps to Take
- Define Pollution Prevention Options
- Perform Feasibility Analysis
- Write an Assessment Report

Step 5: Implement the Pollution Prevention Program

Step 6: Get the Word Out
- Measure Progress
- Maintain Pollution Prevention Program

STEP 1: RECOGNIZE THE NEED FOR POLLUTION PREVENTION

ESTABLISH THE POLLUTION PREVENTION PROGRAM

The best place to begin your involvement with pollution prevention planning is by educating individuals in your organization, especially those in management, about just what pollution prevention is and how company policies concerning pollution prevention can be developed. These steps will lead to the establishment of a pollution prevention program. In order to convince individuals in management, or those who hold ultimate fiscal authority, that pollution prevention should be a goal of the corporation, successful marketing of the benefits of pollution prevention is necessary. The following can serve as an outline to help begin the marketing effort.

Pollution Prevention Saves Money and Energy

Pollution prevention can result in reduced costs. When less pollution is produced, less storage space is required, less pretreatment is necessary, fewer transportation and disposal costs are incurred, and less paperwork for regulatory tracking is necessary. More efficient manufacturing operations results in the use of fewer raw materials and less energy required to produce steel.

Pollution Prevention Reduces Potential Liability

If less pollution is produced, there will be less transported to treatment and disposal facilities, which may result in a decrease in the potential liability associated with future the site clean-up. In addition, it reduces the potential for the facility to be out of compliance with local, state and federal environmental laws. Also, by decreasing pollution output, facilities can typically increase the health and safety of their Workforce and the surrounding community.

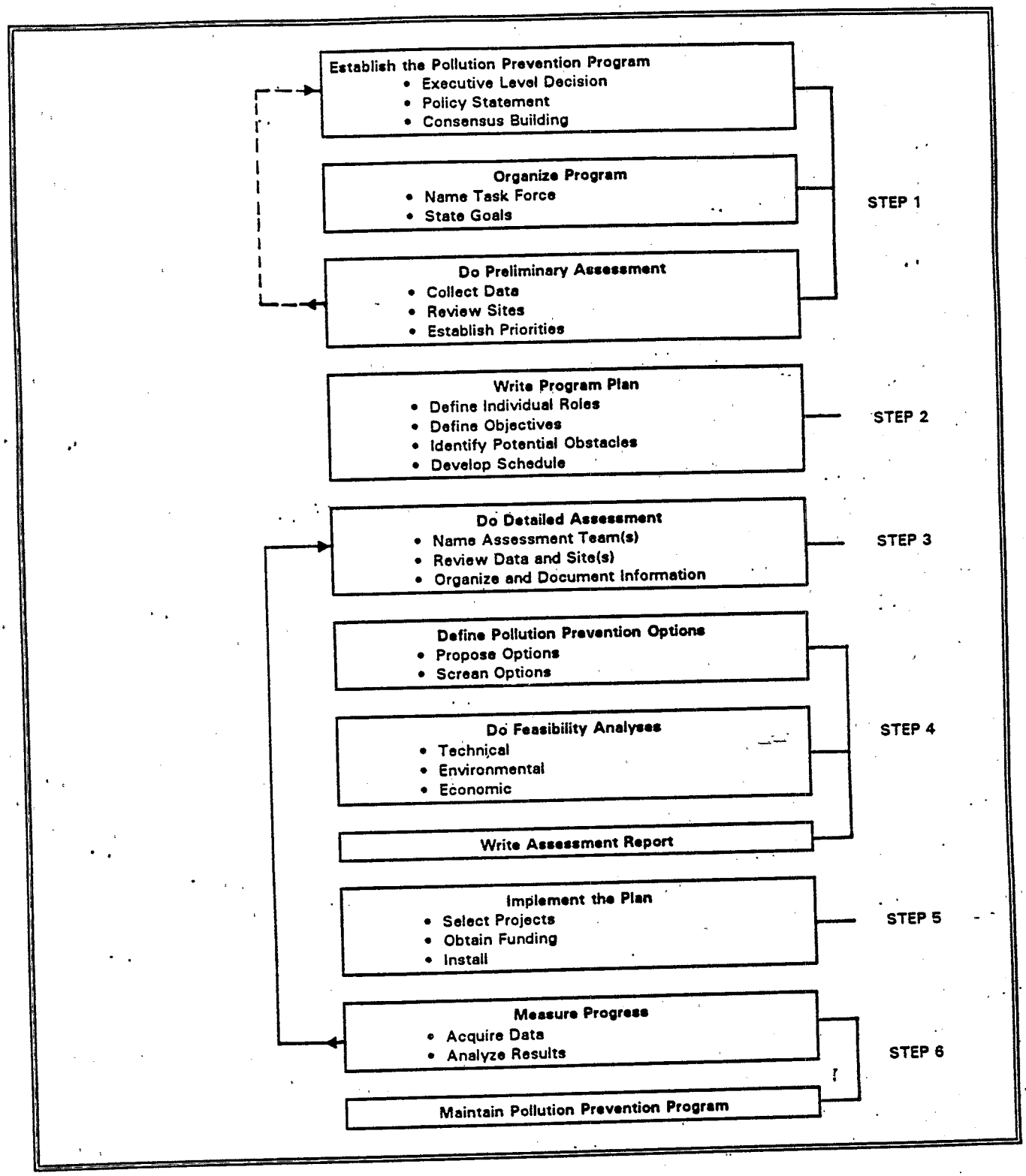
STEP 1

ESTABLISH THE PROGRAM

- Pollution Prevention saves money and energy
- Pollution Prevention reduces potential liability
- Pollution Prevention enhances image
- Pollution Prevention reduces toxics

FIGURE 2.1 POLLUTION PREVENTION PROGRAM OVERVIEW

(Adapted from *EPA Facilities Pollution Prevention Guide*)



Employees' commitment to Pollution Prevention can be encouraged by:

- Helping define company goals and objectives.
- Reviewing processes and operations to determine where and how toxic substances are used and hazardous wastes are generated.
- Recommending ways to eliminate or reduce waste production at the source.
- Designing or modify forms and records to monitor materials used and waste.
- Finding ways to involve suppliers and customers.
- Thinking of ways to acknowledge and reward employee contributions to the pollution prevention effort.

Adapted from EPA *Federal Pollution Prevention Guide*

ORGANIZE A POLLUTION PREVENTION PROGRAM

SELECT A MULTIDISCIPLINARY POLLUTION PREVENTION TEAM

The next step in developing a plan is to organize the staff that will make up the pollution prevention team. It is important to select a multi-disciplinary team from throughout the mill. Obtain a copy of the facility organization chart to select the individuals who might participate on the team. It is important to seek upper management participation and to ask for and utilize those who might volunteer in this effort.

Careful selection of staff who will participate in such an effort will pay dividends later in the process. In particular, their attitude towards the effort will have a direct impact on the eventual success of the effort. The team may include personnel from:

Accounting	Material Control
Engineering	Operations
Environmental Management	Purchasing
Facilities Management	Quality Control
Health and Safety	Research and Development
Human Resources	Receiving
Legal	Upper Management
Maintenance	Warehousing

All individuals who are invited or volunteer to assist with the development of a pollution prevention plan should

Pollution Prevention Enhances the Corporate Image

Citizens are much more aware of industrial pollution output, due to increased public awareness and community Right-to-Know laws. Citizens are looking for the industry to reduce the amount of toxic, and other wastes or emmissions. By implementing and publicizing pollution prevention activities, the iron and steel industry can improve their standing with the regulatory community and with citizens.

Pollution Prevention Reduces Toxic Discharges

Awareness of the dangers associated with hazardous materials has increased the research into alternatives to such materials. Substitutes exist for many of the toxic chemicals in use today in a typical mill. Pollution prevention assessments can identify these hazardous materials and reduce their use within the process operations.

Once management recognizes and supports the need for pollution prevention, a clear corporate commitment needs to be conveyed to all employees. A written policy statement should be prepared, which clearly outlines why the company is implementing a pollution prevention plan, what will be done to implement the plan, who will implement the plan, and asking for each individual's support of the program. Samples of policy statements are included in the Appendix.

Employees will feel committed to pollution prevention when they are encouraged to participate in the development of a plan as illustrated below:

Pollution Prevention Preliminary Assessment Check List

Division: _____
Date completed: _____
Person completing form: _____

INSTRUCTIONS:

Check the appropriate answer for each question.
Yes means that the company business plans are promoting pollution prevention.
No means that the company business plans are not promoting pollution prevention.
Not sure means that the company needs to further evaluate the plan in that area.

A. OPERATIONS PLAN EVALUATION	YES	NO	NOT SURE
1. Are workers and management developing a plan to promote waste reduction in your company?	[ ]	[ ]	[ ]
2. Are business procedures designed to promote source reduction?	[ ]	[ ]	[ ]
3. Is the company recycling every waste that it can?	[ ]	[ ]	[ ]
4. Does the company know the quantity of waste (liquid, solid, gaseous) produced by each process?	[ ]	[ ]	[ ]
5. Is the company shop kept clean and orderly to reduce the chance of spills and increase efficiency?	[ ]	[ ]	[ ]
6. Does the company have a recycling program for computer, ledger, and mixed paper?	[ ]	[ ]	[ ]
7. Has the company determined that air emission waste produced in the plant can or cannot be recycled?	[ ]	[ ]	[ ]
8. Are process wastes segregated to enhance recovery of raw materials?	[ ]	[ ]	[ ]
9. Do workers know which process reduction produces waste?	[ ]	[ ]	[ ]
10. Does the company operations plan include periodic waste reduction audits?	[ ]	[ ]	[ ]
11. Does your company maintain MSDSs to evaluate raw materials prior to purchase to ensure you are using the least toxic material possible?	[ ]	[ ]	[ ]
12. Is Inventory stock limited to prevent possible spills and to avoid over purchasing and other waste?	[ ]	[ ]	[ ]
13. Does the company request pre-purchase information on the waste generating potential for new equipment?	[ ]	[ ]	[ ]
14. Do purchase agreements include provisions for inspecting shipments of raw materials prior to acceptance to ensure that they are not leaking and creating a waste?	[ ]	[ ]	[ ]
15. Does the company attempt to exchange wastes that cannot be reduced at the source?	[ ]	[ ]	[ ]
16. Can fire suppression systems handle a major emergency involving the hazardous material used and waste produced?	[ ]	[ ]	[ ]
17. Are storage areas designed to minimize earthquake damage, control spills, and other mishaps?	[ ]	[ ]	[ ]
18. Are all workers trained about what to do in the event of a hazardous materials incident?	[ ]	[ ]	[ ]
19. Does company policy promote employee training and development in the area of waste reduction?	[ ]	[ ]	[ ]

have an understanding of, and an interest in, pollution prevention. They should want to participate, since a motivated and knowledgeable team is very important to the success of pollution prevention plan implementation.

SELECT A TEAM LEADER WITH A STRONG INTEREST IN POLLUTION PREVENTION

Once the entire team is selected, one individual should be selected from among this group to act as team leader. A leader is necessary to provide the guidance to keep the team and the planning process moving on track. The leader should have both the influence and authority to insure that pollution prevention is adopted by the corporation. Other individuals should be appointed to serve as leaders of specific tasks during the development of the pollution prevention plan, according to their skills and interests. For example, a manager from the electric arc furnace operation might be selected to conduct a waste audit while the purchasing department representative might be responsible for organizing an evaluation of possible alternatives for hazardous materials substitution.

CONDUCT A PRELIMINARY ASSESSMENT

Once the pollution prevention team has been selected, it is valuable to sit down and assess the facility in terms of pollution prevention opportunities. The following *Pollution Prevention Preliminary Assessment Check List* can be distributed to different divisions within your mill to begin a preliminary assessment. The answers may well prove useful in preparing the goals and objectives for your pollution prevention plan. It will also assist the pollution prevention team to review already available data and establish ways to assess that data. It is a start and can be adapted to your mill by adding additional questions at the end of each section. *[This form is included in Word Perfect 5.1 format on the enclosed computer disk for your use and modification, ed.].*

THE OBJECTIVE OF THE FIRST PHASE OF DATA COLLECTION IS TO OBTAIN AN OVERVIEW

In this first phase of data collection, the objective is to get an overview of the processes and operation areas where pollution prevention can best be applied. Another useful form is worksheet 2, *Site Description,* included in the Appendix. Data collection just for the sake of accumulating data is not very useful. In fact, much of

the data may already be available as part of your response to existing regulatory requirements. A multi-media approach, including air, water, and solid waste emissions and releases is most effective. Sources of information to consider include regulatory reports from the National Pollutant Discharge Elimination System (NPDES), SARA Title III reports or the Toxic Release Inventories (TRI). The new Form R, used to track these releases (SARA Title III, Section 313) requires the reporting of pollution prevention efforts. Steel companies which have volunteered to participate in EPA's 33/50 program have accumulated data which may be valuable.

ALREADY AVAILABLE DATA

- **NPDES Reporting**
- **TRI Reporting**
- **33/50 Reporting**

STEP 2: WRITE A POLLUTION PREVENTION PROGRAM PLAN

STEP 2

DEVELOP POLLUTION PREVENTION PLAN GOALS AND OBJECTIVES

With the answers to the above questions in hand, the next step is to establish goals and objectives to define the long-term direction for the pollution prevention program. These goals and objectives will serve as a guide to get the project started and help evaluate the progress over an extended time period. By initially establishing a set of realistic goals and objectives, the team has a place to turn if the project gets off track.

Goals can be qualitative, spelling out a general direction in which to head. Quantitative goals, however, are typically of greater value. A goal such as "the electric arc furnace division will achieve a 90% reduction (or recycling) of EAF sludge by 1995" specify exact pollution reduction amounts and provide a numeric basis by which to measure progress. Most importantly, in setting up pollution prevention planning goals, such goals need to be achievable, challenging, and flexible. Over time, a facility's focus may change, and economics that once were unfavorable may become promising. Goals should be periodically reviewed and adjusted to keep the program up to date as lessons are learned.

