United States Environmental Protection Agency

An Organizational Guide to Pollution Prevention

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EPA Info on P2

Info on the P2 Tools

P2 Checklists

P2 and the EMS Model

P2 and the Quality Model

P2 Manuals

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Green Zia Environmental Excellence Program

Jewelry Manufacturing

Guidance for improved environmental performance and pollution prevention in your jewelry manufacturing business

Acknowledgements

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The Green Zia Environmental Excellence Program

Guidance materials for jewelry manufacturing.

Introduction

This workbook contains information on how to establish a pollution prevention program specific for a jewelry manufacturing operation. The workbook also contains waste management and regulatory guidance materials to help assure that you are in compliance with environmental, health, and safety regulations. Used together, this information can help you establish a pollution prevention program that will help you be in compliance and reduce waste. Use of the tools from start to finish also helps you qualify for the Green Zia Environmental Excellence Program.

The Green Zia Environmental Excellence Program is a voluntary program based on quality management principles that is designed to help New Mexico businesses achieve environmental excellence through pollution prevention programs.. This program is administered by a partnership of state, local, and federal agencies, academia, private industry, and environmental advocacy groups. This packet has been specifically developed for a jewelry manufacturing operation and is designed to meet the needs of a small business.

The basic logic of the Green Zia Environmental Excellence Program is that:

- waste or pollution is the result of inefficiency;
- reducing waste increases profits;
- waste that is not created cannot pollute.

This guidance has been developed to aid in your company's understanding of best management practices to help your company comply with environmental health and safety regulations and to reduce waste and associated liabilities.

It is important to remember that environmental health and safety regulations are triggered by the use of equipment and chemicals. Better use of chemicals, use of safer chemicals, and efficient operation of machinery can help reduce your regulatory burden—if you aren't using hazardous materials, then you have fewer regulations to be concerned with! This program is based on first understanding work processes and materials use and then improving work practices to reduce cost, waste, and regulatory concerns.

Working through the Green Zia Environmental Excellence Program will result in a system that helps address environmental issues in cost effective ways, based on sound business practices. The system provides a framework for continuous improvement over time and contributes to a thorough understanding of environmental issues in your business.

What is Pollution Prevention?

Simply put, pollution prevention means not creating a waste in the first place. Pollution prevention is achieved by the efficient use of resources, including raw materials, energy, water and even time and distance. The goal is to produce a product or deliver a service as efficiently as possible, with the least amount of wasted materials and the least possible environmental impact.

The bottom line is that pollution prevention or improved efficiency can help businesses save money and help protect the environment at the same time.

What is Environmental Excellence?

Environmental excellence means moving beyond compliance with environmental, health and safety regulations by establishing an environmental management system that incorporates pollution prevention into core business practices.

A prevention-based environmental management system will:

- Help a business identify *all* the environmental compliance and health and safety concerns as well as costs associated with a waste generating process, and
- Use prevention approaches to reduce or eliminate the waste and reduce the associated costs.

In the Green Zia Environmental Excellence Program, attention is focused on the *process* that generates the waste, not the waste. Identifying and implementing process improvements will reduce waste and costs. This is a major shift from the traditional, reactionary approach that concentrates only on managing wastes or pollutants already created to an anticipatory approach that concentrates on prevention of wastes or pollutants to improve environmental and economic performance. This prevention-first environmental management system will identify cost effective ways to achieve "beyond compliance" status, creating a win-win situation between economics and environment.

The Green Zia Tools

The Green Zia Program provides tools to establish a basic prevention-based environmental management system. Management and employees walk through the tools as a team to gain a complete understanding of their operation. Examples have been worked out for the auto repair business. We encourage you to customize the examples to your own operations. The packet includes a series of process maps (Tool 1) for some operational areas of the auto repair business. Tools 2-6 are also explained and illustrated to help you develop your program. Use of these tools on a regular basis will help your company qualify for the Green Zia Environmental Excellence Program.

Green Zia Tools:

Knowledge of Process

Tool 1: Process Mapping: Illustrates the work steps materials pass through as they are transformed into your final product. Maps allow for the identification of all inputs and outputs such as water, chemicals, electricity or other materials from a process, helping you to understand wastes and their sources. Maps also help you understand regulated activities.

Full Cost Accounting

Tool 2: Activity-Based Costing: Identifies the true costs of wastes or losses and helps participants identify areas to target for pollution prevention, by assigning dollar values to these wastes and losses.

Pinpointing Problems

Tool 3: Root Cause Analysis: Creates a cause and effect diagram to highlight why and where the losses occur in the process. Understanding why and where the loss occurs will help participants focus on specific areas for improvement.

Problem Solving

Tool 4: Brainwriting: Addresses problems by generating as many alternatives as possible to minimize loss.

Prioritization of Options

Tool 5: Bubble-up-bubble-down: Ranks alternatives to determine the optimal solution. Factors such as cost, ease of implementation and effectiveness are considered in evaluating and ranking the alternatives.

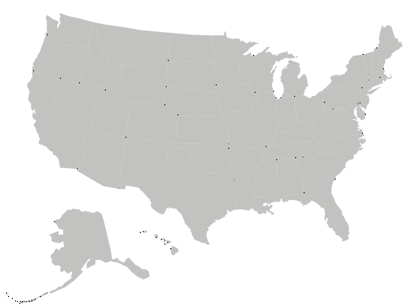
Ensuring Success

Tool 6: Action Plan: Details each step that needs to be taken to implement the alternative and reduce or eliminate the loss from the process.

Tool #1: Process Mapping

To begin incorporating pollution prevention into your business, you must first get a full understanding of where wastes are being generated. This tutorial will discuss the advantages of using process maps to logically evaluate each step of your process.

Warm-up Exercise



Maps have been used throughout the ages for many purposes from helping sailors navigate the seas to providing a safe route for climbers hiking to the tallest peaks. You have probably drawn maps to your home or office so that someone could visit. It is important that the information on this map is complete and accurate or, as you may have found, your guest will get lost!

Take a minute now and think of a coffee shop or restaurant nearby that everyone in the group knows. Draw a map from the building you are currently in to this establishment - include traffic lights, landmarks, and any other important features along the way. Now compare maps with the other members of your group. Are they the same? If a person not familiar with the area were to use your map, would they have found their way?

Introduction

Are you aware of the amount of waste that your business generates? Could this waste be turned into profit? By considering methods of reducing wastes, recycling used and unused raw materials, and reusing lost material, you could not only help the environment but also reduce your raw material and waste disposal costs.

This section discusses process mapping, a method of analyzing a process in order to catalogue all the materials used and lost in the process. With process mapping, you will systematically identify the series of steps materials pass through as they are transformed into the final product. Evaluating your process in this manner will allow you to recognize the opportunities to prevent losses and possibly streamline operations. Each loss identified during the process mapping is an opportunity to prevent that loss.

A series of process maps have been developed for jewelry manufacturing operations and are included in this packet. You should customize these maps for your operation, since no two businesses are exactly alike. These maps become a reference for you to use for your pollution prevention program and can be updated to reflect changes as you improve your operations. These maps are also great for training new employees and for other problem solving needs.

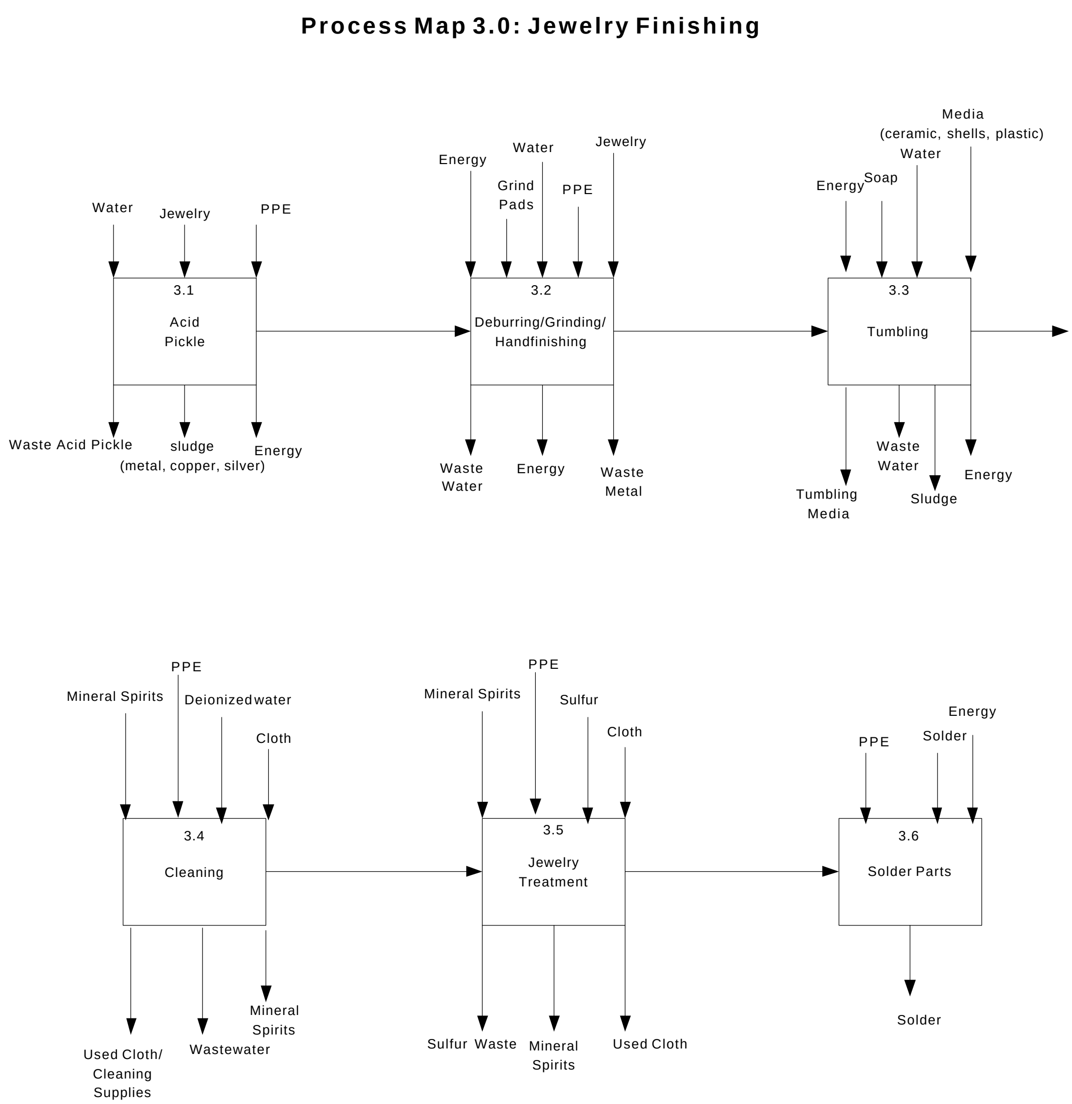
Large businesses and manufacturers use these tools to understand and improve their manufacturing processes. Small businesses can benefit by using these tools as well!

It is helpful to also prepare a narrative to go along with your process maps to explain the process in detail. We recommend that you include regulatory activities in the narratives as part of your environmental management system. Narratives are also included in this packet; please revise to reflect your business operations.

Create a team of employees to complete this exercise. During this exercise you will:

- Examine and revise the process maps and narratives in the packet to accurately reflect your operation
- Fully understand the functionality of each step of a process
- Identify the inputs and outputs/losses within the process
- Communicate findings in a clear and concise manner to members of the team.

Example of a process map for jewelry manufacturing:



Please review the process maps in the back of this booklet and make changes to reflect your operation.

Once you have reviewed and revised the process maps to your operation, move to the next section…Activity-Based Costing!

Tool #2: Activity-Based Costing

Every waste or environmental loss costs you money. By determining the activities that cause waste, you can focus your pollution prevention efforts to minimize the cost to your business and protect the environment. This tutorial will introduce you to a method of evaluating your waste.

Warm-up Exercise

Your daughter approaches you one evening and says that she is planning to buy a car. With the $400 she has left over each month, after paying all of her bills, she is sure she will be able to afford the $220 monthly car payment.

What are the other costs of operating and maintaining a car that she is forgetting? Consider not only the annual costs, such as insurance, but also the intermittent (once in a while) costs. Can she really afford this car?

Introduction

Once you have determined the losses in your processes through your process maps, you can discover how these losses are affecting your "bottom line". How much does it cost you to discard 10% of your raw materials, or 2% of your finished products? Which activities have losses that most hurt the profitability of your company? This tool will help you look at the cost of the losses in your business and see how much these losses are costing you. The results may surprise you!

Which losses should you care about? The Pareto Principle suggests that 80% of the problems in a business come from 20% of machines, raw materials or operators. (The same is true for any facet of a business, for example, 80% of sales come from 20% of your customers, etc.) Once you have assigned costs to your activities, you can figure out which 20% of your activities are contributing to 80% of your costs. The Pareto Principle is very important in activity-based costing as it is used to focus on the most important areas for improvement in your pollution prevention program. Use of the Pareto Principle for the activity-based costing section will help you quickly identify areas of your business to focus your prevention efforts.

New Terms

Activity based costing (ABC) - An accounting method used to assign the cost of your losses to the activities that generate these losses. By assigning costs to activities, you will discover the activities should be targeted for prevention.

Environmental costs -The costs associated with the losses in your process.

Intermittent or support operations – Operations that occur once in a while that are necessary for the key processes to operate.

Pareto principle - A principle that suggests that 80% of anything can be attributed to 20% of the factors involved. For example, 80% of your environmental costs can be attributed to 20% of your activities.

Activity-Based Costing

1. Make a list of all the activities in your operation. Be sure to include the activities from your process map as well as any intermittent operations (such as cleaning or maintaining equipment.).

2. Regular activities:

   a. Designing jewelry
   b. Making molds
   c. Making casts
   d. Melting/pouring metals
   e. Devesting materials
   f. Finishing Jewelry
   g. Packaging and shippibg

3. Support activities:

   a. Managing pickling solution
   b. Managing devestment wastes
   c. Equipment maintenance
   d. Managing cleaning wastes
   e. Managing various wastes such as molds, waste metals, wastewater
   f. Equipment maintenance

4. List all of the losses in your operation. Look on your process map and add any others that you think of.

5. Reviewing your process maps, identify the operations in your plant that generate most of your waste or pollution problems. For example, does cleaning solvent use cause most of your environmental problems? Do pickle wastes or air emissions from baking flasks or melting metals result in your biggest environmental problem? Does the 80/20 Rule apply? Focus your efforts for now on the areas of your operations that you do the most or that create the biggest environmental problem for you.

6. Use process maps to review material use and losses for your selected process or operation. You will use these maps as a guide to assign costs to these losses.

7. Identify which major costs or general ledger costs apply to the material use and losses on the process maps (utilities, metal purchase costs, waste disposal costs, costs that are easy to get information on and that you typically consider when looking at your processes). Enter into Table 1. (See example provided)

8. Identify which other activities are related to the use of these materials that are not in the major costs (protective equipment such as gloves or goggles, monitoring, record keeping, maintenance, permits, metal recycling services, waste management service contracts, fees to the state or city, storage space for chemicals, the cost of spill clean-up and reporting). These activities are not usually considered when thinking about the cost of a process, yet the costs associated with them can be significant.

9. Write the activities in the first column of Table 2. Along the top list all the costs or services required for these activities. Add or delete categories as appropriate for your business. Put an "x" for every cell that applies.

10. Count the total number of "x's" in Table 2. Then circle the x's that represent what you estimate to be about the top 20% of the most expensive activities in your operation. Again, you are using the 80/20 rule: 20 percent of your activities will probably add up to about 80% of your total costs.

11. Then estimate only the cost of each of these top 20% of activities that you circled and write them in a new table. Cost estimates are allowable as you are using this method to prioritize your most expensive activities. You can refine costs once you have chosen a project to work on. (In the example, the top 20% of the cost categories chosen have the estimate beside them.) Add these numbers into Table 1 under the appropriate waste stream in the "Hidden costs" line.

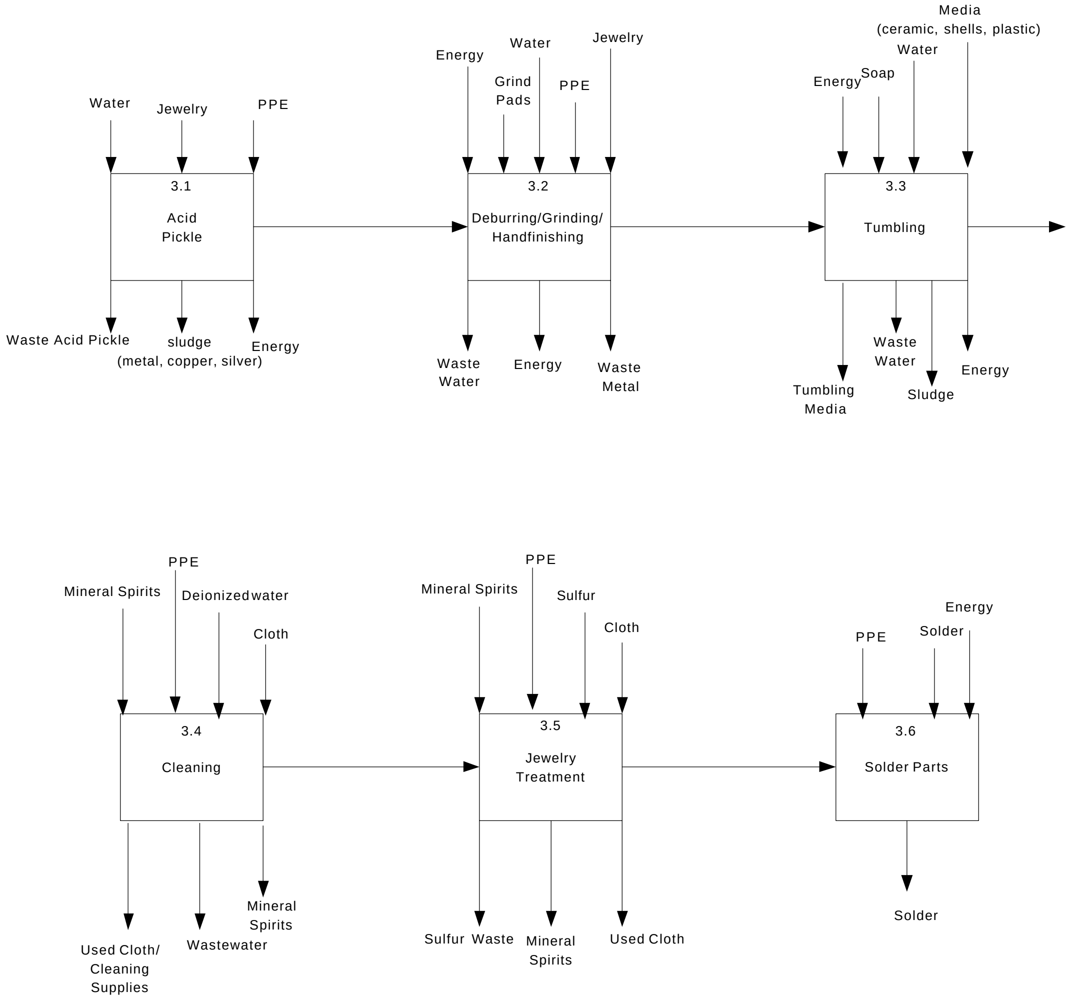
12. Add the ledger costs and the hidden costs together to discover the true costs.