B.	**RECORD-KEEPING PLAN EVALUATION**			
1.	Are records maintained on the amount of raw material used per process to monitor process efficiency?	[ ]	[ ]	[ ]
2.	Are logs maintained on the types and the quantities of waste produced so that specific wastes can be targeted for waste reduction?	[ ]	[ ]	[ ]
3.	Are MSDSs or equivalent information used to help identify possible hazardous waste stream?	[ ]	[ ]	[ ]
4.	Does the company have written plans and procedures to document plant operation procedures and waste reduction policies?	[ ]	[ ]	[ ]
C.	**FINANCIAL PLAN EVALUATION**			
1.	Are waste generation and disposal costs included in profit and loss statements?	[ ]	[ ]	[ ]
2.	Have waste generation costs been determined for each process in the business?	[ ]	[ ]	[ ]
3.	If yes, do you charge the costs directly to the process?	[ ]	[ ]	[ ]
D.	**MARKET PLAN EVALUATION**			
1.	Do you and your workers recognize the importance of proper materials management and wastes/emmisions reduction?	[ ]	[ ]	[ ]
2.	Do your marketing strategies incorporate a positive public image related to the reduction of emmisions?	[ ]	[ ]	[ ]
3.	Do you publicize your company's efforts to reduce the production of all environmental emmissions?	[ ]	[ ]	[ ]

Adapted from *Profiting from Waste Reduction in Your Small Business*, David Wigglesworth, Alaska Health Project, 1988

with the generation and treatment of waste materials. Because innovative pollution prevention programs can result in the elimination of entire waste streams, costly control equipment would not be necessary. However, companies may have already installed the equipment, or the equipment may be required by law. The EPA is attempting to change this. As mandated in the Pollution Prevention Act of 1990, the Agency is implementing the Source Reduction Review Program (SRRP). This program, outlined in the enclosed pamphlet, has as its goal to foster the following:

> *The use of source reduction measures is the primary means of achieving compliance. Initially, the project focus is to ensure that source reduction measures and multi-media issues are considered during the development of air, water, and hazardous waste standards affecting certain industrial categories. For the long term, the project aims to provide a model for the regulatory development process throughout EPA.*

Institutional

Companies may not fully implement pollution prevention strategies, due to corporate reluctance to change production processes for fear of degrading product quality or quantity. More often than not, their accounting practices do not highlight the need for pollution prevention. In addition, companies do not typically promote their successes with pollution prevention projects due to competition from other firms. Because pollution prevention is multidisciplinary by nature, traditional organizational structures often do not accomodate plans and activities that cut over a variety of departments.

OVERCOME BARRIERS TO PROMOTE POLLUTION PREVENTION

Both industry and government need to re-examine how each looks at pollution generation and pollution prevention. The EPA has moved towards helping industry overcome many of these barriers. They have defined much of what is and is not classified as pollution

IDENTIFY POSSIBLE OBSTACLES

While pollution prevention is a relatively simple concept, and sometimes may be easy to implement, many times there are barriers which impede the success of such a plan. Barriers can be economic, technical, regulatory, and very often institutional. Examples of each may include:

OBSTACLES TO POLLUTION PREVENTION

- Economic
- Technical
- Regulations
- Institutional

Economic

Financial constraints may prohibit a company from making the investments necessary to implement a pollution prevention plan. The company simply may not have the capital required to upgrade inefficient processes or have the staff to discover the different options. For example, when faced with the decision to make changes to rolling mill operations to improve product quality or reduce pollution, product quality will win every time. A means of permitting the pollution prevention project to "compete" economically with product improvement is the challenge when capital dollars available for investment are scarce. One means of pursuing this is through total cost accounting, which assures that all waste generation costs for all environmental media have been determined for each process and that those costs are charged directly to the process.

Technical

Pollution prevention plans do not often consist of equipment that companies can purchase, take out of a box, read the instructions, and install. Limited flexibility in process inputs, lack of space within a facility to incorporate new recovery equipment, or simply lack of information and assistance in conducting a pollution prevention audit can all be difficult obstacles to overcome.

Regulatory

Government regulations have typically taken an end-of-the-pipe or top-of-the-stack approach in dealing

- Specify use of non-hazardous materials for new facility construction, when possible.

- Specify use of non-hazardous materials for production processes, when possible.

- Meet with suppliers on a regular basis to discuss product substitution for hazardous materials.

- Design chemical storage areas with appropriate containment and with no connections to any drain.

- Decrease water flowrates where possible by using techniques such as:

  - Water reuse by processes requiring lower quality water;
  - Use of spent process waters as heat transfer media;
  - Wastewater reuse for feedstock makeup water;
  - Compatible wastewater used for process equipment cleanup;
  - Pump seal water used for rinse makeup water; and
  - Use of treated wastewater for makeup water where possible.

- Properly segregate wastewaters that significantly differ in composition or concentration.

- Provide adequate spill containment structures that will route any spill directly to a waste treatment system or to a segregated containment area to lessen the possibility for widespread contamination.

prevention. They have established an Office of Pollution Prevention, which, among other work tools, serves as a repository for documentation of pollution prevention projects, and undertakes their own research into several areas of pollution prevention. Industry needs to capitalize on the opportunity to explore various options for pollution prevention activities rather than be forced to accept a required technology under pollution control laws. Both the EPA and industry need to continue to work together, however, to reduce or eliminate these barriers. In Region V, this conference serves as one step in reducing the barriers to pollution prevention.

DEFINE INDIVIDUAL ROLES

Once the company is committed to the notion of pollution prevention, the organization of a program to identify and develop pollution prevention opportunities will be built upon the foundation provided by the firm's functional organization. Each functional group within the organization must be called upon to contribute to the overall goal of effective pollution prevention. Roles for each functional group are outlined below.

Management's role in pollution prevention is to decide to establish a pollution prevention program and upper management should:

- convey the commitment to pollution prevention to all employees through a formal policy statement.
- provide resources and support to the pollution program

Engineering's role in pollution prevention is site and process specific. Engineering staff should:

- Consider waste minimization in each step of product and process design and coordinate product design with process engineering.
- Document materials used in each step of the process.

FUNCTIONAL GROUPS THAT IMPACT ON THE MILL'S POLLUTION PREVENTION PROGRAM

- Management
- Engineering
- Manufacturing
- Maintenance
- Materials Control
- Purchasing
- Receiving
- Warehousing
- Facilities Management
- Accounting
- Human Resources
- Research & Development
- Legal
- Environmental Management

- Evaluate equipment maintenance procedures to insure that equipment functions at peak efficiency.

- Assure that all valves and pipes are leak free.

- Assure that all sources of fugitive emmissions are eliminated or reduced.

Material Control designs pollution reducing materials into the process. This function should:

- Project accurate chemical use requirements to maintain a **minimum** inventory.

- Establish a minimum/maximum chemical inventory (not to exceed some pre-determined level at any one time in inventory).

Purchasing's function is to procure the raw materials and equipment necessary to run the mill. Some possible tips for this function include:

- Use as few chemical suppliers as possible to achieve better prices and to ensure that suppliers are familiar with your requirements

- Purchase a chemical only if it has been approved for purchase by your Environmental Management group and if a Material Safety Data Sheet (MSDS) has been received and reviewed.

- Ensure that chemical container size is consistent with normal chemical use; chemicals should be purchased in as large a container as practical in order to minimize the number of containers requiring disposal, but not so large as to prohibit the complete emptying of the container.

- Arrange for chemical deliveries on a just-in-time basis in order to minimize on-site storage requirements. Use a local chemical supplier if possible.

- Require chemical suppliers to accept any shipment rejected for any reason and accept for return, even at

- Make sure that the mill's spill prevention plan is up to date and reviewed regularly.

- Investigate and evaluate the economics of barcoding techniques to track chemical materials from entry into the mill to their use and ultimate disposal.

Operations (Manufacturing) role is to make the product but reduce waste emissions to the lowest possible level. Pollution prevention staff should:

- Segregate waste streams.

- Use equipment properly and efficiently.

- Report any defective equipment.

- Ensure adequate spill prevention and containment in production/chemical use area.

- Replace chemical solutions on a regular schedule, but only as required by the contamination resent.

- Use trained personnel for chemical transfer operations.

- If possible, automate chemical supply to production line to ensure chemical conservation and accurate chemical dosage.

- Monitor chemical use per unit of production and establish an acceptable range for usage.

- Maintain contact with the environmental management group.

Maintenance keeps the mill and equipment in good repair to assure optimum performance for mechanically based pollution prevention options. Staff should:

- Insure that all water use is minimized with proper valving and spray nozzles.

approved chemical list from the appropriate authority.

- Have a well developed and documented hazardous chemical spill response plan to minimize contamination in the event of a chemical spill.

Warehousing has the responsibility to store and distribute production materials, spare parts, etc. They should:

- Store chemicals properly or move to use area immediately upon receipt, to lessen the potential for spills.
- Plug any drains to sanitary storm or process sewers leading from storage area, or assure that bulk storage areas are properly designed.
- Store chemicals in original leak-free, properly identified containers only.
- Minimize available storage areas to discourage unnecessary storage.
- Store chemicals in the same place consistently and away from other materials.
- Maintain inventory information in the storage area.
- Maintain maximum/minimum quantities for inventory and post values.
- Ensure that all materials received are properly labelled.
- Not dispense any chemicals in the chemical storage area.
- Conduct a chemical product inventory every month and compare with manifest.
- Return unused chemicals to the supplier or to a proper chemical storage site.

some cost, any unused or unusable chemical.

- Require chemical suppliers to propose nonhazardous substitute chemicals for engineering evaluation.

- Notify receiving personnel when a chemical has been purchased and when delivery is expected, providing information concerning container size, weight, MSDS, and any special information.

- Negotiate for waste disposal services from the chemical supplier, as a condition for purchase.

- Arrange for use of returnable chemical containers as a condition of purchase.

- Monitor receipt, of and disbursement of, chemicals by use of a log.

- Do not choose a waste disposal firm or waste transporter based on cost alone; seek advice or direction from a knowledgeable source. Choice of such a firm is better left to Environmental Management with Purchasing performing the price negotiation.

Receiving's responsibility is to accept appropriate production materials. The receiving staff should:

- Receive only those chemicals that have been ordered and only those meeting the specifications detailed on the purchase order such as container size, etc.

- Receive only those chemicals for which there exists an MSDS and a company authorization to purchase.

- Never receive damaged or leaking chemical containers.

- Document receipt of all chemicals immediately, including transporter information, etc.

- Maintain copies of all MSDS and the approved chemicals list; request periodic updates of the

Accounting's function in pollution prevention cannot be overemphasized. In fact, adopting accounting standards which fairly represent pollution prevention projects can often be the single most important criteria for accepting or rejecting a proposed pollution prevention project. Accounting should:

- Assign costs for waste disposal to the area of operation which generates the waste budget control.
- Monitor and report all costs associated with hazardous and nonhazardous waste activities.
- Establish an acceptable return on investment for waste minimization capital projects to evaluate costs associated with potential liabilities due to hazardous waste activities.
- Investigate insurance carrier considerations due to activities associated with handling hazardous waste.

Human Resources provides a trained work force to implement the adopted pollution prevention plan.

- Train all employees in the concepts of pollution prevention.
- Encourage all staff to suggest pollution prevention projects.
- Develop an employee incentive program to foster employee involvement.
- Minimize the number of personnel involved in hazardous material handling
- Ensure adequate and routine training of hazardous material handlers and proper use of personal protective equipment

Research and Development is involved with the development of new products or new production methods. Their involvement in the pollution prevention

For the issuance of chemicals, the following may apply:

- Dedicate a person(s) to issue chemicals
- Issue chemicals to approved personnel only
- Document all chemical issuances
- Update existing inventory
- Rotate stock

Facilities Management role is to assure thtat proper utilities are available to run the facility and that water conservation and energy efficient processes are used wherever possible. The facilities management staff should:

- Implement a water reuse program.
- Assist in segregating various waste streams.
- Minimize the use of water conditioning chemicals or use nontoxic/nonhazardous corrosion inhibitors and bactericides.
- Develop and adhere to a preventive maintenance program for all units requiring replacement of potentially hazardous materials.
- Maintain inventories and use rates of lubricating oils, etc., consistent with a preventive maintenance program.
- Use degreasing solvents, where possible, that are recyclable by the original supplier.
- Minimize the amount of waste oils stored on site.
- Use nonhazardous cleaners and degreasers where possible.
- Use industrial cleaning services for rags, uniforms, etc.

ESTABLISH PRIORITIES AND DEVELOP SCHEDULE

Assigning priorities to processes, operations, and materials, as noted below, will focus the remainder of the pollution prevention plan development effort. When priorities are set at this stage, they will guide the selection of possible projects for the detailed assessments. Criteria may be targeted based on the volume of waste produced or the cost of disposal. Regulatory concerns such as the RCRA land disposal restrictions or SARA Title 313 chemicals may also guide prioritization.

Typical considerations for prioritizing waste streams for further study include:

- compliance with current and anticipated regulations
- costs of waste management (pollution control, treatment, and disposal)
- potential environmental and safety liability
- quantity of waste
- hazardous properties of the waste (including toxicity, flammability, corrosivity, and reactivity)
- other safety hazards to employees
- potential for pollution prevention
- potential for removing bottlenecks in production or waste treatment
- potential recovery of valuable by-products
- available budget for the pollution prevention assessment program and projects
- minimizing air emissions
- minimizing waste water discharges
- reducing energy use

The final aspect of planning your pollution prevention program is to list the milestones within each of the stages from detailed assessment through implementation and assign realistic target dates. This effort will then assist you in implementing the development of the plan as outlined in Chapter 3. Sticking to the schedule may also help control the startup or implementation costs of the program.

planning process is vital. Research and Development staff should:

- Consider pollution generation and pollution prevention when undertaking development of a new or refinement of an existing processes.

- Devote resources to evaluating alternative methods for steel making processes; e.g. consider the research on dezincing galvanized steel currently underway by numerous organizations.

Legal can be involved in the pollution prevention planning effort as well. The legal staff can:

- Use their knowledge of environmental regulations and requirements to help identify areas where pollution prevention activities can save money by reducing corporate liability.

Environmental Management generally has been left to "pick up the pieces" and deal what is left over. Now, with the advent of pollution prevention programs, they are more involved, providing support and resources and sometimes leading the pollution prevention effort.

- Prepare an environmental impact statement with the assistance of engineering for each product and process to ensure use of non-hazardous materials whenever possible.

- Conduct the hazardous material management and reduction program plant-wide.

- Perform regular environmental compliance audits.

- Review hazardous materials data from Form R and evaluate for pollution prevention opportunities.

- Maintain contact with operations.

In conducting a detailed assessment of your facility, it is necessary to:

- Select assessment teams;
- Review data and sites; and
- Organize and document data.

SELECT ASSESSMENT TEAMS

A detailed assessment focuses on each operational area from materials handling, to operation of the furnaces, to the rolling mills and beyond. Assessment teams are developed, assigned to each identified area of operation, and given the responsibility to gather and develop data and plans for later evaluation. The first task step in this process is to recruit members of the pollution prevention task force.

Using several teams presents some logistical problems, but spreads the work load among more staff members, most of whom will probably not have a lot of time to devote to this effort. The team leader will typically be an individual with experience and hopefully some pollution prevention experience. Teams are normally composed of three to five members. A typical team for a rolling mill operation might include the team leader (environmental engineer), the rolling mill supervisor, a maintenance engineer, the lead foreman and a shift leader.

In addition to a candidate's qualifications based on their expertise, it is also important that they have an interest and commitment to making the pollution prevention program work. Creative thinking is critical.

REVIEW DATA AND SITE(S)

In the preliminary assessment, data that was readily available from NPDES or SARA Title III reports was collected and reviewed. In this more detailed phase, additional data sources will be identified and in some cases sampling may be undertaken. Site review

CHAPTER 3
ELEMENTS OF A POLLUTION PREVENTION PROGRAM

In simple terms, a pollution prevention program is the application and integration of proven engineering, operation, and management techniques oriented toward the goal of improving process operating efficiency to the degree that wastes are minimized, first at the source and then by a variety of other techniques as noted in the definition of pollution prevention in Chapter 1. This chapter describes the basic steps that need to be taken to develop a pollution prevention program.

For example, an effective pollution prevention program for hazardous wastes will address all issues surrounding the specification, purchase, inventory, storage, issuance, and communication of all chemical materials used in production, maintenance, and general facility operations. The goal of minimizing hazardous wastes is to apply effectively and efficiently the basics of sound engineering and management to reduce this use. Similar examples can be developed for many other procedures. This chapter outlines how to do it.

STEP 3: CONDUCT A POLLUTION PREVENTION ASSESSMENT

While a pollution prevention assessment could be a simple walk-through survey of the mill to visually identify opportunities for waste reduction, it should be a more technical process which involves waste stream sampling and engineering analysis. The assessment can focus on only one waste stream and process, or it can become an extensive mill-wide analysis. Whichever approach is taken, it is important to understand the basics of process operations before beginning the assessment. While the pollution prevention audit may uncover compliance issues, one purpose of this audit is to understand and identify pollution prevention opportunities.

ORGANIZE AND DOCUMENT DATA

It is important to walk through your facility to observe manufacturing operations. By conducting a walk-through, the audit team will be able to verify the information obtained earlier, as well as collect additional information, and get a clear profile of the waste generating processes and operations in the business. A walk-through will also provide the audit team a chance to objectively look at their facility. The use of videotapes and pictures is particularly recommended.

In the more detailed audit, you will want to collect additional data. Check with appropriate mill offices for information which may be available to help your audit team complete this task. They include:

- Accounting Information
- Annual records
- Available lab analyses
- Emissions inventories
- Employee interviews
- Environmental compliance audits
- Equipment specification
- Form R reports for SARA Title III
- Inventory records
- MSDSs
- Operating manuals
- Operating logs
- Past inspection reports
- Permits
- Product composition sheets
- Purchasing records
- Shipping papers
- Vendor information
- Waste manifests

The following is a list presenting a range of waste types that may be associated with integrated iron and steel making processes. The intent of this list is to provide the audit team with clues on what form your pollution may take. They include:

- Air emissions (point source and fugitive)
- Hazardous wastes (reactive, ignitable, corrosive, toxic, radioactive)
- Heat and/or energy loss
- Maintenance and cleanup waste
- Obsolete, out-dated stock
- Solid wastes (paper, boxes, trash)
- Spills and container leaks
- Spoiled production runs
- System leaks (pipes, joints, etc.)

guidelines are noted in Table 3.1. Table 3.2 illustrates questions you might want to ask as the site review is conducted.

TABLE 3.1 SITE REVIEW GUIDELINES

- **Prepare an agenda** in advance that covers all points that still require clarification. Provide staff contacts in the area being assessed with the agenda several days before the site inspection.
- **Schedule the inspection** to coincide with the particular operation that is of interest.
- **Monitor the operation at different times** during all shifts, and if needed, during all three shifts, especially when waste generation is highly dependent on human involvement.
- **Interview** the operators, shift supervisors, and work leaders in the assessed area. Discuss the waste generation aspects of the operation. Note their familiarity with the impacts their operation may have on other operations.
- **Photograph or videotape** the area of interest. Pictures are valuable in the absence of plant layout drawings. Many details can be captured in pictures that otherwise could be forgotten or inaccurately recalled at a later date.
- **Observe the "housekeeping" aspects** of the operation. Check for signs of spills or leaks. Visit the maintenance shop and ask about problems in keeping the equipment operating efficiently. Assess the overall cleanliness of the site. Pay attention to odors and fumes.
- **Assess the organizational structure** and level of coordination of environmental activities between various departments.
- **Assess administrative controls**, such as cost accounting procedures, material purchasing procedures, and waste collection procedures.

(Adapted from: Waste Reduction Institute for Training and Applications Research, Inc. [WRITARI], *Survey and Summaries*, 1991, and Minnesota Office of Waste Management, Feb. 1991. *Minnesota Guide to Pollution Prevention Planning*)

TABLE 3.2 QUESTIONS TO ASK DURING A SITE REVIEW

- What is the composition of the waste streams and emissions generated? What is their quantity?
- From which production processes or treatment system do these waste streams and emissions originate?
- Which waste materials and emissions fall under environmental regulations?
- What raw materials and input materials in the production process generate these waste streams and emissions?
- How much of a specific raw or input material is found in each waste stream?
- What quantity of materials are lost in the form of volatile emissions?
- How efficient is the production process and the various steps of that process?
- Are any unnecessary waste materials or emissions produced by mixing materials-which could otherwise be reused with other waste materials?
- Which good housekeeping practices are already in force in the company to limit the generation of waste materials?
- What process controls are already in use to improve process efficiency?

(Adapted from EPA *Facility Pollution Prevention Guide*)

Later in the process you will record the possible options you have selected on the *Options Description Form* (Worksheet 8 included in the Appendix). This will be used to describe the option and make an assessment of its feasibility. Independent thinking, as well as brainstorming by team members, will encourage the most productive development of options. This requires effort on your part to do research, discuss among the team and seek out additional information from knowledgeable individuals and groups.

DATA SOURCES

There are many sources of possible options that you may want to consider. These include state information, EPA Region V sources and some information from local governments. Most notable for its possible potential is the **Pollution Prevention Information Exchange System (PIES)** maintained by the EPA. The system basically includes:

PIES

- Pollution Prevention Database
  - Case Studies and References
  - Corporate Program Summaries
  - Directory of Contacts
  - Federal & State Program
  - Summaries
  - Global Climatic Change Databases
  - International Calendar
- Bulletins
- Mini Exchange
- Online Library
- Message Center

The PIES system can be accessed by personal computer and a modem. Additional current information regarding

OTHER SOURCES OF OPTIONS

- **AMERICAN IRON AND STEEL INSTITURE**
- **Published Literature**
  - **Technical Magazines**
  - **Trade Journals**
  - **Government Reports**
- **Other Companies**
- **Consultants**

- Water treatment byproducts
- Wastewater
- Wastewater sludge

Finally, the following list from the Johnston Works of Bethlehem Steel illustrates all of the material that is currently (1992) being recycled. This list provides some excellent suggestions for possible pollution prevention activities at your mill.

RECYCLING OPPORTUNITIES FROM JOHNSTON WORKS OF BETHLEHEM STEEL YOU MIGHT ADOPT

- ELECTRIC ARC FURNACE DUST
- LEADED STEEL BAGHOUSE DUST
- WOOD PALLETS
- LEAD-ACID BATTERIES
- MATERIALS HANDLING SYSTEM DUST
- SOLVENTS
- GREASE
- 46" MILL SCALE
- WASTE OIL
- TIRES
- MILL SCALE
- OFFICE PAPER
- GLASS
- ALUMINUM CANS
- SLAG
- STEEL SCRAP (INCLUDING EMPTY DRUMS)
- COPPER WIRE & TUBING
- BRASS FITTINGS, VALVES, TUBES, ETC.
- STAINLESS STEEL
- PIT BOTTOM MATERIAL
- FORK TRUCK TIRES
- ALUMINUM DROSS
- LADLE FURNACE BAGHOUSE DUST
- VACUUM FILTER CAKE
- GRAPHITE SCRAP
- GRINDER SWARF

STEP 4: DECIDE WHAT STEPS TO TAKE

DEFINE POLLUTION PREVENTION OPTIONS

Once all the data is collected and organized, and process diagrams have been developed, waste reduction options can be identified for your mill. This is the opportunity for the audit team(s) to be creative. The audit team should consider a comprehensive list of pollution prevention opportunities, no matter how unworkable or costly they may initially seem. When generating options, it is important to focus on measures that reduce waste at the source or promote on-site recycling. Failure to reduce the volume of wastes produced in the mill defeats the ultimate goal of waste reduction efforts. You may be tempted by waste treatment alternatives. However, such methods are not considered waste reduction as they do not eliminate waste within the process, as previously noted in the EPA pollution prevention definition discussed in Chapter I.

STEP 4

DON'T BE TEMPTED BY WASTE TREATMENT ALTERNATIVES - THEY ARE NOT POLLUTION PREVENTION

CREATE A PROCESS DESCRIPTION

- DEVELOP PROCESS FLOW CHART
- DEVELOP ORGANIZATION/ RESPONSIBILITY CHART

Process Flow Charts can be developed for virtually any process by following a few simple rules:

- Include all process operations
- Include all utilities
- Include a representation of all inputs and outputs
- Include material- and energy-balance information
- Number each process flow stream

A complete process operation flow chart must include all process steps necessary to transform raw materials into a finished product and other process steps required for waste treatment and utilities management. Some typical steps might include the coking operation, conversion or rolling processes.

Each process step can be simply viewed as:

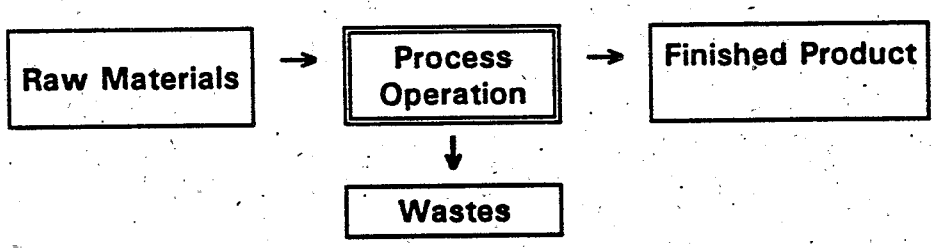


Figure 3.1 represents a complete typical process operation flow chart. The various streams identified represent the pathways that materials travel through a process. Materials and chemicals are consumed or transformed by the process, can be used by the process or can exit the process unaltered. Worksheet 3, *Process Information*, in the Appendix can assist in documenting general process information. Worksheet 4,

FORMS

Worksheet 3

PROCESS INFORMATION

this system including access phone numbers, etc. is included in the Appendix.

Although the outline and data sheets provided by EPA are helpful, it is important that the assessment team leader thoroughly understand both the organization and the manufacturing operations to fully capitalize on the pollution prevention opportunities vailable.

DEFINING THE PROCESS

CONSTRUCT A PROCESS FLOW SHEET FOR EACH MANUFACTURING OPERATION

In order to describe possible options, it is valuable to construct a process flow sheet for each manufacturing process when beginning a pollution prevention assessment. Such a flow sheet will help identify the key processes associated with your mill. Material inputs to each step, maintenance operations, and waste outputs should be identified. From the data collected in Step 3, wastes and other pollution releases can be considered process losses.

Although 100 percent efficiency from a process is probably not possible, a conceptual diagram of each process can help maximize process efficiency. Inputs can be lost through a variety of circumstances. Non-standard raw materials represent a loss of inputs. More standard losses include air emissions, wastewater production, solid waste generation, chemical spills or leaks, and accidents. Typically, once the process is fully described, potential losses can be identified and tracked more easily.

One approach of particular usefulness in preparing an audit is to examine the total plant operation by viewing the entire operation as a "black box" with total inputs (raw materials) and outputs (finished products and wastes). More detailed analyses then would consist of constructing additional "black boxes" for each step outlined in the ovearall process diagram. In using the "black box" analogy, the search for emission outputs and consequently for pollution prevention options begins with examination of all inputs that could possibly become wastes.

Missouri

Missouri Environmental Improvement and Energy Resources Authority
P.O. Box 744
325 Jefferson St.
Jefferson City, MO 65102
(314) 751-4919

Waste Management Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102
(314) 751-3176

Montana

Department of Health and Environmental Sciences
Room A-206
Cogswell Building
Helena, MT 59620
(406) 444-3454

Solid and Hazardous Waste Bureau
Department of Health and Environmental Sciences
Cogswell Building
Room B-201
Helena, MT 59620
(406) 444-2821

Nebraska

Hazardous Waste Section
Nebraska Department of Environmental Control
P.O. Box 98922
Lincoln, NE 68509-8922
(402) 471-2186

Nevada

Nevada Small Business Development Center — Technical Assistance Program
Business Environmental Program
College of Business Administration, MS032
University of Nevada — Reno
Reno, NV 89557-0100
(702) 784-1717
(800) 882-3233 (Nevada only)

State Energy Conservation Program
Office of Community Services
Nevada Energy Program
Capital Complex
400 W. King
Carson City, NV 89710
(702) 687-4990

New Hampshire

New Hampshire Department of Environmental Services
Waste Management Division — Planning Bureau
6 Hazen Drive
Concord NH 03301-6509
(603) 271-2901
(603) 271-2902

New Jersey

New Jersey Hazardous Waste Facilities Siting Commission
Room 614
28 West State Street
Trenton, NJ 08608
(609) 292-1459
(609) 292-1026

Hazardous Waste Advisement Program
New Jersey Department of Environmental Protection & Energy
401 East State Street
Trenton, NJ 08625
(609) 777-0518

New Jersey Institute of Technology
Hazardous Substance Management Research Center
Advanced Technology Center Building
323 Martin Luther King Jr. Boulevard
University Heights
Newark, NJ 07102
(201) 596-5864

New Mexico

Economic Development Department
Bataan Memorial Building
State Capitol Complex
Santa Fe, NM 87503
(505) 827-0380

Idaho

Division of Environmental Quality
Department of Health and Welfare
1410 North Hilton Street
Boise, ID 83720-9000

Illinois

Hazardous Waste Research and Information Center
Illinois Department of Energy & Natural Resources
One E. Hazelwood Drive
Champaign, IL 61820
(217) 333-8940

Industrial Waste Elimination Research Center
Pritzker Department of Environmental Engineering
Illinois Institute of Technology
3201 South Dearborn
Room 103 Alumni Memorial Hall
Chicago, IL 60616
(312) 567-3535

Illinois Environmental Protection Agency
Office of Pollution Prevention
2200 Churchill Road
P.O. Box 19276
Springfield, IL 62794-9276
(217) 782-8700

Indiana

Environmental Management & Education Program
School of Civil Engineering
Purdue University
2129 Civil Engineering Building
West Lafayette, IN 47907-1284
(317) 494-5036

Indiana Department of Environmental Management
Office of Technical Assistance
P.O. Box 6015
105 South Meridian Street
Indianapolis, IN 46206-6015
(317) 232-8172

Iowa

Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, IA 50319-0034
(515) 281-5145

Iowa Waste Reduction Center
75 BRC
University of Northern Iowa
Cedar Falls, IA 50614-0185
(800) 422-3109
(319) 273-2079

Iowa Waste Reduction Center
University of Norther Iowa
75 Biology Research Complex
Cedar Falls, IA 50614
(319) 273-2079

Kansas

Division of Environment
Department of Health and Environment
Forbes Field, Building 740
Topeka, KS 66620
(913) 296-1535

Engineering Extension Program
Ward Hall 133
Kansas State University
Manhattan, KS 66506
(916) 532-6026

Kentucky

Waste Minimization Assessment Center
Department of Chemical Engineering
University of Louisville
Louisville, KY 40292
(502) 588-6357