13. Create a Pareto Chart. Create a chart showing all these costs graphically. On the x axis (vertical), place costs in dollars, on the y axis (horizontal), show the true costs of the wastes. This chart will help graphically show how all the costs stack up against each other. Does the 80/20 Rule apply here? Use this chart to identify the most expensive processes. This can be used to identify the first area for improvement. Which waste stream do you think you should focus on from this Pareto chart?

An example of Activity-Based Costing is provided in the next section. Please note that this is an example to demonstrate how to assess costs. The costs included are not from an actual case study. Water and energy costs are not included in this example but should be considered in developing improvement and cost saving projects. The example provided addresses only the major processes in a jewelry manufacturing operation. Environmental improvement can be applied to every waste generating activity in your operation!

Activity-Based Costing Example

Process Map 3.0: Jewelry Finishing



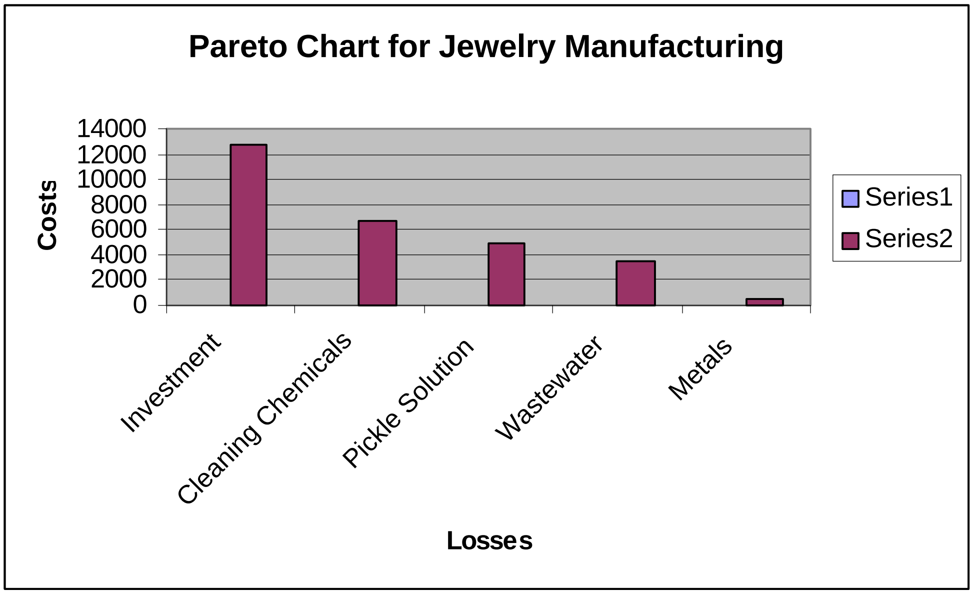
Activities	Materials and Losses
Acid Pickling Deburring Tumbling Treatment Soldering	Wastewater *Spent Pickle Solution *Energy (major cost across organization) *Metals *Waste Cleaning Solutions Devestment Waste *Paper (*) indicates most important waste streams and materials

Table 1. Activity-Based Costing Analysis (Per year)

Workstep						
Costs/Losses	Pickle Solution	Cleaning Chemicals	Investment materials	Waste-water	Metals	Total
Raw material	$2,000	$500	$2,500	$1,500	$2,500	$12,000
Disposal fees	$2,500	$1,500	$3,500	$2,0000	0	$13,500
Other ledger costs	$500					
Hidden Costs	**($2,000)**	**($4,650)**	**($6,650)**	**($500)**	**$2,000**	**($11,300)**
Total	**$5,000**	**$6,650**	**$12,650**	**$3,500**	**$500**	**$28,300**
%of Total	.18	.240	.45	.12	.08	1.0

Table 2. Hidden Cost Analysis (per year)

Pickle Solution					
Activities/Cost Factors	Materials	Space	Utilities	Services	Labor and or fee costs
HW Gen. fees					X ($1,000)
Reporting					x
Pickle Recovery Unit	X ($1,000)	x	x		x
Total hidden costs for pickle solution					***($2,000)***
Cleaning Chemicals					
Record keeping					x
HW Gen. fees					X ($1,650)
Recycling services	x	x		X ($3,000)	
Cleaning equip.	x			x	x
Total hidden costs for cleaning chemicals					***($4,650)***
Investment Materials					
Discharge fees					X ($1,650)
Handling	x	x	x	x	X ($5,000)
Water use fees					x
Total hidden costs for investment materials					***($6,650)***
Wastewater					
Discharge fees				x	X ($500)
Total hidden costs for wastewater					***($500)***
Metals					
Recovery service				X $3,500	X ($1,500)
Total hidden costs for metals					***$2,000***



Pareto Chart for Jewelry Manufacturing. The Pareto Chart illustrates costs relative to each other and helps choose areas to target for pollution prevention activities. In this example, investment materials, the most expensive loss, will be the focus of the pollution prevention efforts in the following sections.

Now that the process mapping and activity-based costing are completed, you have a sense of the relative environmental costs of your operations. Since investment materials are the target, we will use the following problem-solving and decision-making tools to find a way to reduce investment use, increase efficiency and save money.

Most of your work is done. These two tools can be revised as needed. Use these maps and information annually (or more often!) to keep improving your operation on an ongoing basis. Now that you have identified your most expensive wastes, you can now move towards solving problems and eliminating waste…the next tool is Root Cause Analysis!

Table 1. Activity-Based Costing Analysis (Per year)

Workstep							
Costs/Losses							Total
Labor							
Raw material							
Disposal fees							
Other ledger costs							
Hidden Costs							
Total							
%of Total							

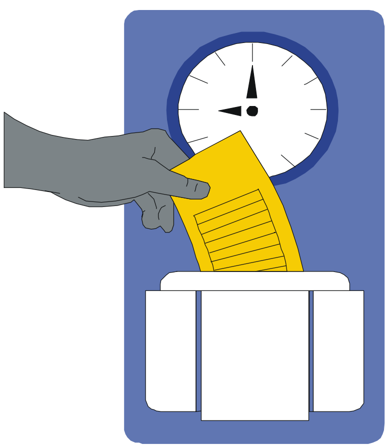
Table 2. Hidden Cost Analysis (per year)

Activities/Cost Factors	Materials	Space	Utilities	Services	Labor
Waste Stream					
Monitoring					
Reporting					
Repairs					
Recycling disposal service					
Spill clean-up					
Storage					
Record keeping					
Generator fees					
Total hidden costs for (waste stream)					
Waste Stream					
Monitoring					
Reporting					
Repairs					
Recycling disposal service					
Spill clean-up					
Storage					
Record keeping					
Generator fees					
Total hidden costs for (waste stream)					
Waste Stream					
Monitoring					
Reporting					
Repairs					
Recycling disposal service					
Spill clean-up					
Storage					
Record keeping					
Generator fees					
Total hidden costs for (waste stream)					

Tool #3: Root Cause Analysis

Now that you have recognized the activities in your process that are costly or expensive to your business, you can begin to focus your efforts on pollution prevention. This tool presents a method of detecting the underlying reason for an environmental loss so that the loss can be prevented.

Warm-up Exercise



Think of all of the times that you have been late for work and list the different reasons for your delay. Maybe your alarm clock did not go off, or perhaps your child was sick and you needed to arrange for a sitter. Did you spend too much time reading the newspaper or did you need to run to the store to pick up milk.

Arrange all these reasons in the categories listed below, or create an additional category. Some of the items on your list may be entered more than once. Now consider the last time you were late for work. Why were you late? Circle the reason.

MACHINES
broken alarm clock

PEOPLE
sick child

METHODS
reading the newspaper

MATERIALS
out of milk

Introduction

In the last tool you determined the key losses responsible for the greatest amount of environmental costs. In order to try to prevent a loss, you must first understand why it is occurring. The underlying reason for a loss is also known as its “root cause”. The root cause will answer the question: What *ultimately* caused the loss? Determining the root cause of an environmental loss is very similar to determining the root cause of being late for work

A cause and effect diagram is one method of determining the root cause for a loss. This tool provides a visual description of all possible causes for a specific loss. Once all the possible causes are depicted on the diagram, the most plausible cause or causes are identified. It is imperative that all persons involved in determining the root cause are in agreement. The next step is to write a “Dear Abby” letter summarizing the cause or causes for a loss will ensure that all participants see the problem in the same way.

During this exercise you will:

- Construct a cause and effect diagram with all potential causes for a loss.
- Discuss the most probable cause or causes.
- Write a Dear Abby letter describing the reason for the loss.

Root Cause Analysis

After participating in process mapping and activity based costing exercises, it was determined that the largest loss, investment materials, accounts for approximately 80% of all environmental costs in the jewelry manufacturing operation. The next step is to discover the root cause of this loss.

To determine the root cause of a loss, you must ask, “Why is the loss occurring?” One way of gathering information concerning the generation of a loss is called a cause and effect diagram, or fish bone diagram, since it resembles a fish bone. Major categories of possible causes for the loss are first defined and entered on the diagram as an offshoot from a main horizontal line. Next, all possible causes of the waste are assigned to a category and entered on the diagram. Once all the causes are defined, an agreement is made as to the most plausible reason for the loss.

Divide the causes into four major categories - Methods, Machines, Materials, and People - and then write down all the possible reasons why investment materials could be lost from the process and assign them to a category. Begin the diagram and then write down some of the things that immediately come to mind. An example has been provided in Figure 2.

Several things may come to mind. Investment is used for each piece of jewelry that is processed. People may not fully utilize the wax trees and less jewelry is made per flask and investment materials. Spills may occur often. Investment may not be mixed right and could cause failure. Also people operating the various mold and jewelry making processes are critical and training and a good work attitude are critical to efficient operations. All of these ideas should be entered under one of the four categories in the fishbone diagram: Machines, Methods, Materials and People as in the example in Figure 2.

Now that all the possible causes investment being lost during the jewelry manufacturing process are categorized, it is time to determine the most probable cause. Go back to the diagram and circle the most probable causes. One of these should be the root cause**.** Then, working with employees as a team, discuss which one of these major causes is the root cause. To come to clear understanding of the root cause, we suggest that the team write a short "Dear Abby" letter describing his or her interpretation of the problem to ensure that each person sees the problem the same way. Once the letter is in place, the group becomes Abby and seeks to solve the problem. *(see Figure 3)*

Another method for determining the root cause of a problem is the "5 whys".

By asking the question "why?" five times, you may get to the root cause of a problem. An example of how the five whys works is as follows.

The Five Whys:

1. Why has the machine stopped forcing an interruption in production?
   A circuit breaker tripped due to an overload.
2. Why was there an overload?
   There was not enough lubrication for the bearings.
3. Why was there too little lubrication for the bearings?
   The pump was not pumping enough lubrication.
4. Why was there not enough lubricant being pumped?
   The pump shaft was vibrating because of abrasion
5. Why was there abrasion?
   There was no filter, which allowed chips of metal to get into the pump.

The solution is then to place a filter on the pump to capture metal chips.

Both tools can be used to find the root cause of the problem. For most problems to be permanently solved the root cause must be addressed. The fishbone diagram is a good visual tool that helps you understand all the areas that contribute to a problem. Understanding all the contributing factors will help facilitate problem solving. The Five Whys will also help you move past dealing with the symptoms of the problem to solving the real problem.

Examples of the fishbone diagram and a Dear Abby letter are included as well as a blank fishbone diagram for your use.

The next tool will present brainwriting - a method to generate ideas.

Figure 1: Jewelry manufacturing Process - Process Map

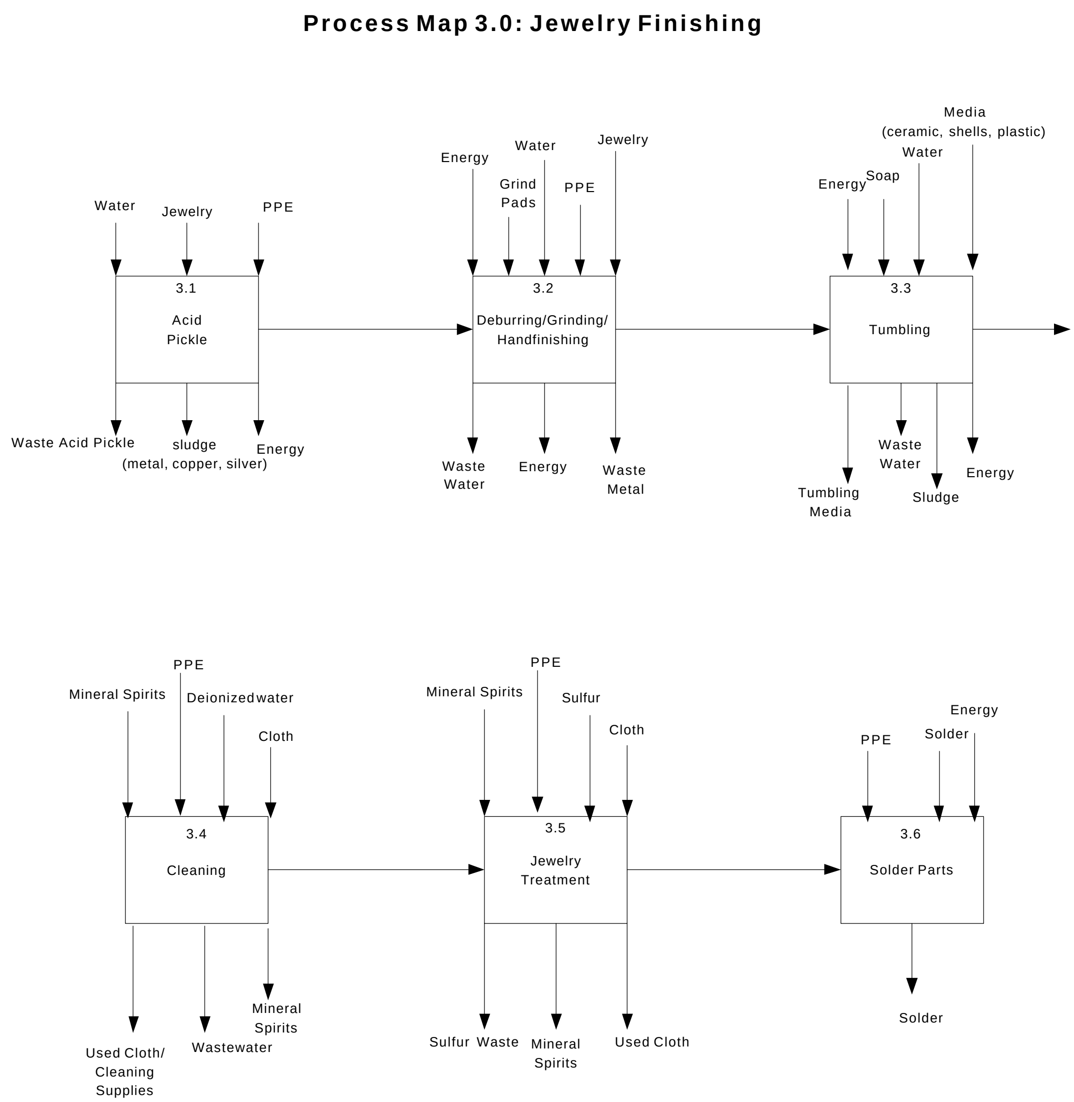


Figure 2: Cause and Effect Diagram

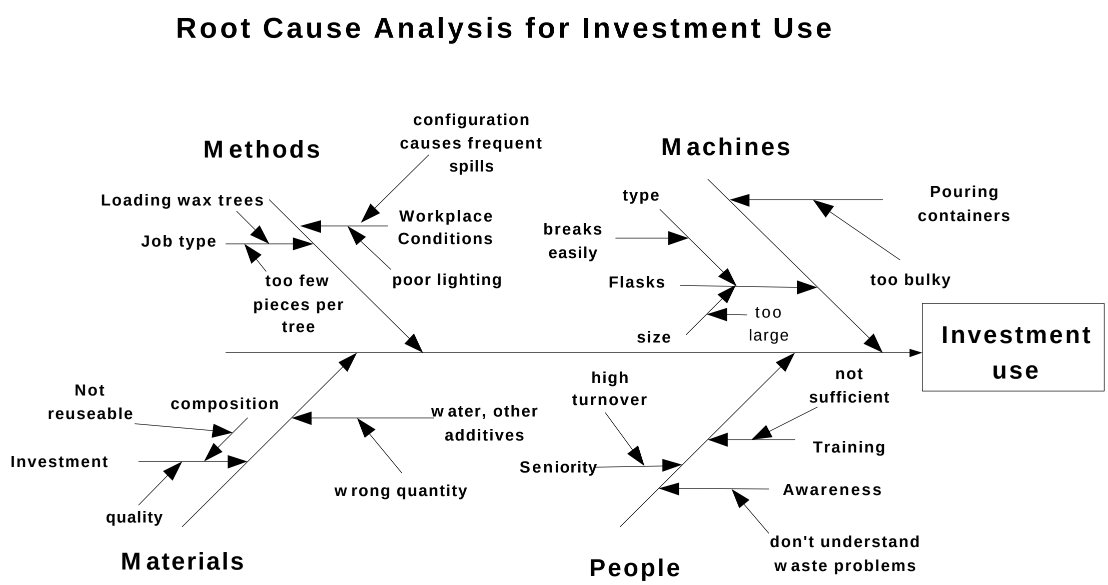


Figure 3: Dear Abby Letter

Dear Abby,

We run a small jewelry manufacturing operation. Investment use and disposal is our most expensive business issue. We use lots of investment materials that must be managed as a solid waste. That means that lots of materials must be thrown in the dumpster. Our solid waste fees are outrageous and it seems bad to be sending so much material to the landfill. These are issues that we wish to take seriously.