Kentucky Partners
Room 312 Ernst Hall
University of Louisville
Louisville, KY 40292
(502) 588-7260

Louisiana

Department of Environmental Quality
Office of Solid and Hazardous Waste
P.O. Box 82178
Baton Rouge, LA 70884-2178
(504) 765-0355

Alternate Technologies Research and Development
Office of the Secretary
Louisiana Department of Environmental Quality
P.O. Box 44066
Baton Rouge, LA 70804
(504) 342-1254

Maine

Office of Pollution Prevention
Department of Environmental Protection
State House Station 17
Augusta, ME 04333
(207) 289-2811

Office of Waste Reduction and Recycling
Maine Waste Management Agency
State House Station 154
Augusta, ME 04333
(207) 289-5300

Maryland

Hazardous and Solid Waste Management Administration
Maryland Department of the Environment
2500 Broening Highway — Building 40
Baltimore, MD 21224
(301) 631-3315

Maryland Environment Service
2020 Industrial Drive
Annapolis, MD 21401
(301) 454-1941

Technical Extension Service
Engineering Research Center
University of Maryland
College Park, MD 20742
(301) 454-1941

Massachusetts

Executive Office of Environmental Affairs/ Office of Technical Assistance
100 Cambridge Street, Room 1904
Boston, MA 02202
(617) 727-3260

Source Reduction Program
Massachusetts Department of Environmental Protection
1 Winter Street, 7th Floor
Boston, MA 02108
(617) 292-5870

Massachusetts Department of Environmental Protection
75 Grove Street
Worchester, MA 01606
(508) 792-7650

Michigan

Resource Recovery Section
Department of Natural Resources
P.O. Box 30241
Lansing, MI 48909
(517) 373-0540

Office of Waste Reduction Services
Michigan Departments of Commerce and Natural Resources
P.O. Box 30004
Lansing, MI 48909
(517) 335-1178

Minnesota

Minnesota Pollution Control Agency
Solid and Hazardous Waste Division
520 Lafayette Road
St. Paul, MN 55155-3898
(612) 296-6300

Minnesota Technical Assistance Program
1313 5th Street S.E., Suite 207
Minneapolis, MN 55414
(612) 627-4646
(800) 247-0015 (in Minnesota)

Minnesota Office of Waste Management
1350 Energy Lane
St. Paul, MN 55108
(612) 649-5741

Waste Reduction Institute for Training Application Research, Inc. (WRITAR)
1313 5th Street, S.E.
Minneapolis, MN 55414
(612) 379-5995

Mississippi

Waste Reduction & Minimization Program
Bureau of Pollution Control
Department of Environmental Quality
P.O. Box 10385
Jackson, MS 39289-0385
(601) 961-5171

Mississippi Technical Assistance Program (MISSTAP) and Mississippi Solid Waste Reduction Assistance Program (MSWRAP)
P.O. Drawer CN
Mississippi State, MS 39762
(601) 325-8454

Environmental Institute for Waste Management Studies
University of Alabama
Box 870203
Tuscaloosa, AL 35487-0203
(205) 348-8403

Hazardous Material Management and Resource Recovery Program (HAMMAR)
University of Alabama
Tuscaloosa, AL 35487-0203
(205) 348-8401
FAX 348-9659

Retired Engineers Waste Reduction Program
P.O. Box 1010
Muscle Shoals, AL 35660
(205) 386-2807

Alaska

Alaska Health Project
Waste Reduction Assistance Program
1818 West Northern Lights, Suite 103
Anchorage, AK 99517
(907) 276-2864

Alaska Department of Environmental Conservation
Pollution Prevention Program
P.O. Box O
Juneau, AK 99811-1800
(907) 465-2671

Arizona

Arizona Department of Economic Planning and Development
1645 West Jefferson St.
Phoenix, AZ 85007
(602) 255-5705

Arizona Department of Environmental Quality
Office of Waste and Water Quality Management
2005 N. Central Ave, Room 304
Phoenix, AZ 85004
(602) 257-2380

Arkansas

Arkansas Industrial Development Commission
One State Capitol Mall
Little Rock, AR 72201
(501) 682-1121

Arkansas Department of Pollution Control and Ecology
Hazardous Waste Division — P.O. Box 8913
Little Rock, AR 72219-8913
(501) 570-2861

California

Bay Area Hazardous Waste Reduction Committee (BAHWRC)
City of Berkeley Environmental Health
2180 Milvia, Room 309
Berkeley, CA 94708
(415) 644-6510

Cal-EPA
Department of Toxic Substances Control
Alternative Technology Division
P.O. Box 806
Sacramento, CA 95812-0806
(916) 324-1807

California Conference of Directors of Environmental Health — Subcommittee for the Development of Hazardous Waste Programs
Ventura County Environmental Health
800 S. Victoria
Ventura, CA 93009
(805) 654-5039

California Environmental Business Resources Assistance Center
100 South Anaheim Boulevard
Suite 125
Anaheim, CA 92805
(714) 563-0135
(800) 352-5225

Central Valley Hazardous Waste Minimization Committee
Environmental Management Division
8475 Jackson Road, Suite 230
Sacramento, CA 95826
(916) 386-6160

Local Government Commission
909 12th Street
#205
Sacramento, CA 95814
(916) 448-1198

Pollution Prevention Program
San Diego County Department of Health Services
P.O. Box 85261
San Diego, CA 92186-5261
(619) 338-2205, -2215

Colorado

Pollution Prevention Waste Reduction Program
Colorado Department of Health
4210 E. 11th Ave.
Denver, CO 80220
(303) 320-8333

Connecticut

Bureau of Waste Management
Connecticut Department of Environmental Protection
18-20 Trinity Street
Hartford, CT 06106
(203) 566-8476

Connecticut Technical Assistance Program
900 Asylum Avenue, Suite 360
Hartford, CT 06105
(203) 241-0777

Delaware

Pollution Prevention Program in Dept. of Natural Resources & Environmental Control
89 Kings Highway
P.O. Box 1401
Dover, DE 19903
(302) 739-3822

District of Columbia

U.S. Department of Energy
Conservation and Renewable Energy
Office of Industrial Technologies
Office of Waste Reduction,
Waste Material Management Division
Bruce Cranford CE-222
Washington D.C. 20585
(202) 586-9496

Office of Recycling
D.C. Department of Public Works
2000 14th Street, NW, 8th Floor
Washington, D.C. 20009
(202) 939-7116

Florida

Hazardous Waste Reduction Management
Waste Reduction Assistance Program
Florida Dept. of Environmental Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400
(904) 488-0300

Environmental Quality Corporation
259 Timberlane Road
Tallahassee, FL 32312-1542
(904) 386-7740

Waste Reduction Assistance Program
Florida Dept. of Environmental Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400
(904) 488-0300

Georgia

Hazardous Waste Technical Assistance Program
Georgia Institute of Technology
GTRI/ESTL
151 6th Street
O'Keefe Building, Room 143
Atlanta, GA 30332
(404) 894-3806

Environmental Protection Division
Georgia Department of Natural Resources
205 Butler Street S.E. Room 1154
Atlanta, GA 30334
(404) 656-2833

Guam

Solid and Hazardous Waste Management Program
Guam EPA
IT&E Harmon Plaza Complex, Unit D-107
130 Rojas Street
Harmon, GU 96911
(671) 646-8863-5

Hawaii

Department of Planning and Economic Development
Financial Management and Assistance Branch
P.O. Box 2359
Honolulu, HI 96813
(808) 548-4617

Hawaii Department of Health
Solid and Hazardous Waste Branch
Waste Minimization
5 Waterfront Plaza, Suite 250
500 Ala Moana Blvd
Honolulu, HI 96813
(808) 586-4226

POLLUTION PREVENTION RESOURCES

There are a number of organizations that can assist you in developing and maintaining a pollution prevention program. This appendix lists offices of the U.S. EPA, state agencies, and assistance programs.

U.S. ENVIRONMENTAL PROTECTION AGENCY

Pollution Prevention Information Clearinghouse

The PPIC is dedicated to reducing industrial pollutants through technology transfer, education, and public awareness. It provides technical, policy, programmatic, legislative, and financial information upon request.

The PPIC provides businesses and government agencies with information to assist them in a range of pollution prevention activities, such as:

- Establishing pollution prevention programs
- Learning about new technical options arising from U.S. and foreign R&D
- Locating and ordering documents
- Identifying upcoming events
- Discovering grant and project funding opportunities
- Identifying pertinent legislation
- Saving money by reducing waste

The PPIC disseminates this information through a number of services. These include:

- a telephone hotline
- a repository of publications, reports, and industry-specific fact sheets
- an electronic information exchange network
- indexed bibliographies and abstracts of reports, publications, and case studies
- a calendar of conferences and seminars
- a directory of waste exchanges
- information packets and workshops.

The electronic network maintained by PPIC is designated as PIES. It provides access to information databases and can be used to place orders for documents. The subsystems of PIES include:

- a message center
- a publication reference database
- a directory of experts
- case studies
- a calendar of events
- program studies
- legislation summaries
- topical mini-exchanges.

This interactive system can deliver information to the user through screen display, downloading, and FAX. It is available to off-site computers via modem 24 hours a day. For information on linking to PIES, contact:

PIES Technical Assistance
Science Applications International Corp.
8400 Westpart Drive
McLean, VA 22102
(703) 821-4800

The PPIC operates a telephone hotline for questions and requests for information. The hotline provides users who cannot access PIES electronically with access to its information and services.

For information on any of PPIC's services, write to: PPIC
U.S. EPA Pollution Prevention Office
401 M Street S.W. (PM-211A)
Washington, D.C. 20460
or call:
Myles E. Morse
Office of Environmental Engineering and Technology Demonstration
(202) ~~456~~ 260-7161
or:
~~Priscilla Flynn~~ Beth Anderson
Pollution Prevention Office
(202) ~~[illegible]~~ 260-2602

PPIC Reference & Referral:
(202) 260-1023

Other U.S. EPA offices that can provide pollution prevention information include:

U.S. EPA Solid Waste Office
Waste Management Division
401 M Street SW
Washington, D.C. 20460
(703) 308-8402

U.S. EPA Office of Pollution Prevention and Toxics
401 M Street SW
Washington, D.C. 20460
(202) 260-3810

U.S. EPA Office of Air and Radiation
401 M Street SW
Washington, D.C. 20460
(202) 260-7400

U.S. EPA Office of Water
401 M Street SW
Washington, D.C. 20460
(202) 260-5700

U.S. EPA Office of Research & Development
Center for Environmental Research Information
26 Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7562

U.S. EPA Risk Reduction Engineering Laboratory
26 Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7931

U.S. EPA Office of Solid Waste and Emergency Response
[For questions regarding RCRA and Superfund (CERCLA), call (800) 424-9346 or (703) 920-9810. To reach the Analytical Hotline, call (703)-821-4789.]

U.S. EPA Regional Offices:

Region 1 (VT, NH, ME, MA, CT, RI)
John F. Kennedy Federal Building
Boston, MA 02203
(617) 565-3420

Region 2 (NY, NJ, PR, VI)
26 Federal Plaza
New York, NY 10278
(212) 264-2525

Region 3 (PA, DE, MD, WV, VA, DC)
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-9800

Region 4 (KY, TN, NC, SC, GA, FL, AL, MS)
345 Courtland Street, NE
Atlanta, GA 30365
(404) 347-4727

Region 5 (WI, MN, MI, IL, IN, OH)
230 South Dearborn Street
Chicago, IL 60604
(312) 353-2000

Region 6 (NM, OK, AR, LA, TX)
1445 Ross Avenue, Suite 1200
Dallas, TX 75202
(214) 655-6444

Region 7 (NE, KS, MO, IA)
726 Minnesota Ave
Kansas City, KS 66101
(913) 551-7050

Region 8 (MT, ND, SD, WY, UT, CO)
999 18th Street
Denver, CO 80202-2405
(303) 293-1603

Region 9 (CA, NV, AZ, HI, GU)
75 Hawthorne Street
San Francisco, CA 94105
(415) 744-1305

Region 10 (AK, WA, OR, ID)
1200 Sixth Avenue
Seattle, WA 98101
(206) 553-4973

STATE LEVEL

The following lists agencies at the state or territory level as well as universities and other organizations that can provide assistance in the areas of pollution prevention and treatment:

Alabama

Department of Environmental Management
1751 Congressman W.L. Dickenson Drive
Montgomery, AL 36130
(205) 271-7939

Vaidyanathan, Pradip D. and P.C. Kapur. 1990. "Production and properties of alinite cements from steel plant wastes." *Cement and Concrete Research 20(1)*: 15-24.

Wang, J.C., M.T. Hepworth, and K.J. Reid. 1990. "Recovering Zn, Pb, Cd, and Fe from electric furnace dust." *JOM (April 1990)*:42-45.

Wu, Li and Nickolas J. Themelis. 1992. "The flash reduction of electric arc furnace dusts." *JOM (January 1992)*: 35-39.

Bethlehem Steel Corporation. 1985. *Electric arc furnace--Dust disposal, recycle & recovery*. Center for Metals Production Report No. 85-2. Mellon Institute, Carnegie-Mellon University. Pittsburg, PA. 15213.

Brandes, Heiner R. and Helmuth Ester. 1992. "Gas cleaning and secondary emissions control with energy recovery: Part I--Basic oxygen converters; Part II--Electric arc furnaces". *Iron and Steel Engineer 69(1)*;49-55.

Clearwater, Scott W. and Joanne M. Scanlon. 1991. "Legal incentives for minimizing waste." *Environmental Progress 10(3)*: 169-174.

Cyrus W. Rice Corporation. 1981. *Development document for effluent limitations guidelines and standards for the iron and steel manufacturing point source catagory*. Proposed. December 1980. EPA 440/180/024b. Six volumes.

Dighe, Shyam V., C. Keith Paulson, and Edward J. Lahoda. 1992. "Westinghouse plasma-fired processes for treatment of industrial wastes." *Iron and Steel Engineer 69(1)*:44-48.

Galloway, S.M., M.J. Green, S.R. Balajee, and F.J. Nahlik. 1992. "Improvement in furnace performance at Inland through models utilization and standardization of operating practices." *Iron & Steelmaker (I&SM) 19(1)*:29-35.

Geddis, R.R. and R.V. Chalfant. 1991. "Clean Air Act Amendments of 1990: impact on the steel industry. A series of articles under Column "Keeping Current II." *Iron and Steel Engineer 68(2-7)*.

Geddis, R.R. and R.V. Chalfant. 1992. " Electric arc furnace shop air permit issues." *Iron and Steel Engineer 69(1)*, Jan 1992:60-63.

McAloon, T.P. 1991. "Direct Steelmaking set for Phase II." *Iron and Steelmaker (I&SM) 18(9)*: 40.

Osipenko, V.D. 1987. *Reducing heat losses with waste gases of electric arc steelmaking furnaces*. Steel in the USSR. 17(2):100-101.