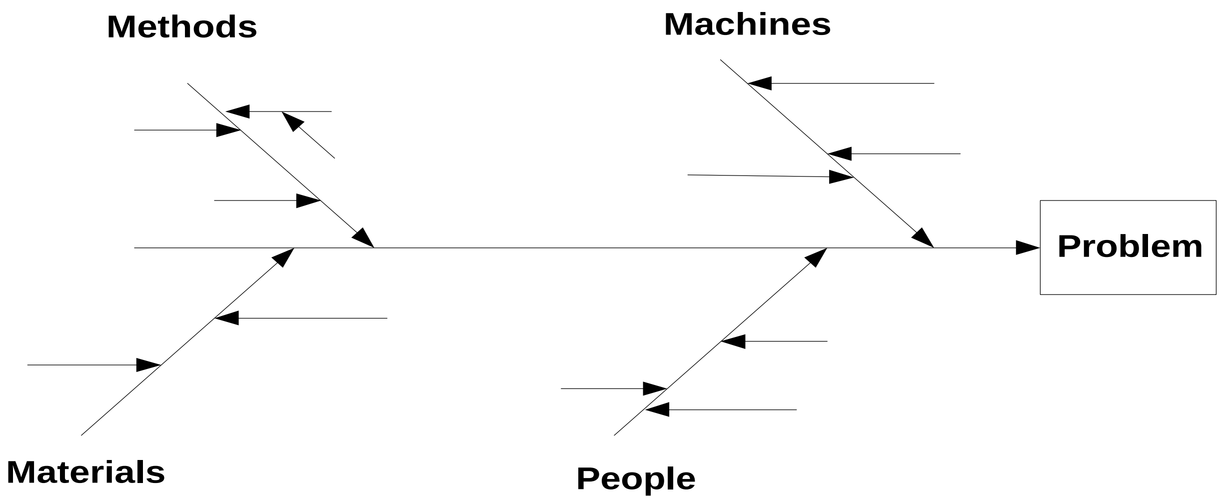
Our root cause analysis revealed that the root cause of investment use is how we load wax trees in the flasks. Much investment is lost through defects, damaged trees and under-utilized flask use. Also, employees tend to create lots of spills and reject materials due to poor investment mixing and flask filling.

Can you help us?

Signed,

Invested in Albuquerque

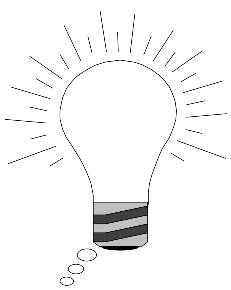
Figure 4. Root cause analysis: Fishbone Diagram



Tool #4: Brainwriting

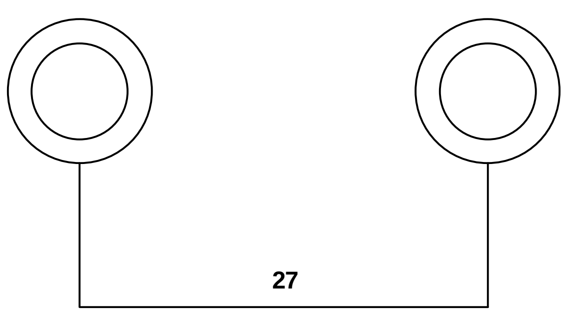
To address an opportunity effectively, it is important to recognize all alternatives. Very rarely is there one "right" way of preventing pollution. Instead, there are many different potential solutions. This tutorial presents a technique of listing many different alternatives for an opportunity.

Warm-up Exercise



You know the old adage "two heads are better than one". This is especially true when trying to come up with new ideas. When you generate ideas in a group you will notice that each member of the group brings their unique set of experiences and strengths to the table.

Try the following exercise with your group. Look at the picture below (turn it on it's side and upside-down). What does it remind you of? Write down all the images that come to mind- even images that seem crazy should be included. Now go around the room, each person sharing one image with the group. One person should volunteer to keep a list of all the images. Repeat this step until every member of the group is out of images. How many images did the group come up with? How does this compare with the number of images you generated alone?



Introduction

In the last tool you evaluated all the probable causes of a loss and determined the underlying reason, or root cause. Once the root cause has been identified, you may be tempted to jump to a premature solution. When you address a loss without considering all the alternatives of prevention you may be overlooking the most appropriate option(s).

Looking for alternatives for pollution prevention by addressing its root cause is the next step towards addressing an opportunity. There are several tools available to help groups develop alternatives. You already explored one tool during the warm-up exercise. In this exercise you will explore another method-brainwriting. Brainwriting requires maximum interaction and creativity between group members. The group should consider all possible alternatives, regardless of how far-fetched they appear to be. Alternatives raised by the group may seem contradictory, or they may build on one another making them better. A comprehensive list of alternatives can then be compiled.

During this exercise you will:

- Conduct a brainwriting session.
- Develop a list of all possible alternatives for an opportunity for improvement.

Brainwriting

First you have completed your process map to see how you can optimize your processes and reduce losses. *(see Figure 1)* In the example provided, Activity-Based Costing helped to identify that 80% of the environmental costs associated with jewelry manufacturing was due to investment use. Not only is investment expensive, it is critical to the process and we use large quantities of this material on a daily basis.

Root cause analysis determined that the greatest losses occurred due to employee handling practices. Employees control the jewelry manufacturing processes from the beginning to the end and also must deal with environmental, health and safety compliance issues.

The next step is to develop as many alternatives to solve the problem as possible. This is done through the process of brainwriting. Through brainwriting, staff works together to generate as many alternatives as possible regardless of how crazy they seem. In fact, to make it more interesting you can give a prize to the person that comes up with the craziest idea.

Make copies of the blank brainwriting sheet included at the end of this chapter. Make enough sheets so that each person on the brainwriting team has one per person with one blank sheet in the middle of the table. Place these sheets in the center of the table. Each person should take a sheet and write two alternatives on it and then place the sheet back in the center. Then take another sheet of paper and write two more alternatives on it. Every time someone picks up a sheet of paper, encourage them to read what others have written and try to make improvements to the alternatives listed. Someone could even say they think someone's idea is completely out in left field, if they try to make it better. Keep repeating this process until everyone runs out of ideas.

Now list all the alternatives that were discovered.

The alternatives on each sheet of paper should be read aloud and discussed. Many of the ideas may be the same and some may have small variations. The group should debate the small variations and eliminated the impossible alternatives. One comprehensive list should be developed-each idea only written once, although all variations of the same idea should be included.

Examples of brainwriting are provided below.

The next tool will present 'bubble-up-bubble-down"…a method for selecting the best option to prevent loss.

Figure 1: Jewelry manufacturing Process Map

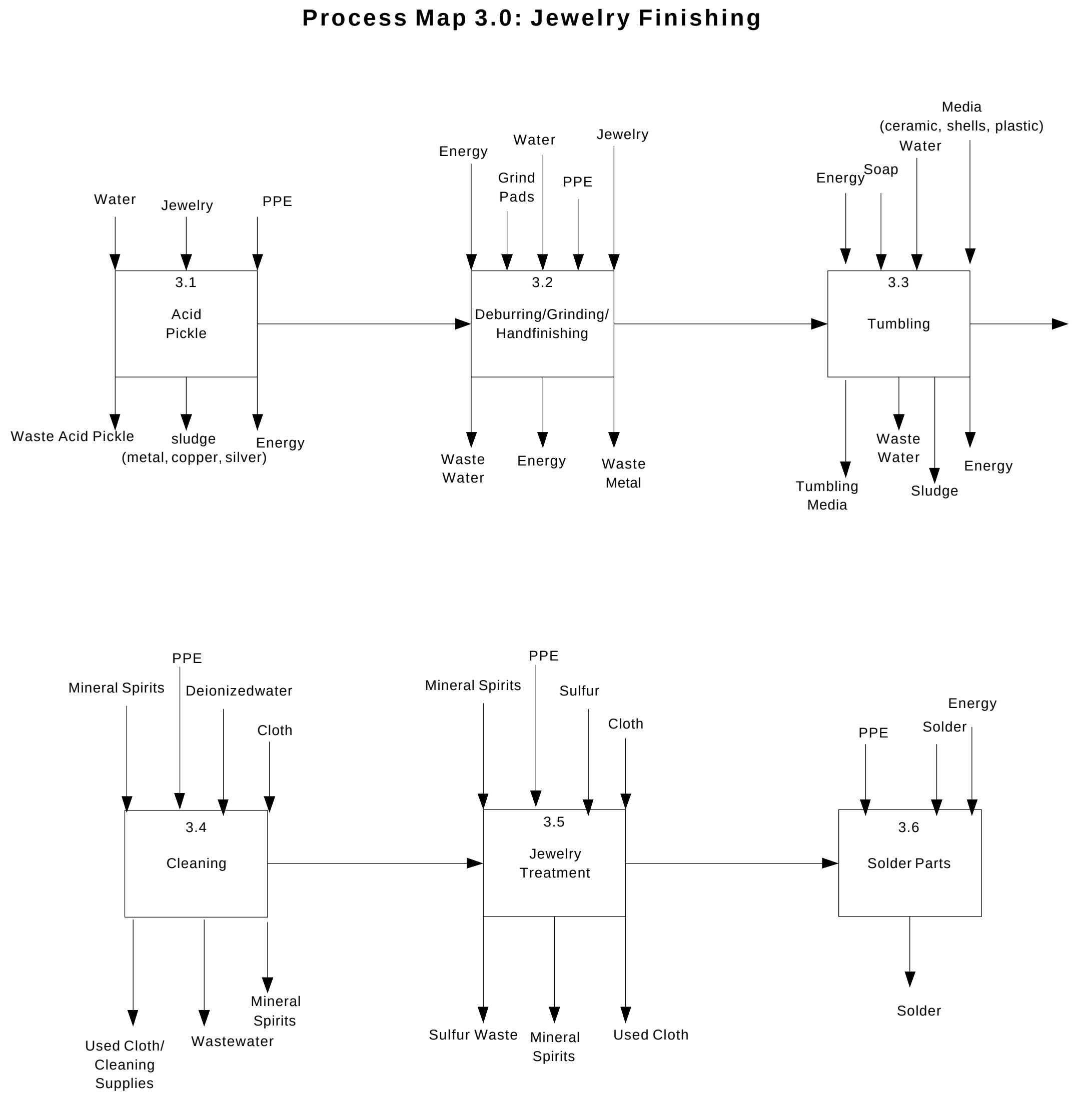


Figure 2: Sample of brainwriting

1. Look for reusable investment to eliminate all environmental problems.	2. Find a market for waste investment.
3. Set up work area more efficiently to reduce carry distances for flasks to save time and prevent dropping, etc.	4. Develop alternative flask design that uses less investment.
5. Start a “clean shop” program to train employees to keep work areas clean to prevent spills and waste.	6. Begin an employee incentive program to reward development of best operating practices that reduce loss from rejects and excessive investment use.
7. Utilize flasks more effectively to get as much jewelry as possible per flask.	8. Develop Standard Operating Practices for mixing investment to prevent rejects and failure.
9.	10.

Figure 3: List of alternatives

1. Look for reusable investment to eliminate all environmental problems.

2. Find a market for waste investment.

3. Set up work area more efficiently to reduce carry distances for flasks to save time and prevent dropping, etc.

4. Develop alternative flask design that uses less investment.

5. Start a "clean shop" program to train employees to keep work areas clean to prevent spills and waste.

6. Begin an employee incentive program to reward development of best operating practices that reduce loss from rejects and excessive investment use.

7. Utilize flasks more effectively to get as much jewelry as possible per flask.

8. Develop Standard Operating Practices for mixing investment to prevent rejects and failure.

Figure 4: Brainwriting Sheet

1.	2.
3.	4.
5.	6.
7.	8.
9.	10.

Tool #5: Bubble Up-Bubble Down

You have now generated a list of alternatives for preventing an environmental loss in your business. But how do you choose the best alternative? This tutorial presents one method of prioritizing alternatives to ensure that the most appropriate alternative is selected.

Warm-up Exercise

Most of us use lists from time to time to make sure that we don't forget to do the things that we need to get done. Without a shopping list, for example, we may return from the store without milk, the reason why we went in the first place. Certain limitations, like time or money, may cause us to drop things off our list. We often need to prioritize and make sure that the most important things get done.

Make a list of the things that you need to get done tomorrow (try to list at least ten things). List these items in the order that they come to mind. Now prioritize this list by putting the most important items on the top of the list and the least important items on the bottom. You should now have a "rank ordered" list. If you only have time to complete one of the items on your list, which would it be? You should have answered the item on the top of the list the most important item.

Introduction

A comprehensive list of pollution prevention alternatives was developed in the last tool using a technique called brainwriting. The alternatives generated during this tutorial can range from operational changes, such as employee training and improvements in operations, to technology changes, such as changing a solvent. The next step is to choose one alternative that is capable of being worked with successfully. Additionally, it is important to select the optimal solution for your business. To accomplish this, you must consider the *feasibility* of each alternative. Such factors as effectiveness, implementability, cost, and potential ramifications of each alternative should be discussed. Personal preferences and biased information should not enter into the decision-making process.

There are several tools available to aid a group in selecting an alternative and avoid bias. These tools allow a group to rank and prioritize alternatives using a systematic approach. When all the alternatives are listed, suggestions are made by the group to improve even the worst alternatives. At this point, many of the alternatives may be eliminated: every realistic alternative remains on the list. These remaining alternatives can then be sorted based on the factors presented above and any other factors that may effect a particular business. The method of selection presented in the exercise is the bubble-up-bubble-down. This tool uses a forced pair comparison to rank alternatives. Using this method you will be able to find the most effective solution to the selected loss.

During this exercise you will:

- Evaluate all alternatives.
- Use the bubble-up-bubble-down method to reach a decision on the best alternative.

Bubble-Up, Bubble-Down

Take the list of alternatives and compare the first two alternatives. Decide which of the two is the best and move this alternative to the top of the list. Go to the next, or third alternative and compare it to the second. If it is better than the second, move it up and compare it to the first, if not, leave it in the third position. Continue this process until all the alternatives are rank ordered. This process should go fairly quickly. Make sure you listen to everyone's opinions and objections. Again, factors to consider are cost, effectiveness and the ability to implement the alternative.

Bubble-up, Bubble-down should generate much discussion among employees on the best solutions. These discussions will help to increase buy-in to the alternatives. As a rule, employees never resist their own ideas.

An example of how the Bubble-Up Bubble-Down method was applied to the list of alternatives generated in the last tool are listed below.

Typically, the three or four alternatives that “bubbled-up” to the top of the list are the easiest and cheapest to implement, the “low-hanging fruit”. The alternatives in the middle may require more research or study to see if they are feasible. The ideas at the bottom of the list may require major equipment changes or capital investments. It is important to keep the entire list on file as part of your continuous environmental improvement program.

The next step is to develop an action plan. Action planning is essential to assure that ideas are implemented!

Figure 2: List of alternatives, prioritized through Bubble-Up, Bubble-Down

1. Begin an employee incentive program to reward development of best operating practices that reduce loss from rejects and excessive investment use.
2. Utilize flasks more effectively to get as much jewelry as possible per flask.
3. Start a “clean shop” program to train employees to keep work areas clean to prevent spills and waste.
4. Develop Standard Operating Practices for mixing investment to prevent rejects and failure.
5. Set up work area more efficiently to reduce carry distances for flasks to save time and prevent dropping, etc.
6. Develop alternative flask design that uses less investment.
7. Find a market for waste investment.
8. Look for reusable investment to eliminate all environmental problems.

Tool #6: Action Planning

Being able to successfully manage a project is important when trying to accomplish a task, especially when you are under a deadline. You need to set up a schedule, ensure that you have the necessary resources, and assign the right person to each part of the job. In this tutorial you will create an "action plan" for the implementation of an alternative to prevent pollution.

Warm-up Exercise

Your group has been assigned the task of making chocolate chip cookies. The cookies need to be ready in one hour and the cooking time is twelve minutes. Pick a person to manage this project. The manager must then assign the ten tasks listed below to individuals in the group.

You will need to know how much time is required for each task, what tasks need to be accomplished before others, what resources (i.e. bowls, flour etc.) are required, and what the most efficient way of organizing these tasks (and remember the clock is ticking). Create a schedule.

Making chocolate-chip cookies:

Mix dry ingredients
Mix wet ingredients
Put the batter on the pan and put pan into the oven
Combining wet and dry ingredients
Turn on the oven
Taste cookies
Wash tools and utensils
Grease pan
Take cookies out of the oven

Developing an Action Plan

Before you begin to implement your alternative you should complete this questionnaire. It will ensure that you are being thorough in your planning and have considered all the important issues that may arise such as the resources that are needed and the problems that may occur. *(see Figure 2)*

Things to consider in developing an action plan are resources needed, both financial and human resources; the need for pilot testing or bench scale testing; information sources from he outside such as trade associations, vendors and suppliers and the Environment Department. Other issues such as employee support and maintaining product or service quality should be considered. A list of questions that should be considered during action planning is as follows:

Action Planning Questionnaire

1. What is the overall objective and ideal situation?
2. What steps are needed to get there from here?
3. What actions need to be done?
4. Who will be responsible for each action?
5. What is the best sequence of action?
6. How long will each step take and when should it be done?
7. How can we be sure that earlier steps will be done in time for later steps that depend on them?
8. What training is required to ensure that all staff have sufficient know-how to execute each step in the plan?
9. What standards do you want to set?
10. What volume or quality is desirable?
11. What resources are needed and how will you get them?
12. How will you measure results?
13. How will you follow up each step and who will do it?
14. What checkpoints and milestones should be established?
15. What are the make/break vital steps and how can you ensure they succeed?
16. What could go wrong and how will you get around it?
17. Who will this plan affect and how will it affect them?
18. How can the plan be adjusted without jeopardizing its results for the best response and impact?
19. How will you communicate the plant to generate support?

Now put all this information in an Action Plan Form. Most of the information you need should come from your answers to the questionnaire. The specific task, or step, to be accomplished is written in the first column under “Action.” In the following column list the person who is responsible for completing this task. A performance standard should then be provided. This standard is a way of establishing how well a task needs to be performed. Under “monitoring technique” enter a measurable goal or target used to track the plan’s implementation. A firm deadline should then be set, and finally, indicate the resources that are needed to perform each task. This form will help you organize your thoughts, keep track of all the actions that need to be completed, and ensure that the proper quality is being maintained.

Use the form provided to track implementation of the project and to measure its success. A sample action planning form is included at the end of this section.

Overall Target: Employee Incentive Program					
Action	Responsible person	Performance standard	Monitoring technique	Completion deadline	Resources needed
1.Develop Program incentives	Carol	List of incentives	Discuss ideas with Marge the owner	Jan 15	Team of Carol and Mark
2.Design a program for review and giving incentives	Marcy	Approved program by Marge	Marge approves, allocates funding.	Feb 1	Action #1 complete
3. Meet with employees	Carol, Mark and Marge	Highly interactive meeting	Question employees before and after	Feb 15	Firm date for meeting; meeting room
4. Set up improvement/suggestion box, system	Carol	System in place, all employees are aware, easy to use	Number of ideas submitted	March 1	Box, access to company computer, review team
5. Review Team	Carol and Mark	Review team reviews suggestions monthly	Marge evaluates work	March 7	Ideas accepted/implemented
6. Incentives awarded	Marge	Ideas implemented, paying off in $$, improvements	Check on progress, success	June1	Cash bonuses, days off, etc

Congratulations!!! You have completed the Pollution Prevention Training. Now it is time to put these tools to work and remember pollution prevention is an ongoing process. If you continue to implement pollution prevention in your business, you will increase the efficiency of your process while helping the environment. Simply revisiting your process maps and Pareto Chart once a year and using the tools to continue to make improvements will make a big difference in your operation. Ongoing use of these tools will help you to participate in the Green Zia Environmental Excellence Program.

Here are a few suggestions to make pollution prevention continue to work for you:

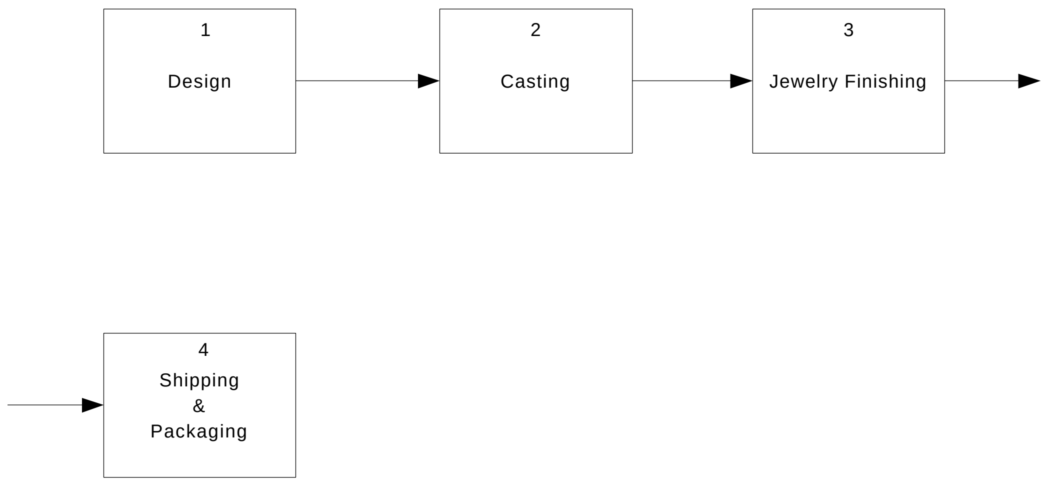
- Return to the Nothing to Waste activities and concepts as you make environmental improvement decisions.
- Schedule regular pollution prevention reviews of your business.

Remember: Pollution Prevention saves resources, saves money, and prevents accidents!

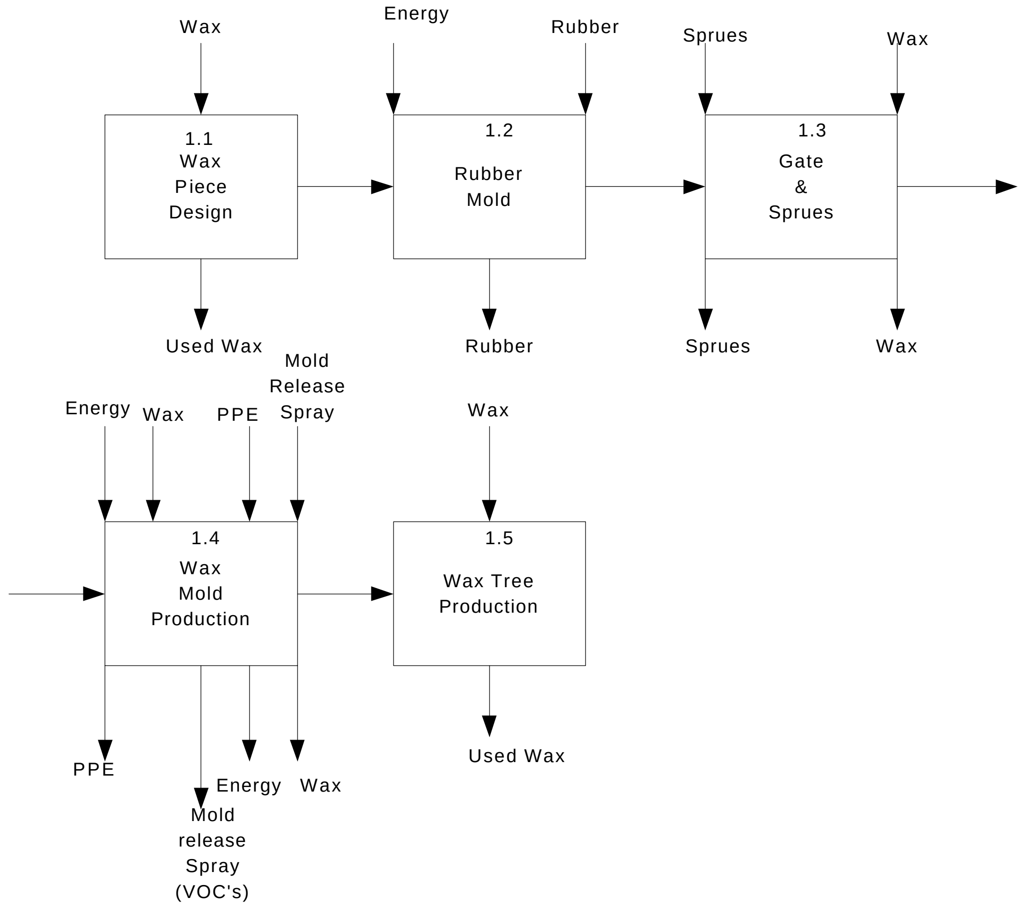
Overall Target					
Action	Responsible person	Performance Standard	Monitoring Technique	Completion Deadline	Resources Needed
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Process Maps for Jewelry Manufacturing

General Overview Map of Jewelry Manufacturing



Process Map 1.0 Design



Process map 1.0: Jewelry Design

1.1 Wax Piece Design

During this process, employees design the wax pieces that will be used for molds later. This process generates used wax waste.

1.2 Gates and Sprues

Employees design gates and sprues for future casting. During this process, proper design allows casting metals to move smoothly into casting forms. This process requires the usage of sprues and wax. The wastes generated are used sprues and wax.

1.3 Wax Mold Production

During this process, employees mold the wax to establish the shape for the future jewelry pieces. This process requires the use of energy, PPE and mold release spray. The waste generated during this process is used PPE, mold release spray (may contain VOCs), energy and wax.

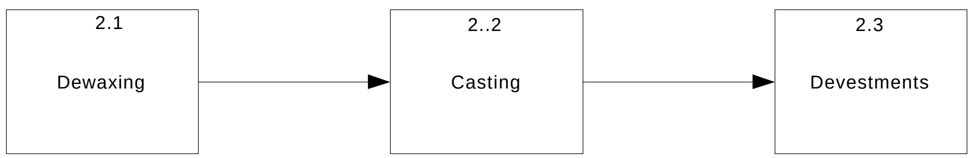
1.4 Create Rubber Mold

Employees prepare rubber molds from the wax pieces that have been prepared. There are many types of molding compounds. These compounds range from standard natural latex to vulcanizable rubbers to the room temperature vulcanizing silicones. This process uses energy and rubber. Waste rubber molds are generated in this process.

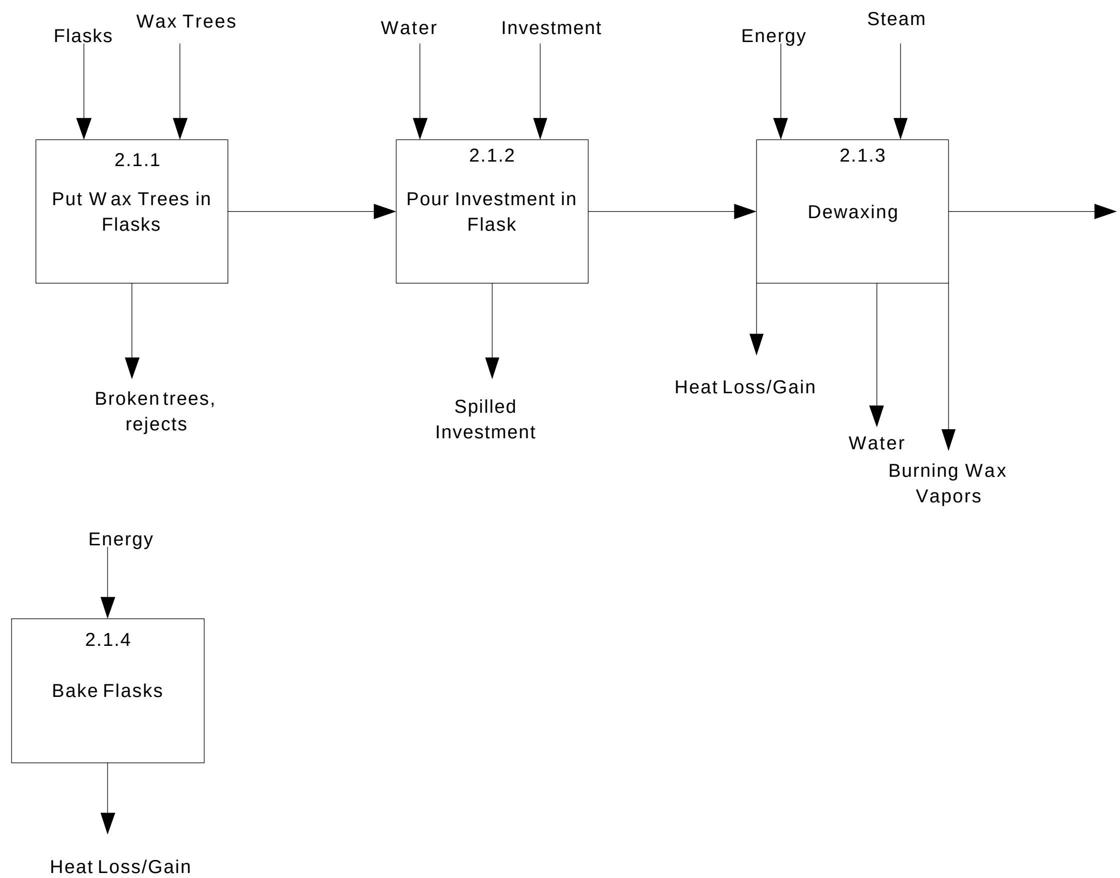
1.5 Wax Tree Production

The wax trees are produced to mount future jewelry pieces onto the tree for further processing.

Process Map 2.0: Casting



Process Map 2.1: Cast Preparation



Process Map 2.1: Cast Preparation

2.1.1 Place Wax Trees in Flasks

Employees prepare the casting. The wax trees are put into flasks. Wastes generated include broken trees and rejects.

2.1.2 Pour Investment

Investment is poured in the flasks to create cast. Investment is mixed with water to the proper consistency and is poured into flasks over wax trees. This process requires investment and flasks/casts. Waste materials may include spilled investment or damaged molds.

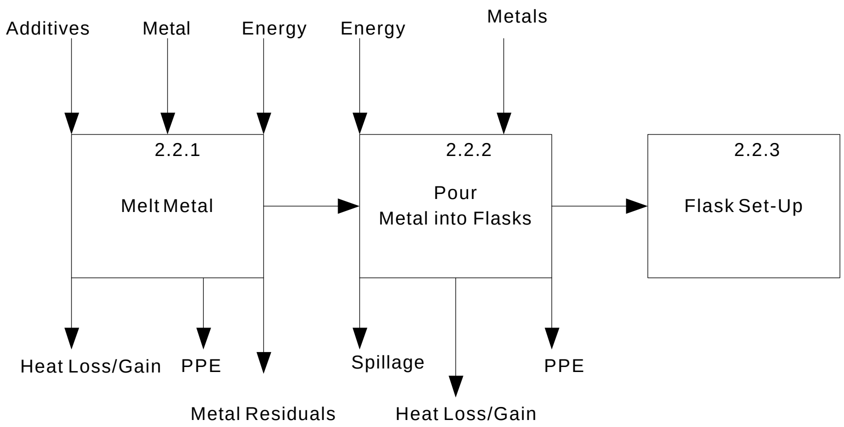
2.1.3 Dewaxing

During this process, wax is removed from the flasks by heat or steam. Typically steam is used. The waste generated during this process is energy, water, and wax vapors.

2.1.4 Bake Flasks

Flasks are baked overnight at high temperatures. This uses a significant amount of energy.

Process Map 2.2: Casting



Process Map 2.2: Casting

2.2.1 Melt Metal

Metal is melted to pour into flasks. Crucibles are used to heat the metal. The crucibles are heated gradually. This process requires energy, crucibles, tongs, shanks, metals, and flasks. The wastes generated are spillage, energy and used PPE. Worker health and safety issues are important in handling heated materials. Wastes generated are energy, air emissions, spilled metals, and PPE.

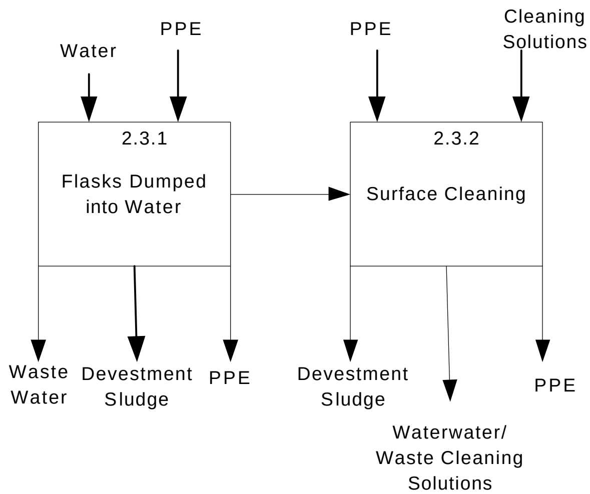
2.2.2 Pour Metal into Flasks

During this process, employees pour molten metal into flasks or casts using a ladle or a crane if it is a large operation. This process requires energy, metal, flasks, shanks, and a ladle or crane. Again safety issues are very important in handling heated materials. The wastes generated are spillage, energy and used PPE.

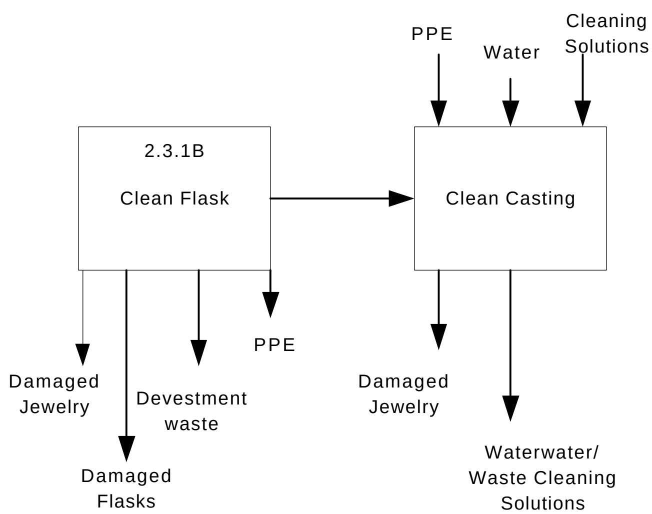
2.2.3 Flask Set-Up

Flasks are set-up to allow metal to solidify.

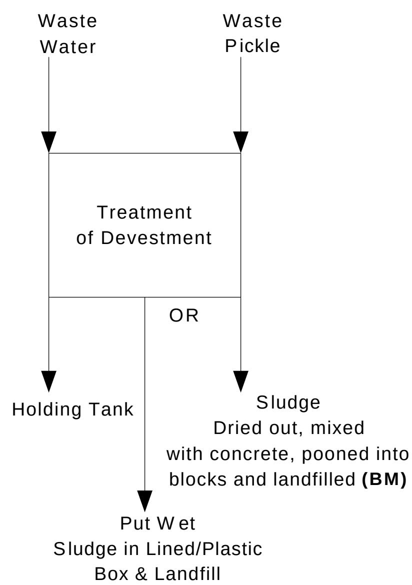
Process Map 2.3 (W): Wet Devestment



Process Map 2.3 (D): Dry Devestment



Management of Devestment Waste 2.3 A



Process Map 2.3: Devestment

2.3 Devestment is the process of removing the casting investment from the casting flask and tree. Two methods are generally used 1) Wet devestment; and 2) dry devestment. Wet processes use water to break apart the investment while dry processes use a flask-stripping device to push and shake the investment out of the flask and off the tree.

2.3.1 (W) Wet Devestment

Employees place the flasks into a sink full of water so they can soften the casts and break off the investment. Employees use a high-pressure hose to clean off residual investment. This process generates used PPE, water, energy, and investment sludge waste.