Puhringer, O., H. Wiesinger, W.L. Kepplinger, B.H.P. Havenga, R. Hauk, and F. Wallner. 1991. "Operational experience and potential of the Corex process". *MPT Metallurgical Plant and Technology 14(5)*: 30-41.

Steiner, Bruce A. 1992. "Impact of 1990 Clean Air Act Amendments on the iron and steel industry." *Iron and Steel Engineer 69(1)*:41-43.

Tarsitano, T. 1991. "The reduction of lead in steel flue dust using a batch leaching process." *An Industrial Waste Diversion Program Report for Waste Management Branch, Ontario Ministry of the Environment*. ISBN 0-7729-8429-8.

APPENDIX C

Iron and Steel Industry References compiled by:

Waste Reduction Institute for Training & Applications Research (WRITAR)

Industry Background and Pollution Prevention Options

Center for Hazardous Materials Research (CHMR). 1990. *Pollution Prevention: Strategies for the Steel Industry*. CHMR Fact Sheet. University of Pittsbury, PA.

Drabkin, Marvin and Edwin Rissmann. 1989. "Waste Minimization opportunities at an electric arc furnaces steel plant producing specialty steels." *Environmental Progress 8(2)*: 88-96.

Nyrienda, R.L. "The processing of steelmaking flue-dust: a review". *Minerals Engineering 4(7-11)*: 1003-1025.

Peters, Anthony T. 1989. *Iron and steel. Minerals Yearbook*. U.S. Dept. of Bureau of Mines.

Prabhu, Damodar U. and Paul F. Cillione. 1992. 1990 "Clean Air Act Amendments: technical/economic impact on U.S. coke and steel making operations". *Iron and Steel Engineer 69(1)*: 33-40.

Williams, Roy E. 1975. Waste production and disposal in mining, milling, and metallurgical industries. Miller Freeman Publications, Inc. Chapter 7.

Wright, J.K., I.F. Taylor, and D.K. Philip. 1991. "A review of progress of the development of new ironmaking technologies". *Minerals Engineering* 4(7-11): 983-1001.

Agarwal, J.C. 1991. "Strategic considerations in direct steelmaking". *Iron & Steelmaker (I&SM)* 18(3):69-72.

Anonymous. 1991. "Geneva Steel installs Q-BOPs". *Iron and Steel Engineer 68(11)*:52-53.

Aukrust, E. 1991. *AISI direct steelmaking program annual technical report for year ending 11/30/90.* U.S. DOE. E 1.99:DOEID128471.

Baure, Karl-Heinz, Dillinger Huette, Heinz-Juergen Lehmkuehler, and Hugo Schmauch. 1990. "Recycling of iron and steelworks wastes using the inmetco direct reduction process". *MPT Metallurgical Plant and Technology 13(4)*:74-87.

APPENDIX B

- **POLICY STATEMENT EXAMPLE 1** - "(Your Company Name) is committed to excellence and leadership in protecting the environment. In keeping with this policy, our objective is to reduce waste and emissions. We strive to minimize adverse impact on the air, water, and land through pollution prevention and energy conservation. By successfully preventing pollution at its source, we can achieve cost savings, increase operational efficiencies, improve the quality of our products and services, maintain a safe and healthy workplace for our employees, and improve the environment. (Your Company Name)'s environmental guidelines include the following:

  - Environmental protection is everyone's responsibility. It is valued and displays commitment to (Your Company Name).

  - We will commit to including pollution prevention and energy conservation in the design of all new products and services.

  - Preventing pollution by reducing and eliminating the generation of waste and emissions at the source is a prime consideration in research, process design, and plan operations. (Your Company Name) is committed to identifying and implementing pollution prevention opportunities through encouraging and involving all employees.

  - Technologies and methods which substitute nonhazardous materials and utilize other source reduction approaches will be given top priority in addressing all environmental issues.

  - (Your Company Name) seeks to demonstrate its responsible corporate citizenship by adhering to all environmental regulations. We promote cooperation and coordination between industry, government, and the public toward the shared goal of preventing pollution at its source."

- **POLICY STATEMENT EXAMPLE 2** - "At (Your Company Name), protecting the environment is a high priority. We are pledged to eliminate or reduce our use of toxic substances and to minimize our use of energy and generation of all wastes, whenever possible. Prevention of pollution at the source is the preferred alternative. When waste cannot be avoided, we are committed to recycling, treatment, and disposal in ways that minimize undesirable effects on air, water, and land."

(Adapted from: Waste Reduction Institute for Training and Applications Research, Inc. [WRITAR], *Survey and Summaries,* 1991, and Minnesota Office of Waste Management, Feb. 1991. *Minnesota Guide to Pollution Prevention Planning*)

Firm _____	Pollution Prevention Assessment Worksheets	Prepared By _____
Site _____		Checked By _____
Date _____	Proj. No. _____	Sheet ___ of ___ Page ___ of ___

WORKSHEET
8

OPTION DESCRIPTION

Option Name: _____

Briefly describe the option: _____

_____

_____

_____

_____

_____

_____

_____

Waste Stream(s) Affected: _____

_____

Input Material(s) Affected: _____

_____

Product(s) Affected: _____

_____

Indicate Type:

☐ Source Reduction
- _____ Equipment-Related Change
- _____ Personnel/Procedure-Related Change
- _____ Materials-Related Change

☐ Recycling/Reuse
- _____ Onsite
- _____ Offsite
- _____ Material reused for original purpose
- _____ Material used for a lower-quality purpose
- _____ Material sold

Originally proposed by: _____ Date: _____

Reviewed by: _____ Date: _____

Approved for study? _____ yes _____ no By: _____

Reason for Acceptance or Rejection _____

Firm _____ Site _____ Date _____	**Pollution Prevention Assessment Worksheets** Proj. No. _____	Prepared By _____ Checked By _____ Sheet ___ of ___ Page ___ of ___

WORKSHEET
9

PROFITABILITY

Capital Costs

Purchased Equipment _____

Materials _____

Installation _____

Utility Connections _____

Engineering _____

Start-up and Training _____

Other Capital Costs _____

Total Capital Costs _____

Incremental Annual Operating Costs

Change in Disposal Costs _____

Change in Raw Material Costs _____

Change in Other Costs _____

Annual Net Operating Cost Savings _____

$$\text{Payback Period (in years)} = \frac{\text{Total Capital Costs}}{\text{Annual Net Operating Cost Savings}} = _____$$

Firm _____	Pollution Prevention Assessment Worksheets	Prepared By _____
Site _____		Checked By _____
Date _____	Proj. No. _____	Sheet ___ of ___ Page ___ of ___

WORKSHEET
6

WASTE STREAM SUMMARY

Attribute	Description		
	Stream No. _____	Stream No. _____	Stream No. _____
Waste ID/Name:			
Source/Origin			
Component or Property of Concern			
Annual Generation Rate (units _____)			
Overall			
Component(s) of Concern			
Cost of Disposal			
Unit Cost ($ per: _____)			
Overall (per year)			
Method of Management[1]			

Priority Rating Criteria[2]	Relative Wt. (W)	Rating (R)	R x W	Rating (R)	R x W	Rating (R)	R x W
Regulatory Compliance							
Treatment/Disposal Cost							
Potential Liability							
Waste Quantity Generated							
Waste Hazard							
Safety Hazard							
Minimization Potential							
Potential to Remove Bottleneck							
Potential By-product Recovery							
Sum of Priority Rating Scores		Σ(RxW)		Σ(RxW)		Σ(RxW)	
Priority Rank							

Notes:
1. For example, sanitary landfill, hazardous waste landfill, on-site recycle, incineration, combustion with heat recovery, distillation, dewatering, etc.
2. Rate each stream in each category on a scale from 0 (none) to 10 (high).

Firm _____ Site _____ Date _____	Pollution Prevention Assessment Worksheets Proj. No. _____	Prepared By _____ Checked By _____ Sheet ___ of ___ Page ___ of ___

WORKSHEET 7

OPTION GENERATION

Meeting format (e.g., brainstorming, nominal group technique) _____

Meeting Coordinator _____

Meeting Participants _____

List Suggestion Options	Rationale/Remarks on Option

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WORKSHEET 4

INPUT MATERIALS SUMMARY

Attribute	Description		
	Stream No. ____	Stream No. ____	Stream No. ____
Name/ID			
Source/Supplier			
Component/Attribute of Concern			
Annual Consumption Rate			
Overall			
Component(s) of Concern			
Purchase Price, $ per _____			
Overall Annual Cost			
Delivery Mode[1]			
Shipping Container Size & Type[2]			
Storage Mode[3]			
Transfer Mode[4]			
Empty Container Disposal Management[5]			
Shelf Life			
Supplier Would			
— accept expired material? (Y/N)			
— accept shipping containers? (Y/N)			
— revise expiration date? (Y/N)			
Acceptable Substitute(s), if any			
Alternate Supplier(s)			

Notes:
1. e.g., pipeline, tank car, 100 bbl tank truck, truck, etc.
2. e.g., 55 gal drum 100 lb paper bag, tank, etc.
3. e.g., outdoor, warehouse, underground, aboveground, etc.
4. e.g., pump, forklift, pneumatic transport, conveyor, etc.
5. e.g., crush and landfill, clean and recycle, return to supplier, etc.

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WORKSHEET
5

PRODUCTS SUMMARY

Attribute	Description		
	Stream No. ____	Stream No. ____	Stream No. ____
Name/ID			
Component/Attribute of Concern			
Annual Production Rate			
Overall			
Component(s) of Concern			
Annual Revenues, $ _____			
Shipping Mode			
Shipping Container Size & Type			
Onsite Storage Mode			
Containers Returnable (Y/N)			
Shelf Life			
Rework Possible (Y/N)			
Customer Would			
— relax specification (Y/N)			
— accept larger containers (Y/N)			

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Date _____	Proj. No. _____	Sheet ___ of ___ Page ___ of ___

WORKSHEET
2

SITE DESCRIPTION

Firm:

Plant:

Department:

Area:

Street Address:

City:

State/Zip Code:

Telephone: ( )

Major Products:

SIC Codes:

EPA Generator Number:

Major Unit:

Product or Service:

Operations:

Facilities/Equipment Age:

Firm _____	Pollution Prevention Assessment Worksheets	Prepared By _____
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WORKSHEET
3

PROCESS INFORMATION

Process Unit/Operation: _____

Operation Type: ☐ Continuous ☐ Discrete ☐ Batch or Semi-Batch ☐ Other _____

Document	Status: Complete? (Y/N)	Current? (Y/N)	Last Revision	Used in this Report (Y/N)	Document Number	Location
Process Flow Diagram						
Material/Energy Balance						
Design						
Operating						
Flow/Amount Measurements						
Stream						
Analyses/Assays						
Stream						
Process Description						
Operating Manuals						
Equipment List						
Equipment Specifications						
Piping and Instrument Diagrams						
Plot and Elevation Plan(s)						
Work Flow Diagrams						
Hazardous Waste Manifests						
Emission Inventories						
Annual/Biennial Reports						
Environmental Audit Reports						
Permit/Permit Applications						
Batch Sheet(s)						
Materials Application Diagrams						
Product Composition Sheets						
Material Safety Data Sheets						
Inventory Records						
Operator Logs						
Production Schedules						

APPENDIX A

POLLUTION PREVENTION WORKSHEETS

Worksheet 1	Assessment Overview
Worksheet 2	Site Description
Worksheet 3	Process Information
Worksheet 4	Input Materials Summary
Worksheet 5	Products Summary
Worksheet 6	Waste Stream Summary
Worksheet 7	Option Generation
Worksheet 8	Option Description
Worksheet 9	Profitability

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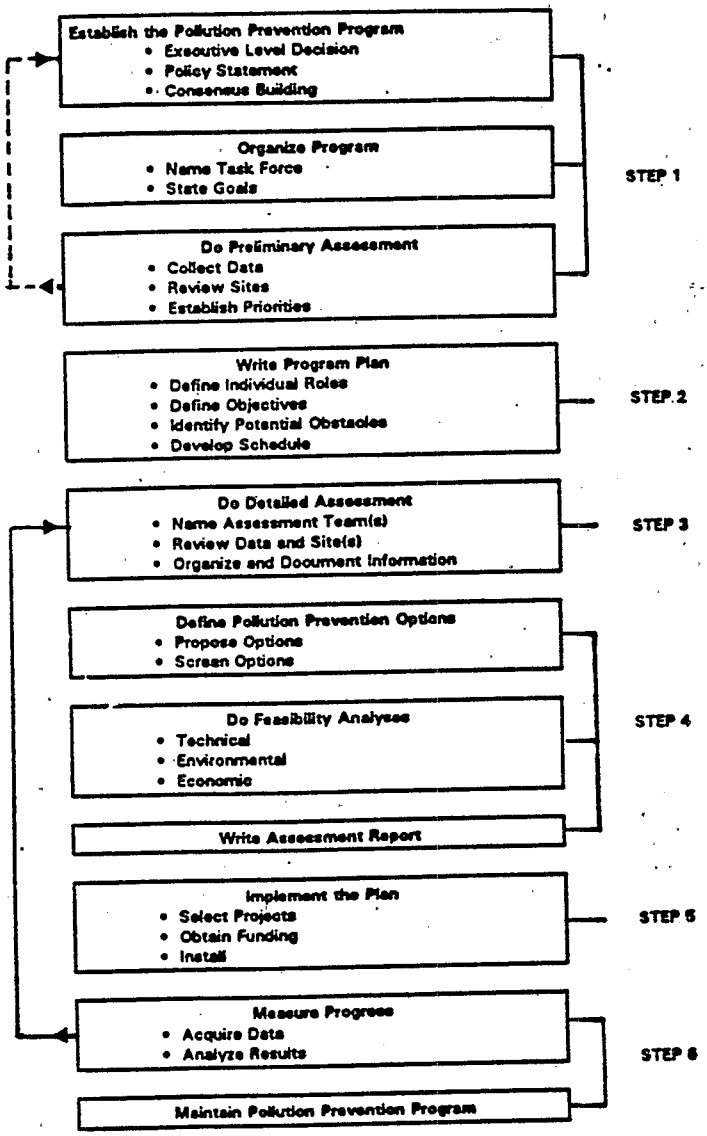
WORKSHEET
1

ASSESSMENT OVERVIEW



Numerous alternatives for pollution prevention and waste minimization were suggested and considered by the assessment team. At the time of this study, recycling of the K061 material as briquetted materials, or the sale of sludge to zinc recyclers were not economically or operationally feasible. The team next focused upon the detoxification of the waste material. The proposed stabilization procedure was expected to produce a non-hazardous residue that could be land disposed at the plant. This option resulted in the savings in disposal costs, and eliminated the need to use hazardous waste landfills. At the time of the study, the annual pre-tax operating savings was estimated at $577,000 per year. It must be noted, that in 1988, by re-evaluating the pollution prevention plan, it was determined that AOD baghouse dust (approximately 10 per cent of the K061 waste) could be briquetted and subsequently blended into the EAF feed. Also, by that time, the percentage of zinc in the sludge was considered high enough to permit recovery by a recycling facility. Currently, the facility now recycles all of the K061 waste generated at the plant.