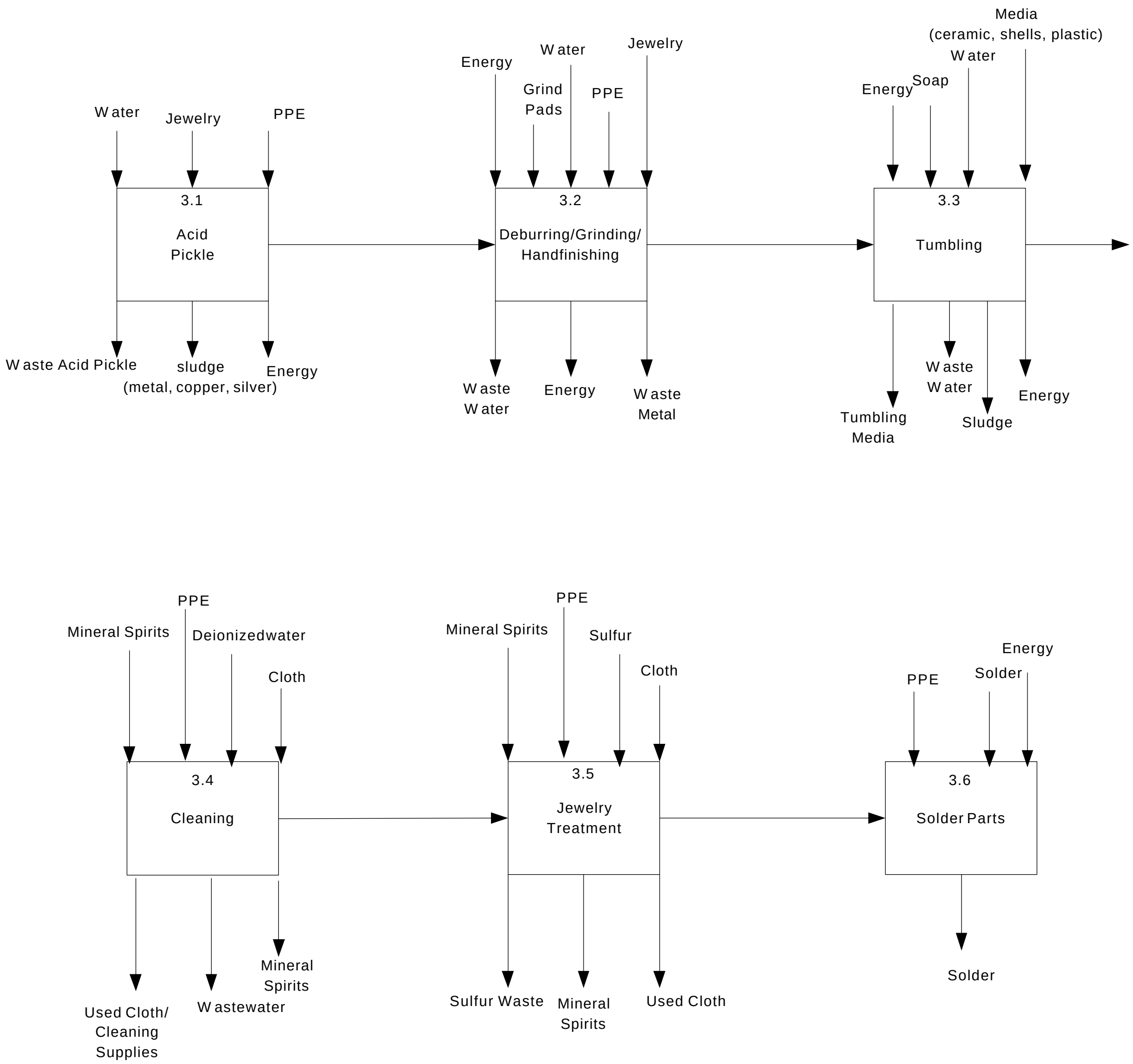
2.3.1 (D) Dry Devestment

The casting tree and investment from the flask are pushed and shaken out of the flask and off the tree without the need for water. The castings are not as clean and may require additional cleaning using water, mineral spirits, or acid pickle. The wastes generated are dry investment, potential for damaged jewelry, energy and used PPE.

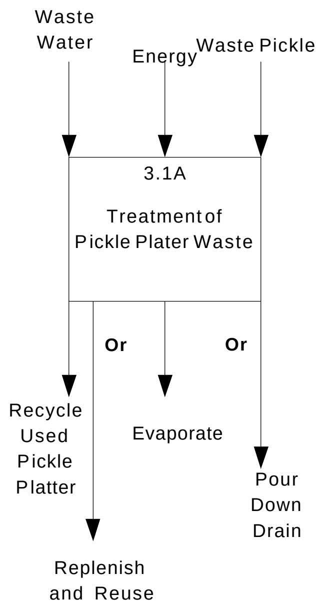
2.3 A Management of Devestment Waste

Devestment wastes are settled out of the used water by using holding tanks with baffles. The devestment sludge is taken out of the settling tanks, dried, put into lined cardboard boxes, then put into a dumpster. Another option is to dry the sludge, mix with Quickcrete, put into lined cardboard boxes and dispose at the local landfill. Alternatives for disposal have been investigated through New Mexico State University. One potential reuse is finger dust for rock climbing.

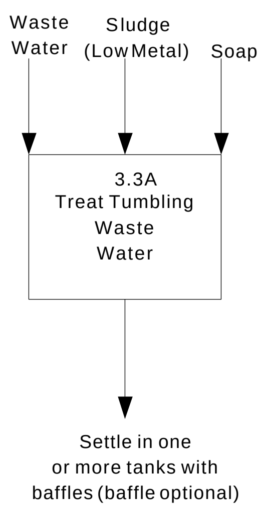
Process Map 3.0: Jewelry Finishing



Process Map 3.1A: Management of Acid Pickle Waste



Process Map 3.3 A: Management of Tumbling Waste Water



Process Map 3.0 Jewelry Finishing

3.1 Acid Pickle

The jewelry is placed into a heated acid pickle solution to remove oxides of copper and zinc. This process generates used acid pickle and energy and produces an acid pickle waste.

3.2 Deburring/Hand Finishing/Grinding

During this stage, employees remove casting tree spurs or additional casting metals from the castings. Employees grind off residual metals from the castings using a grinding wheel and an abrasive pad. While some deburring can be achieved in a mass finishing operation, hand deburring is common. Most of the metal from a deburring operation is recoverable either through settling tanks, filtration, or a combination in the recovery process. The waste generated during this process is PPE, energy, and grinding pads.

3.3 Tumbling

Jewelry pieces are put into a tumbler along with water, soap and media, (media is either ceramic, steel shot, or natural; ground corncobs, walnut shells, etc.) The jewelry pieces are tumbled with the media and soap in order to shine and clean the pieces. This process generates wastewater, sludge, and energy.

3.4 Cleaning

Mineral spirits and other alcohol-based cleaners are sued as a final product rinse. They can be replaced by deionized water. The wastes from this process include q-tips, cloth, mineral spirits or other cleaning solutions.

3.5. Antiquing

In some cases, an antiquing process is used to give some jewelry pieces an antique finish. The waste material from this process is used mineral spirits, hand cloths, used PPE.

3.6 Soldering

Soldering can be divided into hand solder (silver or gold solder) or brazing with a filler metal. Silver solder is used for solder joints. This process uses a solder gun, PPE, energy, solder, tips and flux. The waste generated from this stage is a small amount of flux and fumes.

3.1 (A) Management of Acid Pickle Waste

3.1.1 Option 1: Treatment of Acid Pickle with Pickle Plater

The acid pickle can be reclaimed using the pickle plater. The plater is used to remove the metals from the acidic solution. Once the copper is plated out from the waste acid pickle the acid pickle can be reused again. The copper may be resold.

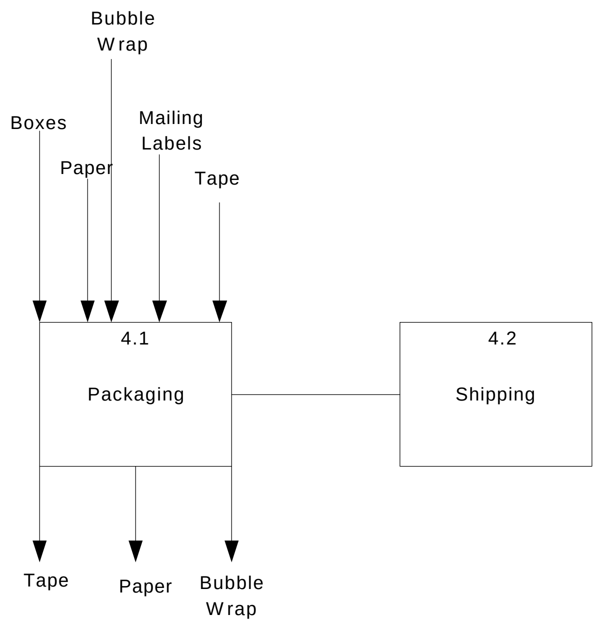
3.1.1 Option 2: Treatment of Acid Pickle by Evaporation

This is an option for small businesses. Acid pickle is evaporated. The dried sludge must be tested using the TCLP method. If testing determines that it is not hazardous, it may be landfilled. If the testing determines that the waste is hazardous, it must be disposed of as hazardous waste.

3.1.1 Option 3: Acid Pickle is continually replenished.

As the acid pickle evaporates, more solution is added to the heated pot and it is used continually. This may reduce the effectiveness of the pickle solution over time.

Process Map 4.0: Packaging and Shipping



Process Map 4.0: Packaging and Shipping

4.1 Packaging

Jewelry is packaged for shipping. Materials include boxes, invoices, paper, special packing materials, labels and tape.

4.2 Shipping

Packages are shipped using appropriate service.

Regulatory Guidance Materials and Pollution Prevention Tips

City of Albuquerque P2 Program:

Jewelry Tip Sheet For Reducing Liability & Protecting The Wastewater Treatment Plant

Areas of opportunity for reducing toxic discharges to the sanitary sewer system include:

1. *Before discharging any type of wastewater to the sanitary sewer system call your local treatment plant, or the Industrial Pretreatment Program to find out if there are any restrictions.*
2. *Wastes that affect the treatment system include heavy metal wastes, chemicals that are listed as toxic or hazardous.*
3. *All facilities that have materials that are or could be considered hazardous should have a written spill prevention plan.*
4. *Training programs regarding proper handling of wastes and chemicals for operators and maintenance personnel are essential.*
5. *Records of how wastes are handled is another factor in making sure that you are meeting wastewater ordinance requirements.*
6. *Inspection and spill control plans are also required.*
7. *Proper maintenance and operation of your wastewater treatment system(s) are fundamental in insuring that your facility is meeting the local wastewater ordinance.*
8. *Ensuring that chemicals and wastes are not stored next to a floor drain, and are elevated and contained properly will guarantee that you are not in violation with your local wastewater ordinance.*

Cyanide Bombings Hidden Costs

Cyanide bombing is an outdated process used to remove oxide materials from casting. The chemicals used in the bombing process makes this a dangerous operation with potentially **dangerous consequences**. Cyanide is a regulated hazardous material. Cyanide is highly toxic. If you are using cyanide to finish jewelry:

1. *You will need to analyze the waste using the Toxicity Characteristic Leaching Process in order to determine if there are hazardous metals present.*

2. *You will need to perform full cyanide oxidation or destruction*

3. *Most likely the waste will be hazardous and will have to be treated and shipped as hazardous waste.*

4. *Because cyanide is highly toxic it will need to be stored properly and employees must use full Personal Protective Equipment.*

Reusing Acid Pickle

Acid Pickle, when used to clean sterling silver and copper alloys, will contain a large amount of copper. Copper is not hazardous, but could cause major problems for sewer treatment facilities. Also, due to their corrosiveness acid pickles are hazardous wastes. The primary reason not to discharge acid pickles is that they can be continuously reused and the copper can be removed for recycling. The primary method for reuse and recycling is to use an Acid Pickle Plater. The plater, plates out the metals from the acidic solution. Once the copper is removed the acid pickle can be reused. Please call the **City of Albuquerque's p2 Program at (505)873-7058** for specifications for building and using the pickle plater.

Why Do I Need A Spill Prevention Plan?

It is required that any business handling materials that are or may be considered hazardous to have a ***Hazardous Material Emergency Response Plan*** (**HMERP**) in case of spills. The HMERP should be filed with your local fire department. By preparing and filing your Spill Prevention Plan with your local Fire Department you will be fulfilling part of the requirements under RCRA, as well as the requirements of your local treatment plant.

Some General Spill Control Procedures Include:

1. *Isolating the spill area and limit entry.*

2. *Tending to any injured or contaminated personnel*

3. *Notifying the proper authorities*

4. *If the spill is treated on site, dispose of the spill in accordance with federal state, and local regulations.*

Pollution Prevention Factsheet for the Jewelry Industry

Overview of Industry Waste Streams:

Most of the pollution generated by both small and large jewelry manufacturers can be categorized as either heavy metal (silver, zinc, nickel, copper, cadmium, etc.) wastes or spent solvent wastes, some of which contain cyanide from stripping processes. Much of the heavy metal wastes and spent cyanide which is not recovered through filtration and distillation methods, is discharged to wastewater treatment facilities where high concentrations of these pollutants can cause malfunctions in the water treatment equipment, leading to poor treated water quality and poor sludge quality (sludge is often reused agricultural or incineration processes). Furthermore, many of these wastes pose serious health hazards to workers and the general public if allowed to contaminate ground water sources. Improper disposal, leaks and spills, inadequate employee training, and process inefficiencies can all increase the risk of adverse human and environmental exposure to these toxic substances. Reducing this risk by solvent reuse and increased metal recovery, is a cost effective means of increasing employee safety, while establishing a good public relations base. Though initial process alterations or equipment retrofitting may require a limited capital investment, case studies have demonstrated great returns in the reduction of regulatory disposal costs, water usage, and regular operational costs, especially raw material procurement.

The purpose of this factsheet is to provide information on the hazards associated with particular pollutants commonly employed or produced by jewelry manufacturing processes, while offering some guidelines and resources which can aid in the reduction or elimination of these materials. Finally, several case studies will be outlined in order to demonstrate the potential economic gains of pollution prevention efforts as well as the ingenuity employed toward this goal. As much of jewelry industry is focused on the artistic expressions of the individual jeweler, the manufacturing processes utilized throughout the industry are very diverse. For this reason, the creativity of the individual jeweler is often the key to effective pollution prevention.

Specific Hazards Associated with Major Wastes:

For a more comprehensive list of hazard descriptions, refer to the U.S. Environmental Protection Agency web page, http://www.epa.gov . By searching this page for jewelry related articles, information on wastes, regulatory codes, and businesses currently being investigated or cited by the EPA can be accessed.

Silver: Most commonly found as a ground water contaminant, silver causes a condition known as Agyria, a permanent blue-gray skin color, as well as causing irritation in the eyes and mucous membranes which line the human digestive tract. Effective water treatments to remove silver are ion exchange systems, in which electrically charged plates are used to attract the electrically charged silver, reverse osmosis, where a semi-permeable membrane is used to filter the silver out of the water stream and distillation, where the water is evaporated leaving the silver behind.

Cadmium: Cadmium, which occurs naturally as an impurity in various ores and was historically used as a solder base, can cause nausea, vomiting, muscle cramps, convulsions, and shock. Chronic, or long term, exposure can cause kidney, liver, bone, and blood damage. According to 1986 figures (these being the most current available), 35% of the cadmium waste is a product of metal plating processes, while 5% is due to alloy wastes.

<u>1,1,1- Trichloroethane:</u> Known as both 111-TCE and 111-TCA, 1,1,1- trichloroethane is a toxic halogenated hydrocarbon solvent, most commonly used as a general purpose cleaner. The EPA has recently cited a number of jewelry manufacturing businesses for failure to report the disposal of this RCRA hazardous waste. Many effective alternative solvents are available, for suggestions as well as specific toxicity information on 111-TCE refer to the "General Solvent Factsheet".

<u>Cyanide:</u> Cyanide compounds that contain a complexed carbon-nitrogen functional group ($C\equiv N$) are highly toxic and regulated as hazardous wastes. When cyanides come in contact with acids, such as many cleaning solvents, hydrogen cyanide gas is emitted. This hardly detectable gas will very quickly kill anyone in the vacinity. Cyanide compounds, such as sodium cyanide, metal stripping agents, and electroplating chemicals, can be fairly easily replaced by less harmful chemicals, which though not as convenient are much more cost effective and safe.

Pollution Prevention Opportunities:

For a step-by-step pollution prevention process review guideline and pertinent case studies, refer to the "Jewelry Manufacturing Code of Practice Checklists" distributed by the City of Albuquerque Pollution Prevention Program. For a copy, call the Pollution Prevention Program Office at (505) 873-7004, or write to Pollution Prevention Program, 4201 Second St. SW, Albuquerque, NM 87105.

Operational Assessment and Improvement:

Many common pollution prevention techniques are simply the development and identification of good operational procedures. These often include the education and training of employees who work around or with waste generating procedures, standardizing all procedures, carefully labeling and separating waste streams to eliminate cross-contamination, and the evaluation of solvent usage. Are cleaning processes completed unnecessarily or too frequently? Can the amount of solvent used be reduced? Can the solvent or wastewater be reused, and if so how many times? The answers to all of these questions are dependent on the individual processes employed by the manufacturer.

The next level of pollution prevention involves an analysis of the manufacturing processes themselves. Which steps create the most costly waste streams? Are there suitable alternatives that lower or eliminate the level or toxicity of waste discharge? For instance, several jewelry manufacturers have found that they can reduce waste water disposal costs by reusing the solvents used in the acid pickling process or eliminating the process altogether. Other facilities have increased dissolved metal reclamation by experimenting with finer filtering apparatus or integrating electrolytic recovery systems which separate the metal from a solvent by creating an electric potential which attracts the conductive metal ions. These processes often have two fold economic returns, an increase in reusable metal and a decrease in costs of wastewater disposal.

SPECIFIC REGULATORY GUIDANCE FOR JEWELRY MAKERS

This briefing paper is intended to be attached to the “General Regulatory Guidance for New Mexico Small Businesses” to provide additional regulatory information specifically to “Jewelry Makers”. It is not intended to be a substitute for actual regulations. If you have questions concerning your regulatory responsibilities, you are encouraged to contact the appropriate bureau.

AIR EMISSION REGULATIONS:

Jewelry manufacturers usually don’t have air emission problems. The exceptions may be those facilities that also include a foundry or use materials that contain VOCs in large quantities. If in doubt about the air regulations, you can contact the NMED Small Business Assistance Program at 1-800-810-7227 or the City of Albuquerque Air Quality Assistance Program at 505-768-1964 if your business is located in Bernalillo County.

HAZARDOUS WASTE REGULATIONS:

Attached to this briefing paper is a document entitled “Fact Sheet for Jewelry Manufacturing Facilities” that can assist you in being compliant with Hazardous Waste Regulations.

WASTEWATER REGULATIONS:

The most potential problem for jewelry manufacturers is dealing with the rinse water. Since this wastewater can contain recoverable materials, it can easily be recycled. Be careful about putting your wastewater into the sewer system. Metals can play havoc with Publicly Owned Treatment Works (POTWs).

OSHA REGULATIONS:

Attached to this document is a checklist entitled “Jewelry Shops (A Hazard Identification Checklist)” that can assist you in being compliant with OSHA.

UNDERGROUND STORAGE TANK REGULATIONS:

There is nothing unique about jewelry making that isn’t already covered in the General Regulatory Guidelines.

SOLID WASTE REGULATIONS:

There is nothing unique about jewelry making that isn’t already covered in the General Regulatory Guidelines.

GENERAL REGULATORY GUIDANCE FOR NEW MEXICO SMALL BUSINESSES

The purpose of this briefing paper is to assist small businesses in New Mexico in trying to understand the environmental regulatory requirements associated with doing business by giving a general overview. It is not intended to be a substitute for actual regulations. Businesses are responsible for operating their business in full compliance of the law (regulations). Each bureau in the New Mexico Environment Department (NMED) have staff available that can help you directly in understanding what is expected of your business from a regulatory point of view. It is in your best interest to contact the appropriate bureau if you have questions.

Periodically the Pollution Prevention (P2) Program in NMED will issue specific guidance briefing papers as an attachment to this document for certain businesses. These will be designed to provide additional information to a specific business. For information call the NMED Pollution Prevention Program staff at 505-827-0677 or the Technical Resource Center in Albuquerque at 505-843-4251.

AIR EMISSION REGULATIONS:

The EPA, in an attempt to control air pollution through regulations, has created a set of rules with many acronyms. Since businesses can come across these acronyms in many publications, they are listed below:

NESHAP:	National Emission Standards for Hazardous Air Pollutants
NAAQS:	National Ambient Air Quality Standards
HAP:	Hazardous Air Pollutants
TAP:	Toxic Air Pollutants
OEL:	Occupational Exposure Limits
VOC:	Volatile Organic Compounds
MSDS:	Material Safety Data Sheet
CTG:	Control Techniques Guidelines
MACT:	Maximum Achievable Control Technology
BACT:	Best Available Control Technology
GACT:	Generally Available Control Technology
RACT:	Reasonably Available Control Technology

Much of the national strategy for controlling air pollution centers around the NAAQS. These standards set limits for the concentration in the ambient (outdoor) air of the six most common air pollutants: Ozone, Carbon Monoxide, Particulate Matter, Sulfur Dioxide, Nitrogen Dioxide, and Lead.

The EPA has established industry based regulatory requirements for the most serious air pollutants, such as HAPs. In many cases the EPA has also established Control Techniques Guidelines that require industries to use certain technologies, such as MACTs.

Any business that has the potential of releasing pollutants to the ambient (outdoor) air, such as VOCs, HAPs, or Criteria Pollutants may be subject to the Air Quality Regulations depending on the amount of pollutants being released. These pollutants are used to determine if a facility is a major or minor source of air pollution and whether or not a business will need an Air Quality Permit. A major source is determined as a function of the amount of HAPs or Criteria Pollutants a business has the potential to emit. For HAPs it is 10 tons per year of any single HAP or 25 tons per year of the total HAPs. For the Criteria Pollutant it is 100 tons per year of any criteria pollutant. In addition the State of New Mexico has added TAPs as a category to be regulated.

Some businesses that would normally be considered a major source can be classified as a minor source by changing the way they conduct their business. Businesses classified as a major source have significant regulatory requirements such as annual fees, maintaining progress reports, records, and a compliance schedule, monitoring emission limits, as well as the possible requirement to have specific control technology installed (MACT, GACT, or RACT). All major sources are required to obtain a Title V Permit. It is generally desirable for a business not to be classified as a major source. An EPA document “Potential to Emit, A Guide for Small Businesses” (EPA-456/B-98-003) is available from the EPA and it may help you to understand Air Quality Regulations.

The State of New Mexico, in addition to HAPs and Criteria Pollutants, has also generated regulations on Toxic Air Pollutants (TAPs) with OELs. These basically limit businesses from allowing TAPs to be emitted to the outside air around their building. OSHA regulates the same kinds of exposure limits inside of a building.

Due to the complexities of Air Quality Regulations, the harm air emissions cause to the environment, and in many cases the high costs associated with “end of the pipe” control technology, it is in the best interest of any business to evaluate their operations with the ultimate goal of eliminating all air pollutants as much as possible.

What all this means is, with few exceptions, the Air Quality Regulations that apply to your business will mostly be determined by what your business does. The best way to find out what air quality regulations apply to your business is to contact the New Mexico Environment Department (NMED) Small Business Assistance Program (SBAP) at 1-800-810-7227. Businesses that are located in Bernalillo County are locally regulated with respect to air emissions. For assistance you need to call the City of Albuquerque/Bernalillo Air Quality Assistance Program (AQAP) at 505-768-1964.

HAZARDOUS WASTE REGULATIONS:

Any business that generates waste that is classified as “listed” or “characteristic” in RCRA must deal with this waste as outlined in the New Mexico Hazardous Waste Regulations. The EPA has generated a list of chemicals that are considered hazardous. They have also stated that certain materials that exhibit a hazardous characteristic (ignitibility, corrosivity, reactivity, or toxicity) should be considered hazardous. To determine which products used in your business contain hazardous material, contact either the EPA or the New Mexico Hazardous Waste Bureau. In some cases this information will be contained on the Material Safety Data Sheet (MSDS) that came with the product.

It is important to understand that any product that contains “listed” or “characteristic” material is only regulated by the hazardous waste regulations when it becomes a waste. Examples are when the product is no longer to be used for its intended purpose and is to be gotten rid of, the shelf life of the product has expired, the product leaks from a piece of equipment, or the product is accidentally spilled. It is also important to note that any product to be discarded that contains one or more hazardous materials is also hazardous waste. Examples are hazardous waste mixed with solid waste, rags to clean up spilled hazardous materials, or wastewater from a process that used a hazardous material.

All businesses that generate hazardous waste are classified based on the quantities of hazardous waste they generate monthly. The three classifications are:

1. Conditionally Exempt Small Quantity Generator (CESQG): generates less than 220 pounds or 100 kilograms of hazardous waste per month. A CESQG cannot accumulate more than 2,200 pounds or 1,000 kilograms of their combined hazardous waste at any one time. Usually this amounts to about one-half of a 55-gallon drum. CESQG’s may dispose of their hazardous waste by mixing it with a solid waste, assuming there are no free liquids in the waste, and taking it to a permitted municipal solid waste (MSW) landfill. You need to verify that the MSW landfill will accept the mixed waste.

2. Small Quantity Generator (SQG): generates between 220 pounds and 2,200 pounds or 100 kilograms and 1,000 kilograms of hazardous waste per month. No more than 13,200 pounds or 6,000 kilograms may be stored on site any longer than 180 days and must be disposed of at a facility permitted to recycle, treat, store, or dispose of hazardous waste.

3. Large Quantity Generator (LQG): generates more than 2,200 pounds or 1,000 kilograms of hazardous waste per month. Hazardous waste with no weight limit may be accumulated for no more than 90 days unless permitted by the State.

Each classification has different record keeping, manifesting, and reporting requirements. Since a businesses’ classification is based on a monthly generation, it is possible to move from one classification to another on a regular basis. All generators of hazardous waste are required to register with the Hazardous Waste Bureau and pay a generator fee based on their classification.

The Hazardous Waste Bureau has an established outreach program that can assist any business in determining their classification and the regulatory requirements that go with it. You may contact the Bureau at 505-827-1511.

It is important for any business generating hazardous waste to understand that RCRA has established a “cradle to grave” responsibility for the generator of said waste. In effect this means that if the hazardous waste the business generates contaminates soil, surface water, or ground water in any manner until it is properly disposed of, the business will be held responsible for the clean up of the contamination. The cost of clean up could be substantial. It is therefore imperative for any business to make sure trained employees handle their hazardous material properly to avoid accidental spills, to only use permitted haulers, to make sure their waste goes to a RCRA permitted facility, to properly store their hazardous waste, and never dispose of their hazardous waste at their facility. It is also advisable to seal the floor of the facility if you use a hazardous material in a liquid form in your operation.

The best way for any business to avoid the costs of contamination clean up is to eliminate the use of hazardous materials in their operation. A complete understanding of how a business conducts its processes is required to determine the best way to eliminate or at least reduce the amount of hazardous waste being generated. A Pollution Prevention Program has been established at the New Mexico Environment Department to assist businesses in evaluating their processes. The number to call at NMED is 505-827-0677 or you can call the Technical Resource Center in Albuquerque at 505-843-4251.

The New Mexico Environment Department has a 24-hour emergency reporting number that can be called in case of an incident dealing with hazardous material. The number is 505-827-9329.

WASTEWATER REGULATIONS:

Any business that generates wastewater that contaminates surface water or ground water can be held responsible for the cost of cleanup. If the contaminant is a RCRA “listed” or “characteristic” waste above the concentration value allowed, then the wastewater is by definition a hazardous waste and must be dealt with under New Mexico Hazardous Waste Regulations. Placing hazardous wastewater directly onto or into the ground is strictly prohibited. Since the cost of cleaning up either surface water or ground water can be substantial, it is in the best interest of any business to eliminate, minimize, and/or control its wastewater.

If non-hazardous wastewater is being discharged so that it can move directly or indirectly into ground water (e.g. septic system, dry sump, etc.) a business is required to file a “Notice of Intent to Discharge” with the New Mexico Ground Water Bureau in accordance with the NM Water Quality Act. The Bureau will then determine if the business requires a Discharge Permit. In some cases the business may be required to request a NPDES Permit from the EPA if the discharge is to surface water.

If non-hazardous wastewater is being place into a sewerage system a business is required to notify the local Publicly Owned Treatment Works (POTW) the nature and concentrations of the contaminants in the wastewater. Attached is a listing of the New Mexico Publicly Owned Treatment Works. Wastewater that has been determined to be hazardous is prohibited from being placed in any sewerage system.

Business need to be aware that even though their wastewater going into the sewerage systems is allowed by the POTW, this does not necessarily relieve them of potential contamination liability. A good example is the case in which a sewer pipe leaks and the wastewater contains hazardous constituents, below RCRA levels, that were generated by your business. Over time the wastewater seeps into the ground water and the concentrations exceed State or Federal water quality standards. If the contamination source can be traced back to your business, you could be liable for the cost of cleanup. Most businesses will find that the costs associated with proper handling of their wastewater are far cheaper than the cost of cleaning up ground water. Prevention is an inexpensive insurance policy.

Another potential source of contamination is through the foundation of your building. An example would be where a business handles hazardous material as a regular part of doing business and a spill occurs that seeps through cracks in the floor. Eventually it reaches ground water and is detected through monitoring of the ground water. Assuming it can be traced back to your business, you could then be held responsible for the cost of clean up.

Any business that generates wastewater from sources other than lavatories, cafeterias, etc., should evaluate ways in which the wastewater can be eliminated, reduced, recycled, reused or handled in such a fashion that the risk of liability for contaminating surface water or ground water is virtually zero. This should include dealing with hazardous waste and all wastewater in a proper fashion, sealing cracks in floors, training of employees, and possible treatment of their wastewater before it leaves their premises.

If you have any questions you can contact the Ground Water Bureau at 505-827-2965 and the Surface Water Bureau at 505-827-0187.

OSHA REGULATIONS:

Every business is required to provide a safe and healthy working environment for its employees. The Occupational Health and Safety Bureau (OHSB) is responsible for making sure businesses are in compliance with OSHA regulations. OSHA regulates permissible exposure limits (PEL’s) for employees exposed to certain air contaminants in the workplace. The Bureau conducts regular inspections of facilities and evaluates the establishment for safety and health compliance. The OSHB has a consulting program to assist facilities to be in compliance with OSHA regulations. The service is free of charge to New Mexico small businesses. Attached is a copy of “Frequently Asked Questions” about the program, a copy of “General Health & Safety Issues”, as well as a poster you are encouraged to display at your facility. They can be contacted at 505-827-4230.

UNDERGROUND STORAGE TANK REGULATIONS:

Any business that stores a regulated substance in an underground storage tank that is not directly connected to some sort of processing operation may or may not be regulated by the Underground Storage Tank Bureau (USTB). If the substance is a hazardous waste, it is regulated under RCRA and you would need to contact the Hazardous Waste Bureau. Since there are a variety of circumstances whereby UST regulations have jurisdiction, it is best to contact the USTB directly for guidance. They can be contacted at 505-827-0188.

SOLID WASTE REGULATIONS:

The Solid Waste Bureau (SWB) deals primarily with regulating solid waste facilities (non-hazardous waste landfills, transfer stations, and recycling facilities) and illegal dumping. The only responsibility for a small business is to see that their non-hazardous waste is either sent to a recycler or to a permitted landfill by a registered solid waste hauler. For information the SWB can be contacted at 505-827-0197.

Pollution Prevention and Regulatory Compliance Contacts for New Mexico

STATE AGENCIES:

Green Zia Environmental Excellence Program

Pat Gallagher
NM Environment Department
Office of the Secretary
PO Box 26110
Santa Fe, NM 87502
505-827-0677
FAX: 505-827-2836
E-mail:
pat_Gallagher@nmenv.state.nm.us

Air Quality Bureau

Steve Dubyk
NM Environment Departrnent
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502
505-827-2859
FAX: 505-827-0045
E-mail:
steve_dubyk@nmenv.state.nm.us

Hazardous Waste Bureau

Debby Brinkerhoff
NM Environment Department
2044 Galisteo
P.O. Box 26110
Santa Fe, NM 87502
505-827-1511
FAX: 505-827-1833
E-mail:
debby_brinkerhoff@nmenv.state.nm.us

Occupational Health & Safety Bureau

Debra McElroy
525 Camino de los Marquez, Suite 3
P.O. Box 26110
Santa Fe, NM 87502
505-827-4230
FAX: 505-827-4422
E-mail:
debra_mcelroy@nmenv.state.nm.us

Ground Water Quality Bureau

Industrial Waste Team Leader
NM Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502
505-827-2900
FAX: 505-827-2965

Solid Waste Bureau

Jim Condiss
NM Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502
505-827-0559
FAX: 505-827-2902
E-mail:
jim_condiss@nmenv.state.nm.us

Underground Storage Tank Bureau

Joyce Shearer, Ph.D.
NM Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502
505-476-3779
FAX: 505-827-0310
E-mail:
joyce_shearer@nmenv.state.nm.us

Please note that a list of all Public Owned Treatment Plants (sewage treatments plants) are listed for all of New Mexico on the following page. Waste Treatment Plant operators are important regulatory contacts for small businesses. Please refer to the list and contact your local plant operator for information specific to your community and business.

City of Albuquerque

Public Works Department

Bob Hogrefe
Southside Water Reclamation Plant
4210 Second Street, SW
Albuquerque, NM 87185
Ph: 873-7030
Fx: 873-7087
Rhogrefe@cabq.gov

Environmental Health Department

John Liberatore
EHD/APCD
P.O. Box 1293
Albuquerque, NM 87103
505-768-1964
FAX: 505-768-2617
E-mail: jliberatore@CABQ.gov

New Mexico State University

WERC P2 Center
1155 University Blvd., SE
Albuquerque, NM 87106
505-843-4251
E-mail: chrisc@werc.net

State of New Mexico Wastewater Treatment Facility Contacts

POTW FACILITY	PHONE NO.	CONTACT PERSON
ALAMOGORDO, CITY OF	(505)439-5643 (505) 437-4530	Jose Miramontes
ALBUQUERQUE, CITY OF	(505)873-7040	Charles Bowman, WW Utilities Div. Director
ANTHONY W & SD	(505)882-3922	Pat Banegas
ARTESIA, CITY OF	(505)746-2122	Ernest Thompson, Mayor
AZTEC, CITY OF	(505)334-8664	Gary Spickelmier
BELEN, CITY OF	(505)864-6081	Robert Rimorin
BERNALILLO, TOWN OF	(505)867-2307	Nick Tobey
BLOOMFIELD, CITY OF	(505)632-8474	Casimiro Ruybalid
CANNON AIR FORCE BASE		Lynn Steinle
CAPITAN, VILLAGE OF	(505)354-2247	Terry Cox
CARLSBAD, CITY OF	(505)887-5412	Gilbert Ybarbo
CARRIZOZO, TOWN OF	(505)354-2247	Steve Sale
CHAMA, VILLAGE OF	(505)756-2184	Tony Gonzales, Mayor
CIMARRON, VILLAGE OF	(505)376-2232	Lino Paiz
CLAYTON, TOWN OF		
CLOUDCROFT, VILLAGE OF	(505)682-2411	David Venable, Mayor
CLOVIS, CITY OF	(505)769-7865	Robert Challender
CONCHAS STATE PARK	(505)868-2900	Leo Wilson
CUBA, VILLAGE OF	(505)289-3864	Faustino Gallegos
DEMING, CITY OF	(505)546-8848	Louis Jenkins, Public Works Director
DEPARTMENT OF ENERGY, LANL AND U OF CA	(505)665-7855	Charles Barnett
DES MOINES, VILLAGE OF		
DEXTER, TOWN OF	(505)734-5482	Joe Alvarez
EAGLE NEST, VILLAGE OF		
ECO Resources #3	(505)891-1223	Donald Thymes
ECO Resources # 2	(505)891-1223	Donald Thymes
ESPANOLA, CITY OF	(505)753-4740	Frank Naranjo
ESTANCIA, TOWN OF	(505)384-2302	
EUNICE, CITY OF	(505)394-2576	Willie Luster
FARMINGTON, CITY OF	(505)599-1315	Tom Wethington, WW Director
FORT SUMNER, VILLAGE OF	(505)355-2401	John McMillan, Mayor
GALLUP, CITY OF	(505)863-1210	Ray Espinoza
GRANTS, CITY OF	(505)287-7927	Willie Alire, City Manger
HAGERMAN, TOWN OF	(505)752-3201	Robert Romero
HATCH, VILLAGE OF	(505)267-3021	Clifford Browning