In the stainless steel annealing and pickling operation line for the processing of various stainless steels, the generation of two corrosive waste streams (RCRA listed wastes K062) occurred. Volumes of over 5,000 gallons per week of spent hydrofluoric acid/nitric acid pickling (HF/HNO_3) were disposed of to the wastewater treatment system. At the time of the assessment, the facility was already recycling a portion of the spent HF/HNO_3 to the pickling tank. The team decided that additional opportunities lay in recovering calcium fluoride from the spent pickle acids and rinse water streams. The option described would not only reduce the generation of sludge from K062 treatment, but also save money by reducing the amount of fluorspar that was previously purchased.

At the time of the assessment, the cost of disposing of the non-hazardous sludge was approximately $228,000 per year. The total investment cost for the proposed calcium fluoride recovery system was approximately $300,000. The operating cost for the new system was

estimated at $46,000 per year. The savings due to replacing the purchase of fluorspar totaled $100,000 per year and the savings realized due to reduced off-site landfill disposal equalled $68,000 per year. Table 6.2 summarizes the costs, savings and payback period for this project. Additional references documenting other pollution prevention and waste minimization efforts are presented in the Appendix.

Table 6.2 Cost Savings for Calcium Fluoride Recovery Scheme
(Adapted from *Environmental Progress*, Vol. 8, No. 2, May 1989, pp. 88-96)

CAPITAL INVESTMENTS	
Total Capital Investment	$300,000
OPERATIONAL COSTS	
Total Annual Operating Costs	$ 46,000
OPERATIONAL SAVINGS	
Savings due to Reduced Fluorspar Purchases	$100,000
Savings due to Reduced Disposal Costs	$ 68,000
ANNUAL OPERATING SAVINGS	$168,000

NET YEARLY SAVINGS

Net Savings = Annual operating savings - Annual operating costs
= $ 168,000 - $46,000
= $ 122,000 per year

Simple Payback Period Required = $300,000/$122,000 per year
= 2.5 years

The pollution prevention team was organized as a first step. Individuals with backgrounds in chemical engineering, physical chemistry, and metallurgy comprised the main assessment team. The team then began the process of developing the pollution prevention plan by evaluating the total amount of steel produced and total tonnage of air emissions generated in producing EAF steels. Figure 6.1 is a schematic of the K061 wastes generation and treatment processes at the plant.

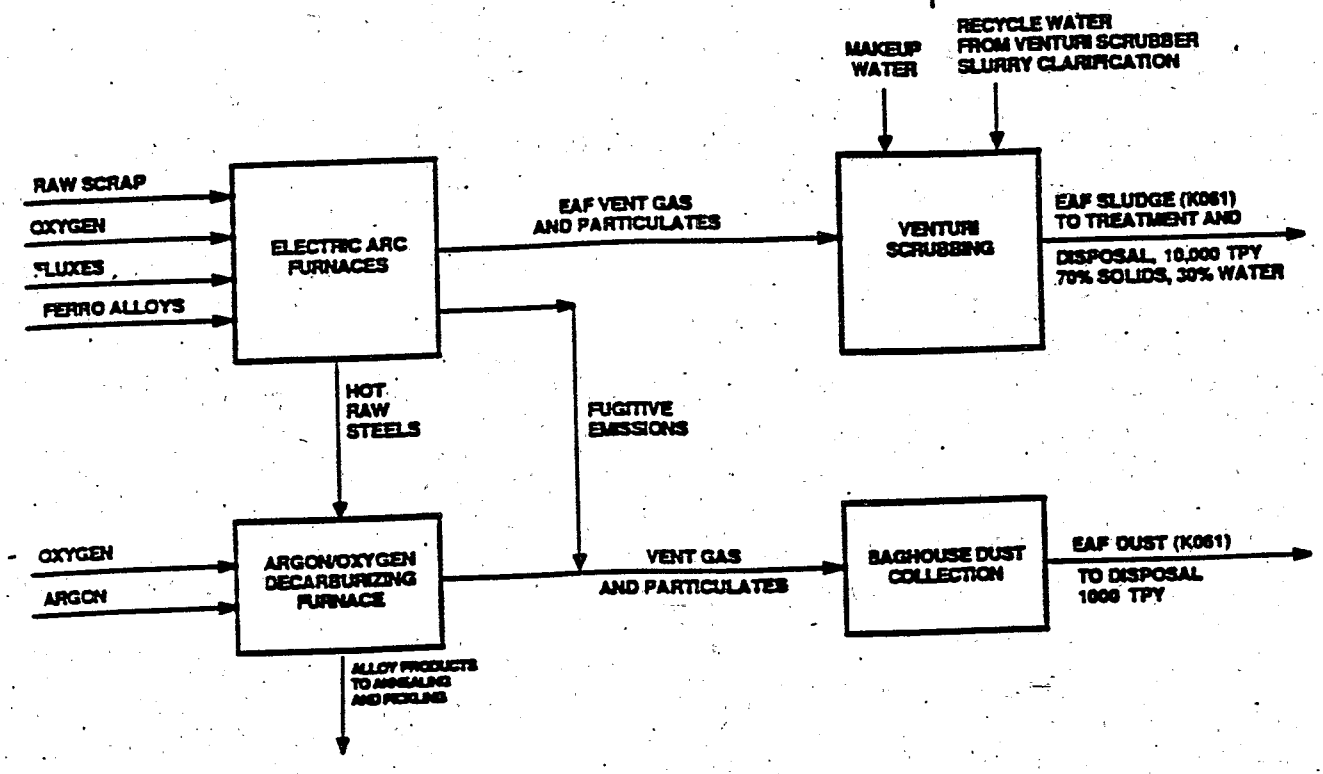


FIGURE 6.1 SCHEMATIC OF K061 WASTE GENERATION AND TREATMENT PROCESSES
(Adapted from *Environmental Progress,* Vol. 8, No. 2, May 1989, pp.88-96)

In order to evaluate alternatives a detailed assessment of the processes that generate and treat the K061 waste was undertaken. The schematic of the EAF treatment process traced the waste from the point of generation to the discharge of the K061 treated waste and is presented in Figure 6.2.

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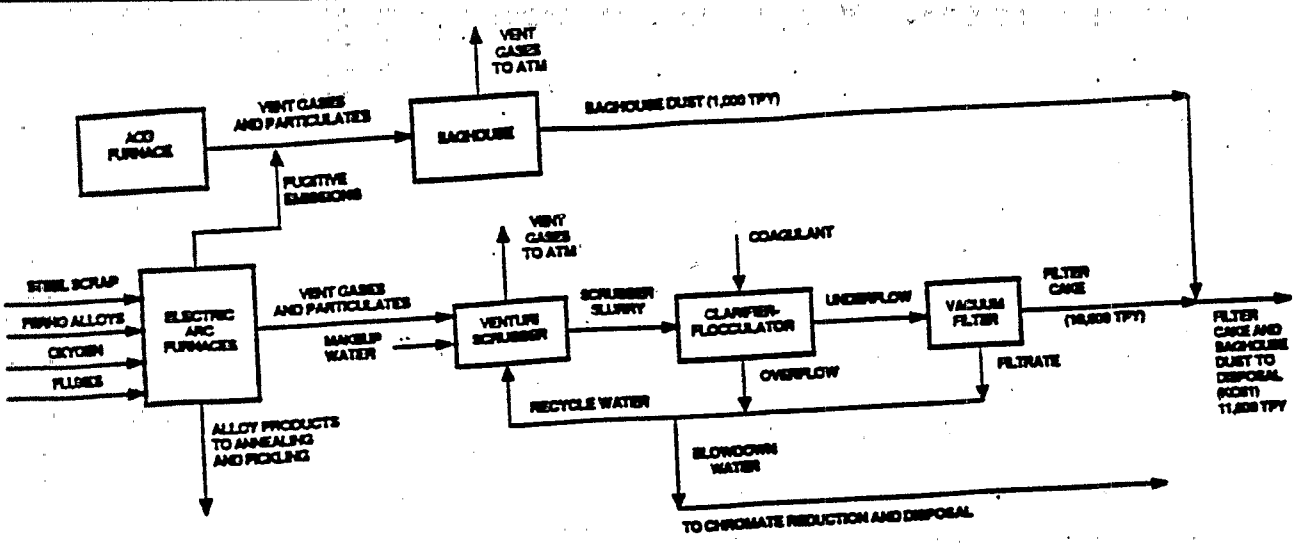

FIGURE 6.2 SHEMATIC OF THE EAF TREATMENT PROCESS
(Adapted from *Environmental Progress*, Vol. 8, No. 2, May 1989, pp. 88-96)

The assessment team used both schematics to aid in the development of alternatives. Additionally, in the assessment phase, the composition of the baghouse dust was analyzed its composition is presented in Table 6.1. The estimated amount spent on disposal of K061 waste was calculated at approximately $100/ton or $1,000,000 per year in 1986. With this data in hand, the assessment team was ready to begin evaluating alternatives.

Table 6.1 Composition of Melt Shop EAF Emissions Control Waste (K061)
(Adapted from *Environmental Progress*, Vol. 8, No. 2, May 1989, pp. 88-96)

Parameter	Amount present (weight percent, dry basis) Venturi Sludge	Baghouse dust
Iron	39.9	27.6
Manganese	3.4	2.8
Silica (SiO_2)	4.9	--
Aluminum	0.3	0.3
Calcium	3.1	5.8
Chromium(total)	1.7	1.2
Copper	0.25	1.7
Nickel	0.36	0.69
Lead	3.1	0.73
Zinc	10.5	8.4
Magnesium	3.2	3.1
Cadmium	0.041	0.009
Barium	0.011	0.002

- Replacing single-pass wastewater systems with closed-loop systems. This results in minimization of chemical use in wastewater treatment and reduced water use.

RECYCLING

Numerous opportunities exist for recycling waste materials generated in the iron and steel industry. The industry already recycles scrap steel extensively as a raw material. By-products produced in coke making operations such as coke oven gas, coal tar, crude or refined light oils, ammonium sulfate, anhydrous ammonia, and naphthalenes, are also used as raw materials for other industrial processes. Several other materials should be considered as well:

- Convert tar-decanter sludge and other tar-based coke plant wastes into a fuel that is suitable for open hearth and blast furnace.

- Recycle or reuse oils and greases. Dewater and recycle mill scale, and recharge slag into the melting furnace.

- Recover zinc from electric arc furnace dust.

- Recover acids by removing dissolved iron salts from spent acids. Employ thermal decomposition for recovery of hydrochloric acid from spent pickle liquor through crystallization.

- Employ the use of a spray roaster, a fluid bed, or a sliding bed to separate hydrochloric acid from iron oxide in spent pickle liquor.

- Use a bipolar membrane/electrodialytic process to separate acid from metal by-products in spent NO_3-HF pickle liquor.

- Recover sulfuric acid using low temperature separation of acid and metal crystals.

- Choose a waste management contractor based on their ability to recycle instead of dispose of waste sludges, etc.

TREATMENT ALTERNATIVES

Sometimes process modifications and materials substitutions are just not possible while still maintaining a required product quality. Alternative methods of treating wastes generated from the steel making process can however, reduce the toxicity or volume of wastes generated. Examples of some alternative methods are:

- In the ductile iron industry, use of thermal destruction of calcium carbide desulfurization slag by rotary kiln; or a chemical reaction between slag and strong oxidizing agents such as potassium permanganate and hydrogen peroxide, can reduce toxicity.

- Reduction of the leaching potential of toxic metals through precipitation, adsorption, chemical reduction or pH control.

SPECIALTY STEEL PLANT CASE STUDY

The following case study provides some ideas to examine pollution prevention possibilities within your plant. As was noted earlier, pollution prevention encompasses not only hazardous wastes, but also non-hazardous solid waste streams, toxic air pollutants, wastewater emissions and other by-products produced during the steel-making process.

A waste reduction assessment conducted on a specialty steel plant by EPA, focused on pollution prevention alternatives for two hazardous wastes streams generated. First, the emission control dust and sludge from electric arc furnace (EAF) steel-making was considered. Second, the waste pickle liquors and rinse waters from the stainless and alloy steel strip products cleaning was analyzed.

CHAPTER 6
CASE STUDY EXAMPLES

AISI IS SUPPORTING RESEARCH THAT WILL IMPACT POLLUTION PREVENTION

Pollution prevention has been underway for a number of years. Many companies have already discovered its numerous benefits. For example, Monsanto has pledged (among other things) to reduce all toxic hazardous releases and emissions, working toward an ultimate goal of "zero effect". The 3M Company's "Pollution Prevention Pays" Program is probably the most publicized example of actual in-plant benefits of a pollution prevention program. There are also pollution prevention projects on-going within the steel industry and the **AISI** is supporting a number of research projects that ultimately will have an impact on pollution prevention.

The steel-making process requires large amounts of raw materials in its production process, probably more per ton of finished product than for any other industry. A myriad of pollutants, both hazardous and non-hazardous, are generated by the different steel-making processes currently in use. Existing environmental regulations provide incentives to reduce the quantity of pollution generated, especially electric arc furnace dust and pickle liquors, which are produced in large quantities.

The Center for Hazardous Materials Research, at the University of Pittsburgh, has prepared a Fact Sheet on Pollution Prevention Strategies for the Steel Industry. The following section summarizes that document, and identifies key areas where pollution prevention planning can be applied to the steel industry.

POLLUTION PREVENTION EXAMPLES FOR THE STEEL INDUSTRY

IMPROVED OPERATING PROCEDURES

Good operating procedures can produce reductions in pollution output. Examples for the steel industry include:

- Improve process control.

- Properly manage oil used for machinery maintenance.

- Choose a waste management contractor on the basis of their compliance record.

MATERIALS SUBSTITUTION

Within the steel-making process the ability to make substitutions of materials while still maintaining a high quality product are limited. Several areas should be considered, however, and include:

- The use of steel scrap with low lead and cadmium content as a raw material when available.

- The elimination of the generation of reactive desulfurization slag generated in foundry work by using a less hazardous material in place of calcium carbide.

PROCESS MODIFICATION

Several new ideas have emerged in designing and modifying process equipment used in the steel making process. Designs not only reduce pollution output but can also reduce maintenance costs and energy consumption. Examples include:

- A technology which uses an induction-heated holding furnace following the electric arc furnace to feed the metal in a pseudo-plastic state, to multiple continuous casting machines. Advantages include the elimination of structural defects that may result from using the traditional approach and better conditions for near-net shaping.

- Switching to induction melting furnaces for grey iron melting can reduce or eliminate the need for air pollution control equipment.

POLLUTION PREVENTION EXAMPLES FOR THE IRON AND STEEL INDUSTRY

- **IMPROVED OPERATING PROCEDURES**
- **MATERIALS SUBSTITUTION**
- **PROCESS MODIFICATIONS**
- **RECYCLING**
- **TREATMENT ALTERNATIVES**

EXPANDED TIME HORIZON

The benefits of many of the pollution prevention projects may not be realized economically in the three- to five-year time frame typically used for other projects. It is important to think in terms of the longer, perhaps even a 25-year time frame when hazardous impoundments are closed and remediation projects begin. Pollution prevention may well eliminate the need for the remediation project.