HOBBS, CITY OF	(505)397-9315	James Tulk
HOLLOMAN AIR FORCE BASE	(505)479-7080	Meryle F. Stueve, TSgt, USAF
JAL, CITY OF	(505)395-2222	Fred Seifts
JEMEZ SPRINGS, CITY OF	(505)829-3540	David Sanchez, Mayor
KIRTLAND AIR FORCE BASE HQ AFSWC/CC		
LAGUNA, PUEBLO OF		Frank Analla
LAS CRUCES, CITY OF	(505)528-3599	Gilbert Morales
LAS VEGAS, CITY OF	(505)454-1401	Andrew R. Jaramillo
LOGAN, VILLAGE OF	(505)487-2239	Julian Cordova
LORDSBURG, CITY OF	(505)524-8273	Alex De La Garza
LOS ALAMOS, BAYO PLANT	(505)662-8147	Paul Pizzoli, Utilities Director
LOS LUNAS, VILLAGE OF	(505)865-9689	Louis Huning, Mayor
LOVING, VILLAGE OF		
LOVINGTON, CITY OF	(505)396-2884	Bob Carter
MAGDALENA, VILLAGE OF	(505)854-2261	Vida M. Trujillo
MAXWELL, VILLAGE OF	(505)375-2752	Leroy Quintana, Mayor
MELROSE, VILLAGE OF	(505)253-4274	Bobby Bennett, Mayor
MORA MUTUAL DOMESTIC WATER & SEWER. WKS.	(505)387-5401	Manuel B. Alcon President
MORIARTY, CITY OF	(505)832-6257	Rosendo Saiz
MOUNTAINAIR, TOWN OF	(505)847-2321	Debra Kelly
ORGAN WATER AND SEWER ASSOCIATION	(503)825-5423	Charles Jefferson
PECOS, VILLAGE OF	(505)757-6591	Joseph Cyde Baca, Mayor
PORTALES, CITY OF	(505)359-3152	Thomas Howell
QUESTA, VILLAGE OF	(505)586-0694	Mike Cordova
RAMAH DOMESTIC UTILITIES	(505)722-4366	Ron Morsbach
RATON, CITY OF	(505)445-2292	Mike Baca
RED RIVER, TOWN OF	(505)754-2277	Jake Pierce, City Administrator
RESERVE, VILLAGE OF	(505)533-6581	Lonnie Graham
ROSWELL, CITY OF	(505)624-6700	Roger Cooper, PE, Dir of Public Works
ROY, VILLAGE OF	(505)485-2204	Alex Deschamps
RUIDOSO-RUIDOSO DOWNS REGIONAL WWTP	(505)258-4014	Gary Jackson, Village Manager
SAN JON, VILLAGE OF	(505)576-2922	Chris Molyneaux
SANTA FE, CITY OF	(505)984-6509	Qustandi Kassisieh
SANTA ROSA, CITY OF	(505)472-3331	Gerald Anaya,Water & Sewer Superintendent
SANTA TERESA SERVICES COMPANY	(505)589-0906	Charles Crowder
SILVER CITY, TOWN OF	(505)388-4981	Stan Snider
SOCORRO, CITY OF	(505)835-0240	Pat Salome, City Clerk
SPRINGER, TOWN OF		
SUNLAND PARK, CITY OF	(505)589-1979	Mark Boling

TAOS, TOWN OF	(505)758-8401	Mark Swan, Supervisor
TATUM, TOWN OF	(505)392-7412	F. L. (Roy) Miller
TEXICO, TOWN OF	(505)482-3314	Mathew Meeks
THOREAU WATER AND SANITATION	(505)862-7136	Vidal Brown
TRUTH OR CONSEQUENCES, CITY OF	(505)894-7331	Quentin Drunzer, City Manager
TUCUMCARI, CITY OF	(505)461-3451	Bernadette Moya, City Manager
TULAROSA, VILLAGE OF	(505)585-2771	Margaret Gonzales, Village Clerk
TWINING, W & SD	(505)776-8845	Joe Harvey
VAUGHN, TOWN OF	(505)392-1266	F.L. Miller - Con. Engineer
WAGON MOUND, VILLAGE OF	(505)666-2408	Alfred Romero Mayor

Online Resources:

City of Albuquerque P2 Program:www.cabq.gov

Additional Sources of Information:

The New Mexico Environment Department's Hazardous and Radioactive Materials Bureau offers free on-site technical assistance for small businesses to help address small business hazardous waste issues. Please contact the Bureau at 505-827-1558 and ask for the Hazardous Waste On-Site Assistance Program for a consultation.

The City of Albuquerque Public Works Department has a guidebook on pollution prevention for the jewelry manufacturing industry. Please contact Bob Hogrefe at 505- 873-7030 for a copy.

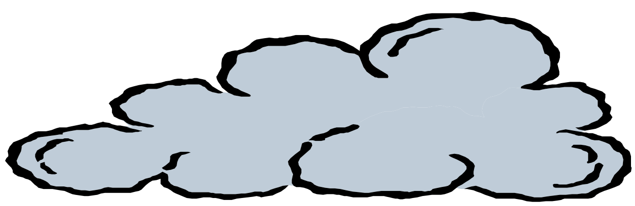
Understanding Solvents: Common Uses and Chemical Composition

Eliminate - Reduce - Reuse - Recycle - Exchange

Solvents are used to create a fluid environment in which reactions or processes can be run efficiently and effectively. Solvents influence pH and temperature factors that affect the binding mechanisms of soiling agents.   The following paragraphs are intended to serve as an introduction to the **chemical composition**, **general activity mechanisms**, and **common uses** of various types of solvents.

Petroleum-Based Solvents

This group refers to a class of solvents that are used as **general-purpose cleaners**. Most petroleum-based solvents consist of a hydrocarbon “backbone" to which chemical functional groups and oxygen groups have been added. In these solvents, the inorganic functional groups are responsible for the activity of the solvent. The exception to this rule is a subclass of petroleum-based solvents called aromatic and aliphatic hydrocarbon solvents, which contain multiple bond arrangements and/or are bonded into ring confirmations. In these solvents, it is the carbon confirmation and arrangement of double and triple bonds between neighboring carbon atoms that give the solvent its activity.



Industry has chosen the petroleum-based solvents with low molecular weight, which have **high volatility**. The high volatility and reactivity of these solvents allows **maximum removal of soils** and contaminants, creating compatibility with varied work surfaces and subsequent process requirements while simplifying process and technique, thereby **minimizing costs**. Furthermore, because many soiling agents are organic compounds, ex.) grease, motor oil, waxes, and most lubricants, they are miscible in organic petroleum-based solvents, allowing for **quicker, more effective clean up**.

Due to their **high volatility**, total containment of petroleum-based solvents during application and waste storage is nearly impossible. The **atmospheric escape** of these solvents, many of which are classified as Volatile Organic Compounds (VOC’s), has been shown to contribute to **stratospheric ozone depletion, air pollution through smog formation, and soil and groundwater contamination**.

Types of Petroleum-Based Solvents:

Halogenated petroleum-based solvents:

These solvents consist of the **highly reactive** functional groups chlorine, fluorine, or bromine. These halogens share the same number of electrons available to participate in chemical reactions. For this reason, the chemical reactivity of these solvents is less dependent on which halogen atom comprises a functional group than on how many functional groups are attached to the hydrocarbon "backbone," a number referred to as the **degree of halogenation**. A solvent with a high degree of halogenation has a **high volatility** and **strong cleaning properties**.

Higher energy levels in the bonds make the molecule more reactive, which can cause it to escape from the liquid phase into the gas phase and enter the atmosphere. The popularity of halogenated solvents arose from their **superior contaminant** and **soil expulsion properties**, **low flammability**, **compatibility with work surfaces** and process equipment, and **relatively low cost**.

Alternatives that Reduce Risk:

Though it is often advisable to seek non-halogenated alternative solvents because halogenated compounds are hazardous to human and environmental health, several new halogenated alternatives have been developed with short atmospheric lifetimes.

- n-Propyl Bromide:
  Many commercial "green" solvents have replaced their chlorinated solvents with n-butyl bromide because it is a nonflammable VOC with a 10-11 day atmospheric lifetime, giving it a **low Ozone Depletion Potential**. However, despite a low bio-accumulation potential, n-butyl bromide solvents are **non-biodegradable**, and in large volumes have the potential to penetrate soil and **contaminate groundwater**. Furthermore, they may **harm** some work surfaces, especially aluminum surfaces.

High-volatility oxygenated solvents:

In these solvents, the halogen functional group is replaced by an oxygen group such as a hydroxide group, such as alcohols; an ethyl group, such as ethers and esters; or a carbonyl group, such as ketones, aldehydes, and carboxylic acids. The hydroxide group has a similar chemistry to the halogen groups with one important exception: most of the oxygenated solvents are **highly flammable** and therefore **restricted** to applications such as ambient temperature immersion and manual wipe.

Oxygenated solvents are also prone to undergo reduction/oxidization (redox) reactions, which is the addition or elimination of double bonds or oxygen atoms. Although redox reactions in these solvents rarely result in more **toxic compounds**, the resulting solvent is **less effective** and **more flammable** under atmospheric conditions. For this reason, a warning not to mix with oxidizing agents often accompanies the oxygenated and aromatic and aliphatic hydrocarbon solvents.

Alternatives that Reduce Risk:

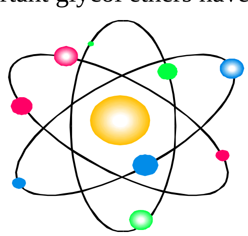
- Acetone:
  Excluded from the U.S. EPA's definition of VOC's due to its insignificant reactivity in the presence of sunlight, Acetone is a nonetheless a **highly volatile organic solvent**. Acetone is suitable as a drying agent and for ambient immersion or manual cleaning applications of soils such as greases, waxes, and inks. Due to its **high flammability**, safety cautions must be implemented during handling as well as during recycling. Although Acetone need not be reported under SARA 113, it is on the RCRA list of **hazardous wastes**, and must be **incinerated** for disposal.

- Alcohols (with perflourocarbons):
  Alcohols, mainly isopropanol, methanol, and ethanol, are excellent cleaning solvents for certain soils. The hydroxide functional group allows the alcohol to exhibit some of the same properties as water, while the hydrocarbon "backbone" allows the alcohol to dissolve low-molecular-weight oils. Alcohol solvents are often **biodegradable and water-soluble**. Alcohols are also **flammable VOC's and** as a result can only be used directly in manual and cold immersion applications, although their greatest efficacy occurs in heated or boiling liquid applications.

  This obstacle can be overcome by placing a perfluorocarbon vapor "blanket" above the heated cleaning system. This vapor "blanket" shields the solvent from atmospheric oxygen that causes combustion. Perfluorocarbons are **nonflammable** and have **low toxicity**, but are **costly** and have **high global warming potential**. Though they are immiscible in alcohol and easily separable and reusable, the capital and operational costs of perfluorocarbon systems are fairly high and prohibitive when other methods are available. Perfluorocarbons, which can be employed as solvents alone, have greatest potential in cleaning equipment that uses fluorinated lubricants or polymeric and elastomeric materials that are easily corroded by other solvents.

- Glycol Ethers/ Ethyl Lactate:
  Because glycol ethers **emulsify well and separate easily**, they are prime candidates for the organic components of semi-aqueous solvents. They are also being substituted for both harmful halogenated hydrocarbon and high-volatility oxygenated solvents in capacities ranging from **dry cleaning to degreasing**. Often azeotropic blends and additives such as isoparaffinic hydrocarbons are supplemented in to increase the solvent's efficacy rating, work surface compatibility, and/ or decrease the solvents flammability. However, glycol ethers are **highly flammable VOC's**.

  Commercially important glycol ethers have been separated into **two categories**: the E-series, or ethylene



  glycol ethers, and P-series, or propylene glycol ethers. Because they have been linked to **miscarriages**, SARA 113 and OSHA heavily regulate the E-series. Due to these concerns, alternatives are being researched.

- n- Methylpyrrolidone (NMP):
  NMP is a **combustible VOC** listed under the SARA 113 Title III. Despite this listing, NMP is **very useful** in removing high-molecular-weight greases and carbon deposits as well as coatings (polyurethane, ink, and resin), enamels, and many plastics. It can be employed in both immersion and ultrasonic processes. Since many oils are only soluble in NMP above 145 F°, oil soils can be easily separated and the **solvent reclaimed** by lowering the solvent temperature. Furthermore, NMP is **biodegradable** and can also be reclaimed through separation and subsequent vacuum distillation.

Aromatic and aliphatic hydrocarbon solvents:

These solvents are also referred to as unsaturated hydrocarbons. Due to their flammability concerns and redox potential, aromatic and aliphatic hydrocarbon solvents share the advantages and disadvantages of the oxygenated solvents.

Alternatives that Reduce Risk

- Terpenes:

  Derived from natural sources such as citrus fruit and pine trees, terpenes are **biodegradable** and are **useful** in semi-aqueous solutions (from which they can often be **separated and reused**). Terpenes are **flammable VOC's** and very **strong cleaners**, removing resin, fingerprints, and high-molecular-weight greases. They can be used in ambient immersion and ultrasonic applications, though they may be too strong for some work surfaces.

- Petroleum Distillates:
  Produced from crude oil cracking, petroleum distillates are also **flammable VOC's** used to remove high-molecular-weight greases, tar, and waxes in immersion or manual applications. This class of solvents includes mineral and white spirits, naphtha, kerosene, and Stoddard solvent, which **vary in cost and toxicity**. Petroleum distillates are able to penetrate and clean porous surfaces, and **evaporative losses can be minimized** through the use of a parraffinic hydrocarbon additive. Furthermore, they can serve in some semi-aqueous solutions, from which they can be **easily reclaimed** through separation or distillation techniques.

Aqueous Solvents

Aqueous solvents are a category consisting mainly of **water and dissolved inorganic water soluble components** such as surfactants, chelating agents, emulsifiers, sequestering agents, and corrosion inhibitors. Water is a polar compound, meaning that a portion of the water molecule, the oxygen atom, has a greater affinity for the molecule's bonding electrons, and hence has a slight negative charge. As a result, the remaining portions of the molecule, the hydrogen atoms, have a slight positive charge. Due to this charge separation within their constituent molecules, aqueous solvents are held together by intermolecular forces in which the negatively charged oxygen atom of one water molecule creates a weak bond to the positively charged hydrogen atom of another water molecule. These intermolecular attractions, referred to as hydrogen bonding, in conjunction with its basicity/ acidity allow the **solvent to "attack" any soil** which contains charged portions.

Aqueous solvents are generally **superior to organic solvent methods**. Due to the **benign nature of water**, aqueous solvents are **less hazardous to both human and environmental health** than their organic counterparts. Aqueous solvents are **often corrosive or harmful** to work surfaces, and are often **ineffective** with porous surfaces or soils. Furthermore, due to their immiscibility with organic contaminants, aqueous solvents must be **repeatedly applied** to common organic soiling agents to achieve effective removal. Often the process requires high pressure or ultrasonic technology. Therefore, in weighing the environmental factors involved in replacing organic solvents with aqueous solvents, the **increased volume of wastewater** streams must be considered. When utilizing aqueous solvents, it is tempting to dispose of the waste solution down the drain; however, the **local water authorities** should always be consulted about proper waste disposal.

Types of Aqueous Solvents:

Alkaline aqueous solvents:

Alkaline aqueous solvents have a pH greater than 7. Adding base to an aqueous solution creates an alkaline solvent, which contains negatively charged ions. These negatively charged particles disrupt the polar bonds binding the contaminants to the work surface, as well as obstruct the intermolecular bonds holding the contaminant together, thereby **dissolving the contaminant**. Due to the **corrosive** nature of these ions, inhibitors must be added to protect metallic work surfaces, especially aluminum surfaces. With the right additives and process optimization, alkaline solvents can be utilized with all types of liquid cleansing processes. With thorough **filtration and rinsing**, very high levels of cleanliness can be achieved, although the process may become **water intensive**. Alkaline aqueous solvents are **widely applicable**, **low waste**, and **cost effective**.

Neutral Aqueous solvents:

Having a pH of approximately 7, neutral aqueous solvents are mixtures of water and above-mentioned process specific additives. **Weaker than alkaline solvents**, neutral solvents are **effective** at removing light oils, salts, particles, and soils that are easily removed. For these contaminants, the **dissolving properties** of hydrogen bonding are sufficient to break up and remove the soil. Due to their weaker activity, neutral solvents are **less widely applicable** and are most effective in spray and ultrasonic applications, especially in degreasing processes.

Acidic Aqueous solutions:

Acidic aqueous solutions have a pH less than 7 and may be comprised of mineral acids, chromic acids, or organic acids that are miscible in water due to their acidic properties. Acids have free floating positive charge, making them **excellent** at removing scale, rust, and oxidizing agents from metals. The positive portions of the acid surround and **dissolve** the aberrant negatively charged metal region. Some metal/ acid combinations cause hydrogen embrittlement on the surface of the metal. This can be significantly reduced or eliminated by changing acids or heat-treating the metal before the cleansing treatment. Because acidic aqueous solvents are less adaptable to general cleaning processes, they are **less common** as cleaning solvents.

Semi-Aqueous Solvents:

Two different types of semi-aqueous solvent procedures are commonly used. The first involves a solvent in which hydrocarbon/ surfactant cleaners are emulsified in water, meaning that the hydrocarbon/ surfactant exists as droplets suspended in the aqueous support. This arrangement combines the **more effective** contaminant dissolution and high-molecular-weight soil removal characteristics of petroleum-based solvents, with the **increased environmental safety** of aqueous methods.

The other semi-aqueous method entails an initial concentrated hydrocarbon application followed by an aqueous rinse cycle. Again, this method utilizes the **effectiveness of organic solvents** while **lessening the environmental impact** of the overall process by reducing the amount of organic solvent employed. The application techniques for both semi-aqueous methods are similar to those used in aqueous methods, though **flammability**, phase separation, and **odor problems** can arise with the mixing of the solvent types, making equipment design an important consideration.

Super Critical Fluids

Supercritical fluids are common gasses such as carbon dioxide under **extreme pressure** and **temperature**. Under these conditions, the fluid no longer exhibits the characteristics of a liquid or a gas, but rather has properties conducive to **high soil dissolution**. The high temperature of a critical fluid confers a high energy level to the individual molecules, which under atmospheric pressure would cause the molecules to increase molecular vibrations and velocity, causing the fluid to expand.

However, because critical fluids are also under high pressure, the high-energy molecules are not able to expand and must exist in a tightly packed, high-energy configuration. It is this dense, high-energy arrangement that gives critical fluids their high soil dissolution properties. This current technology combines application **flexibility** with **low cost**. However, it requires **large capital investment** to design and maintain a system capable of safely withstanding such high temperatures and pressures. **More testing** must be completed to understand the effects on sensitive work surfaces.

New Mexico Occupational Health & Safety Bureau

New Mexico Environment Department
Santa Fe, New Mexico 87502

525 Camino de los Marquez - PO Box 26110
(505) 827-4230 Fax (505) 827-4422

Jewelry Shop Safety Checklist

YES **NO**

General Conditions

☐ ☐ Is ventilation strong enough to remove fumes and odors from work areas?
☐ ☐ Is there good ventilation even when windows are closed on rainy or windy days?
☐ ☐ Is there a break room away from work areas? Are eating, drinking, and smoking prohibited in work areas?

Chemical Storage

☐ ☐ Do all containers have labels?
☐ ☐ Are chemicals stored in fire-resistant cabinets or rooms?
☐ ☐ Are incompatible chemicals (such as cyanide and acids) stored in separate areas?
☐ ☐ Are waste chemicals disposed of properly and promptly?