LONG-TERM FINANCIAL INDICATORS

Three commonly used financial indicators can be selected to account for all the cash flow during the project and the time value of money; The Net Present Value (NPV) of an investment, the Internal Rate of Return (IRR) and the Profitability Index (PI) can be utilized. Discussions on their use are found in any economic analysis text.

DIRECT ALLOCATION OF COSTS

Most mills do not allocate the cost of pollution to any single department or process. In fact, it is often not until a pollution prevention plan is begun that emissions generated are associated with a specific department or process. Three methods from the EPA *Facilities Pollution Prevention Guide* are discussed: the simple pool concept, multiple pool concept, and the service center concept.

The Single Pool Concept distributes the benefits and costs of pollution prevention across all divisions, products, and services. A general overhead or administrative cost is included in all transactions to account for these costs. Because the costs are not itemized, pollution prevention benefits are often not fully recognized for their true benefits.

The Multiple Pool Concept links the cost of pollution more closely with each responsible operation (melt shop, rolling, pickling, annealing, etc.). This concept makes

DIRECT COST ALLOCATION

- **Simple Pool Concept**
- **Multiple Pool Concept**
- **Service Center Concept**

each division accountable, but does not reach a appropriate level that fully associates the costs and benefits of pollution prevention activities.

The final concept presented is the Service Center Concept. This is a much more detailed accounting method directly linking the benefits and costs of pollution prevention activities to those processes from which the pollution emanates. Significant effort is required under this method to accurately track each product, contract, or job, and to associate the relevant pollution prevention charges.

The accounting methods listed above are just examples of how to accurately associate pollution costs and pollution prevention benefits with individual processes. This is a dynamic area of concern that has drawn the attention of accounting firms, educational institutions and the business community as a whole. It is expected that significant advances will be made in this area in the next two to five years and that accounting techniques that reflects pollution prevention opportunities will become commonplace.

cost inventory, extended time horizon, use of long-term financial indicators and direct allocation of costs to processes and products. The first three apply to the analysis of pre-implementation feasibility and the fourth to post-implementation cost accounting. The following summary, from the EPA *Facilities Pollution Prevention Guide*, addresses the elements of TCA in detail. The *Facilities Pollution Prevention Guide* cites several references that provide additional detail on TCA. The following sections of this chapter summarize the important characteristics of TCA. In addition, TCA includes not only direct costs typically included in most project cost analyses, but also indirect costs, costs related to liability and other less tangible benefits. Indirect and liability costs can represent a large cost, if ever assessed against a company. Therefore, proposed pollution prevention projects can lead to a significant net savings. However, the likelihood and magnitude of these concepts are difficult to extrapolate from little, or no, data.

EXPANDED COST INVENTORY

Direct costs, for most capital projects, are the only costs being estimated when one evaluates a project.

Direct Costs include:

- Capital Expenditures
  - Buildings
  - Equipment
  - Utility Connections
  - Equipment Installation
  - Project Engineering

- Operation and Maintenance Expenses/Revenues
  - Raw Materials
  - Labor
  - Waste Disposal
  - Utilities
  - Value of Recovered Materials

EXPANDED COST INVENTORY

- **Direct costs**
- **Indirect Costs**
- **Liability costs**
- **Less tangible benefits**

In the case of pollution prevention projects, indirect costs often are likely to represent significant net savings. These costs must be estimated and allocated to their source.

Indirect Costs include:

- Regulatory Compliance Costs
  - Permitting
  - Reporting
  - Monitoring
  - Manifesting
- Insurance
- On-Site Waste Management
- On-Site Pollution Control Equipment Operation

Reduced liability which is often associated with pollution prevention projects may provide significant short and long term savings.

Liability Costs include:

- Penalties
- Fines
- Personal Injury
- Property Damage
- Natural Resources Damage Clean-up Costs
  - Super Fund
  - Corrective Action

As you would expect, pollution prevention projects often deliver substantial benefits from an improved product or an enhanced company image.

Some of the less tangible benefits of pollution prevention include:

- Increased Sales
  - Improved Product Quality
  - Enhanced Company or Product Image
- Reduced Health Maintenance Costs
- Increased Productivity due to Improved Employee Relations
- Improved Relationships with Regulators

CHAPTER 5
ECONOMIC ANALYSIS

Effective analysis of pollution prevention projects should encompass a review of economic feasibility as well as a determination of technical feasibility. Industrial capital funds always have numerous competing interests. Plant managers typically must choose between two or more alternatives for limited funding. Pollution prevention projects must fight for tight capital available for investment along with the other facility projects, such as process improvements for quality control, ongoing maintenance, plant upgrade or expansion. Unfortunately, conventional accounting measures, such as cost-benefit analyses, are not always easily applied to pollution prevention projects. For example, whereas it is easy to calculate the cost of making process modifications or installing new equipment, it is difficult to associate a financial benefit to reduced liability or improved public perception.

Pollution prevention projects often do not conform to traditional economic analysis

This is not to say that one cannot determine the benefits of pollution prevention projects. Several factors can be realized and other benefits can be estimated. Some direct costs that can be identified include:

- Reduction or elimination in waste transportation and disposal fees.
- Reduction or elimination of environmental compliance costs.
- Elimination of the cost of installing required pollution control equipment under the 1990 Clean Air Act Amendments.
  - This may be a particularly important factor as the Source Reduction Review Project impacts the iron and steel industry.

POTENTIAL DIRECT COSTS

- **Eliminate disposal fees**
- **Eliminate compliance costs**
- **Avoid capital expenditures**
- **Conserve raw materials**

- Conservation of raw materials.
- Reduction in energy use.

Some benefits less easily quantified but of major significance include;

- Enhancement of the Corporate Image.
- Reduction in liability for future clean-up of contaminated sites.
- Elimination of the cost of installing future required pollution control equipment.

INDIRECT BENEFITS

- **Image**
- **Reduced Future Liability**
- **Future Equipment Costs**

The aim of business is profit. Basically, profits equal revenues minus expenses. In order to increase the profit, it is necessary to either increase revenues or decrease expenses. Pollution prevention activities can help in either case. Pollution prevention activities can, in some cases, improve product output or quality, thereby increasing the revenue side of the equation. More frequently, however, pollution prevention activities work to decrease expenses. The following list of costs should be considered when appropriating costs to specific processes:

- Insurance expenses
- Depreciation expenses
- Interest payments
- Labor costs
- Training expenses
- Regulatory transaction costs (permit application and renewals, etc.)

These costs are relatively easy to estimate and calculate. However, these costs are not the only expenses that need consideration. New accounting measures are being adopted to include mechanisms that consider less tangible benefits. In response to the need for new (revised) mechanisms for cost accounting, the EPA has funded several studies using an economic analysis system called the **Total Cost Assessment** (TCA) methodology to undertake pollution prevention economic analyses. This method includes four elements: expanded

TABLE 4.3 METHODS FOR MAINTAINING THE POLLUTION PREVENTION PROGRAM
(Adapted from EPA *Facilities Pollution Prevention Guide*)

- Integrate pollution prevention into corporate planning:
  - Assign pollution prevention accountability to the operating units where waste is generated
  - Track and report program status
  - Conduct an annual program evaluation at the corporate level
- Provide ongoing staff education programs:
  - Make pollution prevention awareness program a part of new employee orientation
  - Provide advanced training
  - Retrain supervisors and employees
- Maintain internal communication:
  - Encourage two-way communication between employees and management
  - Solicit employees' pollution prevention suggestions
  - Follow-up on suggestions
- Reward personnel for their success in pollution prevention:
  - Cite accomplishments in performance reviews
  - Recognize individual and group contributions
  - Grant material rewards
  - Consider pollution prevention a job responsibility subject to review
- Provide public outreach and education about pollution prevention efforts:
  - Submit press releases on innovations to local media and to industry journals read by prospective clients
  - Arrange for employees to speak publicly about pollution prevention measures in schools and civic organizations

the product. It can be difficult to track the shift of a pollutant from one medium to another or to determine what new pollutants may be created by the new procedure, but such qualifications should be documented to the extent feasible.

MEASURING TOXICITY

The toxicity of the waste should be evaluated. Reducing the sheer volume of a given waste product while increasing its per-unit toxicity is a treatment option, but it is not pollution prevention!

It is important to establish a baseline. When a pollution prevention option involves incremental changes to a well-defined process, it is possible to derive a baseline from historical performance. New facilities present a challenge since there is no "baseline". Establishing a baseline is further complicated by changes to existing processes or equipment, and by new facilities that are radically different from older plants for reasons other than pollution prevention alone. In this case, the measure of success may be the amount of pollution that was never generated. Thus, a projected amount of pollution may serve as a baseline.

METHODS OF DATA ANALYSIS

Measuring pollution prevention progress is complex. Using a single measure to summarize pollution prevention will be applicable only in the simplest cases, if at all. The characteristics of several approaches and their advantages and disadvantages are outlined in Table 4.2. Select the method or combination of methods that best fits your data availability, facility characteristics, and corporate goals.

TABLE 4.2 METHODS OF DATA ANALYSIS

- Semi Quantitative Process Description
  - easy to prepare with less utility
- Quantity of Waste Shipped of Site or Treated on Site
  - shipping manifests and compliance reports provide dates
- Quantity of Materials Received
  - An imprecise measure because it does not account for process losses or conversions
- Quantity of Waste Generated
  - Look at both inputs and outputs to provide a more complete understanding
- Process Analyses
  - Often over looks facility level waste
- Pollution Prevention Analysis
  - More useful for production changes than for behavioral changes
- Change in Amount of Toxic Constituents
  - Obtained from SARA Title 313 Form R reporting
- Changes in Toxicity
  - Obtained by discharge analysis

MAINTAIN THE POLLUTION PREVENTION PROGRAM

The task of maintaining a viable pollution prevention program will be made easier with the establishment of a **pollution prevention awareness program.** Such a program is intended to promote employee involvement in the prevention effort. The objectives of the pollution prevention awareness program are to:

- Raise awareness of environment-related activities at the mill.
- Inform employees of specific environmental issues.
- Train employees in their pollution prevention responsibilities.
- Recognize employees for pollution prevention efforts.
- Encourage employees to participate in pollution prevention.
- Publicize success stories.

A summary of methods for accomplishing this appears in Table 4.3. Further detail may be found in the EPA *Facilities Pollution Prevention Guide.*

Publicize Success

GET THE WORD OUT!

CHAPTER 4
MEASURE PROGRESS & MAINTAIN POLLUTION PREVENTION PROGRAMS

STEP 6: GET THE WORD OUT

In order to assess the impact of a pollution prevention program, measurement of progress against goals is important. Review of the program's success and failures can assist managers and foremen in determining which pollution prevention goals at the facility and production unit levels are being met and what the economic results have been. The comparison identifies pollution prevention techniques that work well and those that do not. This information helps to guide future pollution prevention assessment and implementation cycles.

Quantitative evaluations permit comparisons of one project with another, and with similar projects from other companies. You will need this knowledge to plan enhancements of your current pollution prevention program, to select technologies to transfer from other operations, and to help identify new pollution prevention options.

ACQUIRING DATA

To measure success, select what is to be measured (e.g., waste volume or toxicity), measure that quantity, and normalize the data as necessary to correct for factors not related to the pollution prevention method being reviewed. Table 4.1 illustrates a number of potential data sources for your consideration.

Quantitative evaluations permit comparisons of a variety of projects

TABLE 4.1 POTENTIAL DATA SOURCES
(Adapted from *EPA Facilities Pollution Prevention Guide*)

Raw Material/Production Information:
- Product composition and batch sheets
- Material application diagrams
- Material safety data sheets
- Product and raw material inventory records
- Operator data logs
- Operating procedures
- Production schedules

Process Information:
- Process flow diagrams
- Design and actual material and heat balances for:
  - -production processes
  - -pollution control processes
- Operating manuals and process descriptions
- Equipment lists
- Equipment specifications and data sheets
- Piping and instrument diagrams
- Plot and elevation plans
- Equipment layouts and logistics

Regulatory Information:
- Waste shipment manifests
- Emission inventories
- Biennial hazardous waste reports
- Waste, wastewater, and air emissions analyses, including intermediate streams
- Environmental audit reports
- Permits and/or permit applications
- Form R for SARA Title III Section 313

Accounting Information:
- Waste handling, treatment, and disposal costs
- Water and sewer costs, including surcharges
- Costs for nonhazardous waste disposal, such as trash and scrap metal
- Product, energy, and raw material costs
- Operating and maintenance costs
- Department cost accounting reports

Other Information:
- Environmental policy statements
- Standard procedures
- Organization charts

After deciding what data should be tracked, you will need to determine how to collect it and what normalization may be required for each category of data.

The iron and steel industry collects a significant amount of data.

The iron and steel industry already collects a considerable volume of data for regulated waste streams. However, there can be gaps and discrepancies in this data. For example, RCRA wastes are characterized by waste type and total amount, but not by individual components. Therefore, these data may not be specific enough for your evaluation. In addition, accurate measuring devices may not be available for all waste streams (e.g., vaporous or fugitive emissions). In such cases, your regulatory compliance reports will have been based on estimates; comparing estimates from one period to another will not yield reliable percent-of-change figures.

The pollution prevention option may also eliminate part of the target material but may shift some of it to another plant stream, to another environmental medium, or into

- Capital Costs
  - Purchased Process Equipment
  - Materials Cost
  - Utilities Connection
  - Site Preparation
  - Installation
  - Engineering
  - Startup

- Operating Costs
  - Utilities
  - Permitting
  - Handling
  - Treatment
  - Returns
  - Disposal

- Income
  - Product Sales
  - Recycling Income

Further detail on economic analyses of pollution prevention projects are included in Chapter 4.

Option Ranking

Once the options have been technically and economically analyzed, it is important to prioritize each waste reduction option in order to provide a direction for the implementation program. When analyzing options there are a number of points you may want to consider:

- Carefully evaluate technologies with no track record.

- Try to find case studies describing the application of the option to iron and steel.

- Determine how much waste the option itself produces and how much raw material it requires.
- Determine the annual operating and capital costs of the option(s).
- Is the option easy to implement?
- Don't exclude any option until it has been analyzed completely.

High tech options are not always the best. Many mills reduce waste through simple changes in business procedures such as improved housekeeping and waste segregation. Be sure the option does not simply shift waste to a different media (liquid to gas, for example) or different part of your operation.

Write an Assessment Report

As one of the concluding activities of the pollution prevention assessment, the task force must write an assessment report that summarizes the results of the pollution prevention assessment at the company level. Table 3.5 illustrates a typical report outline. The report should provide a schedule for implementing prevention projects and be the basis for evaluating and maintaining the pollution prevention program. It will also be used to secure internal funding for projects since most require capital investment.

TABLE 3.5 TYPICAL POLLUTION PREVENTION ASSESSMENT REPORT OUTLINE
(Adapted from the EPA *Facilities Pollution Prevention Guide)*

- Executive Summary
- Pollution prevention potentials
- Overall project economics
- Required resources and how they will be obtained
- Estimated time for implementation
- Possible performance measures to allow the project to be evaluated after it is implemented

the mill supervisor's and foreman's knowledge of operating procedures, and experience with other installations.

TABLE 3.4 TECHNICAL EVALUATION CRITERIA FOR SCREENING POLLUTION PREVENTION OPTIONS

(Adapted from EPA *Facility Pollution Prevention Guide*)

- Will it reduce waste?
- Is the system safe for mill workers?
- Will product quality be improved or maintained?
- Is space available for installation of equipment?
- Are the new equipment, materials, or procedures compatible with current production operating procedures, work flow, and production rates?
- Will additional staff be required to implement the option?
- Will personnel with special expertise be needed to operate or maintain the new system?
- Do utilities need to be installed to run the equipment?
- How long will production be stopped during system installation?
- Will the vendor provide acceptable service?
- Will the system create other environmental problems?

Environmental Evaluation

In this step, the pollution prevention assessment team must weigh the advantages and disadvantages of each option with regard to the environment. Often the environmental advantage is obvious: the toxicity of a waste stream will be reduced without generating a new waste stream. Most housekeeping and direct efficiency

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improvements have this advantage.

More often, however, the environmental advantage is not always so obvious. Any option which will involve a product, process change or substitution of raw materials should, therefore, be fully evaluated. For example, in an EAF operation at the ARMCO Butler Works, ARMCO reported that by segregating the various air emissions waste streams, the baghouse dust from the Argon/Oxygen Decarbonizing Furnace (AOD) was briquetted offsite and then blended into the EAF feed. Previously, this waste had been sent to disposal. There were no reported problems associated with this "recycling".

Energy Evaluation

Energy consumption should also be considered. To make a sound choice, the energy evaluation should consider the entire life cycle of both the product and the production process.

Economic Evaluation

Estimating the costs and benefits of some proposed pollution prevention projects is straight forward, while others prove to be complex. Cost calculations for each option should be documented to help ensure that these real accomplishments of your pollution prevention program will not be overlooked when you measure the program's progress.

If a project has no significant capital costs, its profitability can be judged by whether or not it reduces operating costs and/or prevents pollution. Installation of water conservation controls and improvement of operating practices, for example, probably will not require extensive analysis before they are adopted. Worksheet 9 *Profitability* (in the Appendix) can be used to document this analysis.

Sources of income and costs to be considered include:

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Worksheet 9

Profitability

In the screening phase, detailed cost/benefit analyses are not necessary; rather, decisions by the team leader or team members to consider a further economic analysis of the option is sufficient. Table 3.3 lists questions that might be relevant for screening options.

TABLE 3.3 TECHNICAL EVALUATION CRITERIA FOR SCREENING POLLUTION PREVENTION OPTIONS

(Adapted from EPA *Facilities Pollution Prevention Guide*)

- Will it reduce waste?
- Is the system safe for mill workers?
- Will product quality be improved or maintained?
- Is space available for installation of equipment?
- Are the new equipment, materials, or procedures compatible with current production operating procedures, work flow, and production rates?
- Will additional staff be required to implement options?
- Will personnel with special expertise be needed to operate or maintain the new system?
- Do utilities need to be installed to run the equipment?
- How long will production be stopped during system installation?
- Will the vendor provide acceptable service?
- Will the system create other environmental problems?

PERFORM A FEASIBILITY ANALYSIS

Once options have been identified for further evaluation, the *Option Description* (Worksheet 8) and *Profitability* (Worksheet 9) (see the Appendix) can be utilized to screen options. This process will assist you in determining which options are technically, environmentally, and economically feasible, and will also assist you in prioritizing them for implementation.

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Worksheet 8

Option Description

Technical Evaluation

The assessment team will perform a technical evaluation to determine whether a proposed pollution prevention option is likely to work in a specific application. Technical evaluation for a given option may be relatively quick or it may require extensive investigation. The list in Table 3.4 suggests some criteria that could be used in a technical evaluation. As you will note, some of these are more detailed versions of questions asked during the option screening phase.

All groups in the mill that will be affected directly if the option is adopted should contribute to the technical evaluation, including staff from process engineering, production, maintenance, purchasing, etc. Customers may also play a part in the decision and their requirements need to be considered. Early contact with these groups will assure consideration of their needs.

WHEN EVALUATING AN OPTION:

- **Talk to Mill Personnel**
- **Your Customers**

Because of economic and competitive forces in the iron and steel industry, careful assessment of the impact of pollution prevention options on product quality is very important. Obviously, if the option degrades product quality it will not be considered. Often, however, closer calls on option viability must be made based on marginal costs or small gains in technical efficiency.

For options requiring little or no significant capital expenditures, the team can use a "fast-track' approach. For example, procedural or housekeeping changes can often be implemented quickly, after the appropriate review, approvals, and training have been accomplished. New procedures for handling spent batteries or other recyclable materials would fall in this category. (See the earlier list of recycled material from the Bethlehem Steel Johnston Works in this chapter.)

LOW COST/NO COST OPTION MAY BE UNDERTAKEN IMMEDIATELY

When installing new equipment, it is particularly important to carefully assess the impact on the production process. Equally important will be the option's ability to function in the field in conditions which are similar to your application. Venders' promises of acceptability and compatibility must be tempered with

Raw materials, chemicals or maintenance materials, or their transformation products can leave the process as:

- Final Product
- Contaminants in air streams
- Constituents in wastewater
- Hazardous waste solids or liquids
- Concentrated waste chemicals
- Non-hazardous wastes

Worksheet 5, *Products Summary,* can be found in the Appendix and is used to assist in defining product information.

Proper management and preparation for pollution prevention activities, evaluation and implementation requires that each stream identified in the generalized process flow be fully characterized. For each waste stream, the following information is required:

- Flow rate
- Chemical composition
- Individual species concentrations
- Stream pH

A sample *Waste Stream Summary* form Worksheet 6 is provided in the Appendix.

Knowing which waste streams or potential waste streams are generated, forms the foundation for a pollution prevention program. It does not, however provide the complete picture. How the process currently is managed and operated comprises a critical element of the information necessary to develop an effective pollution prevention program. Answers to question such as:

- Who specifies chemical/materials?
- Who negotiates their purchases?
- Who manages the inventory?
- Who is responsible for waste disposal?

can provide insight into materials management and any potential impediments to pollution prevention that may be caused by operations management.

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Worksheet 5
Product Summary

Worksheet 6
Waste Stream Summary

Characterize each process stream completely

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A typical production process includes the interaction of a number of other divisions within the corporation besides manufacturers as illustrated below. The functions of these groups have been previously described (See Chapter 2). Be sure to consult them for pollution prevention options

- Receiving
- Warehousing
- Process Planning Support
  - Manufacturing Management
  - Product Engineering
  - Production Planning
  - Materials Control
- Physical Plant Support
  - Maintenance
  - Utilities
  - HVAC
  - Environmental Group
  - Waste Collection
  Waste Disposal
- Personnel Support

SCREEN OPTIONS

In this task, the audit team(s) decides which option(s) to adopt. A full and thorough technical and economic evaluation is necessary. This effort requires particular attention to a review of the technical feasibility and particularly the collection of cost information. The assessment of a project's feasibility ultimately rests with the mill's ability to fund a project. Some options will be found that have no cost or low cost and can be implemented relatively easily (e.g. dust control on mill roads to reduce fugitive "emissions"). In others equipment may be required to be installed to collect and recycle a sludge.

OPTION SCREENING

- **Technical**
- **Energy**
- **Environmental**
- **Economic**

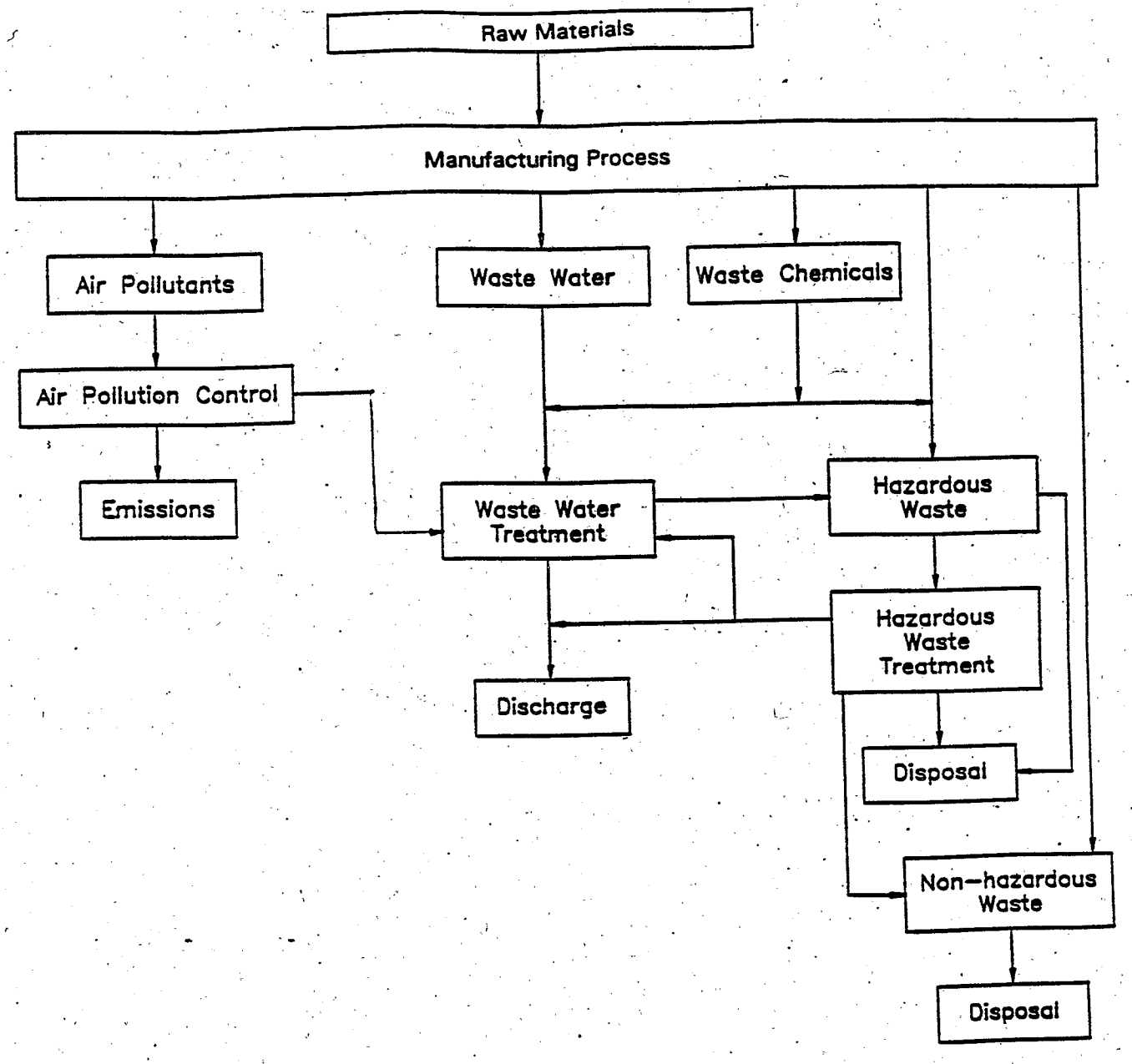

FIGURE 3.1 PROCESS FLOW SHEET

Input Materials Summary, defines materials used in the process.

Figure 3.2 represents how a generic diagram of materials can be related to electric arc furnace (EAF) steel production.

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Worksheet 4

Input Materials Summary

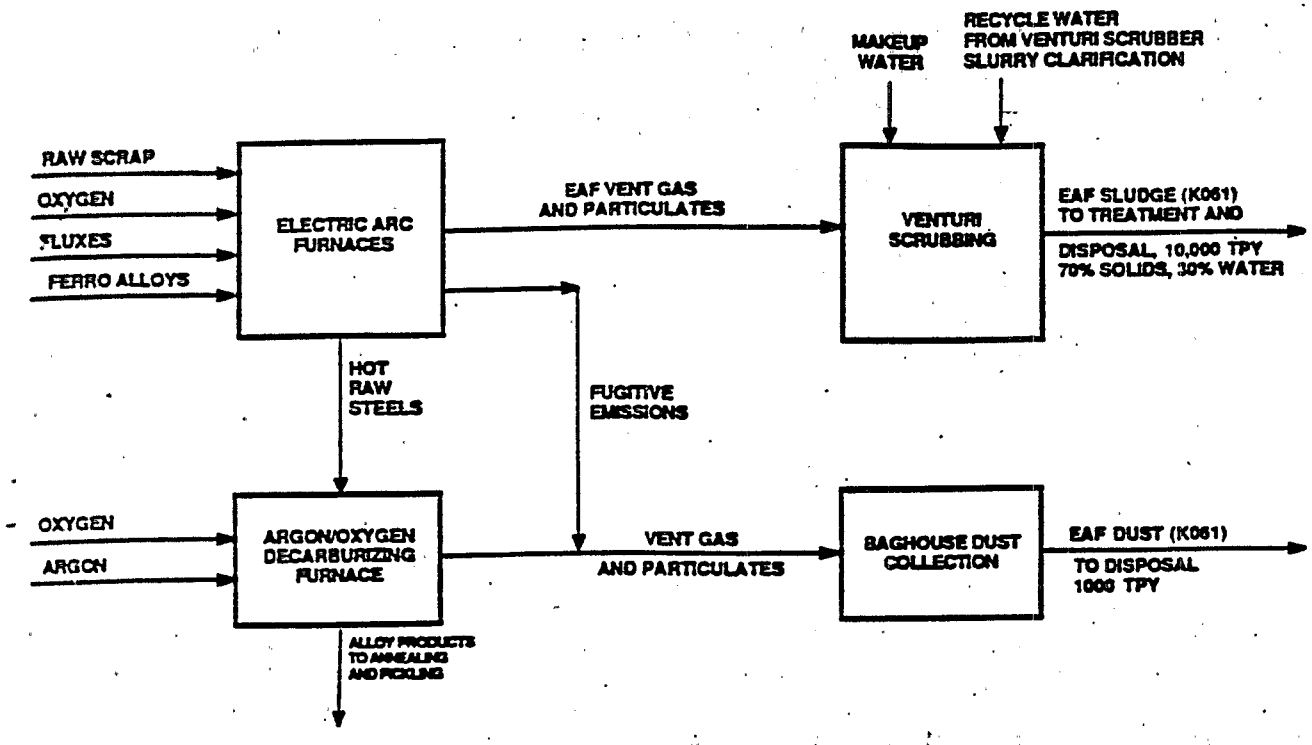

Figure 3.2 EAF Facility Flow Sheet from ARMCO Works
(Adapted from Environmental Progress, Vol. 8, No. 2, May 1989, pp. 88-96)