Waxing

☐ ☐ Does the waxing area have ventilation to remove paraffin fumes?
☐ ☐ Is there enough light for the detailed work done by waxers?

Casting

☐ ☐ Has a hazard assessment been conducted for metal fume exposure to determine if respiratory protection is needed? (i.e. lead, cadmium air monitoring)
☐ ☐ Are safety glasses worn while metals are being melted?
☐ ☐ Is metal kept molten for the briefest time practical to reduce metal fume exposure?
☐ ☐ Do casters wear fireproof (but asbestos free) gloves and aprons while handling hot metals?
☐ ☐ Is there ventilation in the area where metal is melted to remove metal fumes?
☐ ☐ For rotary casting machines: Is there a safety switch that prevents operation of the machine when the lid is open? Is the machine bolted securely to the floor?

Stripping and Knockout

☐ ☐ Has a hazard assessment been conducted for silica exposure?
☐ ☐ Are flasks allowed to cool for a few minutes after casting, before quenching in water?

☐ ☐ When investment is removed from the flasks, is it kept completely wet to reduce dust?
☐ ☐ Are traces of investment removed from cast trees without using hydrofluoric acid?
☐ ☐ Is this done by using: water-jet cleaning? And ultrasonic bath? Glass-bead blasting?
☐ ☐ If hydrofluoric acid is used to remove investment, are the needed safety measures taken?
☐ ☐ Are gloves and chemical goggles worn whenever the acid is handled?
☐ ☐ Are an acid proof coat, goggles, and face shield worn when concentrated hydrofluoric acid is handled?

YES **NO**

☐ ☐ Are gloves made of neoprene, nitrile rubber, or natural rubber?
☐ ☐ Are an emergency shower and eyewash station located within 25 feet of the concentrated hydrofluoric acid area?
☐ ☐ Has stripping been eliminated by using special gold alloys, or by glass-bead blasting of the cast trees?
☐ ☐ If stripping is needed, has bombing been replaced by a cyanide-free stripping process?
☐ ☐ If cyanide stripping is still used, are all necessary safety precautions taken?
☐ ☐ Are employees who handle cyanide trained in its hazards and in safe work practices?
☐ ☐ Are all cyanide containers clearly labeled, indicating the contents and hazards?
☐ ☐ Is the equipment used to measure and mix cyanide used for those purposes only?
☐ ☐ Is cyanide stored in a locked cabinet to prevent unauthorized use?
☐ ☐ Does the stripping area have ventilation to remove airborne cyanide?
☐ ☐ Are eating, drinking, and smoking prohibited in the stripping area?

Soldering and Finishing

☐ ☐ Is cadmium free solder used exclusively?
☐ ☐ Has a hazard assessment been conducted for cadmium exposure if solder is not cadmium free (i.e. air monitoring) to determine if respiratory protection is necessary?
☐ ☐ Has a hazard assessment been conducted for lead exposure (i.e. air monitoring) to determine if respiratory protection is necessary?
☐ ☐ Are the ingredients of all solders clearly identified on their labels?
☐ ☐ If paste solder is used, is the flux free of fluorides, such as fluoborates and zinc fluoride?
☐ ☐ Is a “safety pickle” (such a sodium bisulfate) used as a pickling agent, instead of sulfuric acid?
☐ ☐ Is the lighting strong enough, but free of glare?

Polishing

☐ ☐ Are the dust collectors on all polishing machines working effectively? Check for two warning signs that the ventilation is not working well enough.
☐ ☐ Does grit accumulate rapidly on surfaces surrounding the polishing wheels?

☐ ☐ If you leave a sheet of paper in the polishing room, does it get covered with dust in a few days?
☐ ☐ Are safety glasses or other shields always used when polishing to prevent eye injuries?
☐ ☐ Are vibratory polishers or tumblers used instead of ordinary polishing wheels where appropriate?
☐ ☐ Are the noise levels produced by tumblers below the 8 hour time weighted average of 85dBA (action level)?

Stone Setting

☐ ☐ Are stone setters encouraged to work under magnifying lenses to reduce eye-strain?
☐ ☐ Are setters given tools that can be used comfortably without placing strain on the hands or wrists?

☐ ☐ Is the lighting strong enough, but free of glare?

Machining

☐ ☐ Are safety glasses worn during all jobs that might produce flying objects? These jobs include drilling, milling, engraving, stamping, stretching, and others.
☐ ☐ Do all presses have safeguards that prevent amputation of hands or fingers? Check to see that at least one of the effective safety mechanisms is used:
☐ ☐ Are guards installed that completely prevent placement of fingers between the dies?

☐ ☐ Are there switches that must be pressed with both hands to begin operation, along with simple guarding to keep the hands clear during each operating cycle?

<u>YES</u> **<u>NO</u>**

☐ ☐ Are all lathe cutting tools solidly mounted on the lathe, rather than being hand-held?
☐ ☐ Do rolling mills have an automatic shut-off bar in the pinch point between the rollers?
☐ ☐ Are all drive belts and gears properly guarded?

Plating

☐ ☐ Are the contents of each plating bath clearly labeled?
☐ ☐ Are gloves and goggles worn when handling acids and other corrosive chemicals?
☐ ☐ Is an emergency shower and eyewash installed in the plating room, in case of an accident?
☐ ☐ If cyanide solutions are used for plating, are all the cyanide precautions descried in **"Stripping and Knockout"** being followed?
☐ ☐ For black plating, have solution that are free of chromium salts (which cause cancer) been tried?

Cleaning

☐ ☐ Are steam tanks inspected and certified yearly?
☐ ☐ If ammonia solution is used, is there ventilation to reduce the amount of ammonia in work areas?
☐ ☐ Are ammonia baths kept covered whenever possible?
☐ ☐ If solvents such as acetone or trichloroethane are used, is good ventilation and protective equipment provided?

Refining

☐ ☐ Have alternatives to in-house refining been considered?
☐ ☐ Are gloves, goggles, and an acid suit worn while handling corrosive chemicals?
☐ ☐ Is an emergency shower and eyewash installed in the refinery, in case of an accident?
☐ ☐ Are refinery employees trained in the use of acid-gas respirators, for protection when handling spills?
☐ ☐ Is a generous quantity of acid-resistant absorbent stored nearby, for use on acid spills?
☐ ☐ If cyanide is used, are all the cyanide precautions described in **"Stripping and Knockout"** being followed?

General Health and Safety Issues

YES **NO**

☐ ☐ Do the employees wear respirators?

If so,

☐ ☐ Does the company have a written respiratory protection program?

☐ ☐ Are employees trained to properly wear, clean/maintain, and know in what situations the respirators are needed?

If not,

☐ ☐ Is the indoor air quality such that they are not needed?

☐ ☐ Is there a written Hazard Communication Program?

☐ ☐ Are MSD sheets available for all the hazardous chemicals in the workplace and are they updated regularly?

☐ ☐ Have employees received Hazard Communication training?

☐ ☐ Are there elevated storage/equipment lofts or platforms present?

If so,

☐ ☐ Are signs showing the weight capacity present?

☐ ☐ If the floors are more than 4 feet above a lower floor, are guardrails present?

☐ ☐ Are all exits marked with signs?

☐ ☐ Are exit doors free to access and are routes to these exits kept free of obstructions?

☐ ☐ Is there a procedure in place for obtaining medical treatment for injured employees?

☐ ☐ Are there first aid supplies readily available?

☐ ☐ Are there fire extinguishers on site?

☐ ☐ Are they charged and ready for use?

☐ ☐ Are employees required to use these extinguishers?

If yes,

☐ ☐ Is the path unobstructed?

YES **NO**

☐ ☐ Are they subjected to an annual inspection?

☐ ☐ Are employees trained to use them?

If not,

☐ ☐ Is there a written policy that requires employee evacuation?

☐ ☐ Does the company have an emergency action plan and fire prevention plan?

☐ ☐ Has the electrical system throughout the facility been assessed for situations where an employee may come into contact with an electrical current, or the electrical system is such that a fire hazard exists (i.e. bare conductors, faulty equipment, exposed electrical equipment where a flammable/explosive environment may exist)?

☐ ☐ Does the employer (if 10+ employees are employed) record occupational injuries and illnesses on the OSHA-200 log?

Note: If any of the above questions that are answered with "Yes", then the condition is probably adequate. If any of the above questions are answered "NO", then re-evaluate the situation, as a violation of the standards may exist. For assistance contact:

NEW MEXICO OCCUPATIONAL HEALTH & SAFETY BUREAU
CONSULTATION PROGRAM
505-827-4230

The Consultation Program provides safety and industrial hygiene surveys of workplaces, along with evaluation of, and assistance with the establishment of safety and health programs. The program is administered by the State but is operated separately from the Enforcement Program. The services are primarily targeted to smaller businesses, both public and private. The goal is to reduce workplace injuries and illnesses by helping businesses identify workplace hazards and find effective, economical solutions for eliminating or controlling them. The service is free and there are no penalties or fines, even if problems are found. Participation in this voluntary program has helped many New Mexico Businesses lower their costs associated with worker's compensation claims and increase their efficiency and productivity.

OSHA CONSULTATION/TECHNICAL SERVICES

FREQUENTLY ASKED QUESTIONS

What is the Consultation Service all about?

The Consultation program provides safety and industrial hygiene surveys of workplaces, along with evaluation of, and assistance with establishment of safety and health programs. Although the service was established by the same Act that created the Occupational Safety and Health Administration, and the associated enforcement/compliance agencies on the federal and state level, the Consultation Service does not issue fines or penalties. Since the same regulations are covered, the service allows the employer to benefit from the professional assistance, without fines being imposed.

What does your service cost and who is eligible?

The Occupational Health & Safety Bureau (OHSB) offers consultation services free of charge to New Mexico employers with 250 or less employees on location or 500 statewide. Limited services are available to larger companies. Consultation is offered only at the request of an employer.

What types of places do you visit?

The extent of the OSHA Act is to protect employees in all places of work. These include machine shops, hospitals, offices, chemical manufacturing plants etc. The consultation program is designed to assist employers (especially small employers) in complying with the requirements of OSHA regulations. We therefore, visit any place of employment that has employees.

Where does the Consultation Service get its funding?

The program receives funding from both the federal and the state government.

How long does the consultation process take?

Depending on the size of the company and the scope of the visit, a consultation may take anywhere from one or two hours to a full day. If exposure monitoring is requested or recommended, another day is often scheduled.

What kinds of things do you look at?

In order to evaluate the systems in place, sufficient information from the employer may be needed. This would include assessing existing safety and health programs, the OSHA 200 logs, accident investigation reports, and a walk-through of the facility to identify potential injury and illness hazards in the workplace.

Do we have to let you in all areas?

You, the employer makes that determination. If you requested a comprehensive survey, the consultant will look at all areas.

Can it be arranged for both the safety and the industrial hygiene visits to be conducted on the same day?

Visits are scheduled based on the caseload of the consultants. Where the caseloads permit such an arrangement can be made.

Do I (the employer) have to fix everything you find?

The employer is obligated to correct all serious hazards found by the consultant, within a reasonable time frame. Time extensions are granted for abatement of hazards when needed, if the employer is providing interim protection for employees.

How are hazards classified as "serious" & "other than serious"?

A serious violation results where there is substantial probability that death or serious physical harm could result. An other than serious violation is a hazard that has a direct relationship to job safety and health, but probably would not cause death or serious physical harm.

How much will it cost to correct/fix the hazards identified?

Usually, it is not prohibitively costly to correct hazards identified by our consultants.
However, where cost becomes an overriding consideration or where the employer can show that engineering controls are not feasible the employer may seek a variance from OHSB. In this case the employer must show that a combination of work practices, administrative controls, and personal protective equipment will provide equal or better protection for the employees.

Do you come back to verify hazard correction?

For regular consultation visits, a statement of assurance of correction for each hazard is usually acceptable. For special program consultations (SHARP) a follow-up visit is usually conducted to verify correction of hazards.

How do we request an extension of time on corrections?

All extensions have to be requested in writing. The letter should include the reason for the extension, what has been done to date to correct hazards; and if corrections have not been made, the employer must state what interim measures have been taken to protect the employees.

What is the SHARP Program all about?

SHARP or Safety and Health Achievement Recognition Program is one of our special programs for companies wishing to go the extra mile to establish a fully functional overall safety and health program, in addition to the correction of hazards. SHARP is primarily a recognition program for exemplary companies, but an added incentive for SHARP participants is a one-year exemption from OHSB's general schedule inspections.

Does Sharp keep OHSB enforcement out in all cases?

No, At SHARP sites, OHSB will continue to make inspections in the following situations:

- imminent danger;
- fatality/catastrophe;
- formal complaints;
- referral from other government agencies; or
- follow-up on previously cited violations.

Where can I get information on establishing written programs (i.e. blood borne pathogen, hazard communication, confined space, etc?

Many of the safety and health programs are available through the New Mexico Occupational Health & Safety Consultation Program. They are available upon request.

How do we know which elements of the safety and health program requirements need to be fixed, if it doesn't show up on your report to us?

It is addressed in the safety & health program management section of the report the employer receives. These issues are also discussed by the consultant with the employer.

Is it necessary to have a written certification of hazard assessment at work sites that do not require (PPE) Personal Protective Equipment for any task?

Yes, according to 1910.132(d)(2), the employer shall verify that the required workplace hazard assessment has been performed through a written certification that identifies the workplace evaluated.

Can you come to our company and conduct a class or safety meeting?

Onsite training and education by consultants will be based on available resources and the employers request. The training and education will be tailored to the nature of the hazards or potential hazards in each specific workplace. Training in specific areas is also available through private consultants and the New Mexico Workers Compensation Administration or your insurer.

Can the consultant come back for specific things such as checking new equipment or processes that we bring on line?

Yes, Visits for specific purposes can be requested, in addition to regular consultation visits.

May I call your office anytime to ask questions?

Consultants are available to answer questions between 7-5pm Monday-Friday

Can anyone gain access to my report?

No, our files are confidential and are destroyed after 3 years.

Will a consultation visit lead to an inspection by OSHA compliance? Will your findings be passed on them?

All information is kept confidential. OHSB compliance inspectors cannot discover where we have been and then inspect those companies. The only time enforcement is contacted, is if a company neglects to correct serious hazards beyond time extensions. Then we are obligated to refer those items to enforcement, but only after we have made every attempt to work with the company.

What determines when a compliance inspection is going to occur? How do they decide whom they are going to visit?

Factors that may trigger a compliance inspections include:

- formal complaints by employees or their authorized agents;
- fatalities;
- catastrophe or major incidents;
- history of the company (previous OSHA activity);
- referral by other governmental agencies;
- general schedule inspections; or
- special emphasis programs

Have you been or will you go to my competitor?

Our service extends to all eligible companies who request it. All information is kept confidential; therefore, no hazards, or processes that may be a trade secret, seen in your facility will be discussed in another place of business.

Where can I get a copy of the regulations?

The Government Printing Office (GPO) processes all sales and distribution of the CFR. For payment by credit card, call (202) 512-1800, M-F, 8am to 4 pm or fax your order to (202) 512-2250, 24 hours a day. For payment by check, write to the Superintendent of Documents, Attn: New Orders, PO Box 371954, Pittsburgh, PA 15250-7954. Regulations and other material are available on the Internet at www.osha.gov.

Previously Released EPA Publications

Waste Minimization Opportunity Assessment Manual (EPA/625/7-88/003)

Facility Pollution Prevention Guide (EPA/600/R-92/088)

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Other P2 Manuals

Department of Energy P2 Manual

EPA Federal Facility P2 Planning Guide

Canadian P2 Handbook

Joint Services P2 Opportunity Handbook WWW EXIT EPA

State of Texas P2 Manual

State of Minnesota P2 Manual

State of Ohio P2 Manual

State of Washington P2 Manual

Kentucky Development of a P2 Plan

Air Force Materiel Command – Compliance Through Pollution Prevention

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P2 Manuals

The U.S. Environmental Protection Agency (EPA) has published two P2 manuals prior to the publication of this Guide. Both of these publications are available on this CD-ROM. In addition, a link is provided to an electronic version of this EPA manual. A number of other excellent P2 manuals and sample P2 plans are also available to help guide an organization that seeks to follow Chapter 8 in the Guide and prepare its own unique P2 program.

EMS Case Studies

- Novozymes, North America Inc.
  December 2000 - three pages
- Philips Communication Security Imaging Inc.
  December 2000 - two pages
- Gastonia Wastewater Treatment Division
  January 2001 - two pages
- U.S. Postal Service
  November 1999 - 12 pages
- Saturn and five of its suppliers
  describes efforts of automobile manufacturer Saturn and five of its suppliers in Tennessee to implement an EMS as part of a pilot program of the Tennessee Manufacturing Extension Program. Lessons learned, benefits and costs of implementation - Fall 1999 - eight pages
- Printed Wiring Board Case Study 7 - Identifying Objectives for Your Environmental Management Systems Materials
  6/99 - six pages
- Printed Wiring Board Case Study 8 - Building an Environmental Management System: H-R Industries' Experience
  6/99 - six pages
- IBM's Experience Implementing ISO 14001 on a Global Basis: Does ISO 14001 Achieve Its Intended Goals?
  2/99 - FELSEF Newsletter - seven pages
- Environmental Management System Demonstration Project
  This final report on NSF International's Environmental Management System (EMS) Demonstration Project summarizes the EMS implementation experiences of 18 organizations of a variety of types and sizes. The goals of the project were to: (1) document the experiences of a variety of organizations as they attempted to develop an EMS based on ISO 14001; (2) demonstrate the benefits and challenges of, and incentives for, EMS implementation; (3) determine what types of tools and assistance organizations need to be successful with

EMS implementation; and (4) provide a forum for organizations to learn from each others' EMS experiences. 12/96 - 112 pages

The following are workshop presentations available in both PowerPoint and HTML:

- IBM's Environmental Management System by Susan Clarke
- Dawn B. Sudmeyer, Camp Lejeune
- David Rachels, Exide Electronics Large System Group
- Doug Gaylord, Honda Power Equipment Manufacturing Inc.
- Matt Caton, Lufkin/CooperTools, Apex, N.C.
- Sean Bir, Konica Manufacturing USA Inc.
- Environmental Management System Development and Implementation by Don E. Carmichael, City of Gastonia Wastewater Treatment Division
- ISO 14001 Management Perspective by Bob Danhauser, Charleston Commissioners of Public Works
- Covered Anaerobic Digester: Case Study from Barham Farm by Julian Barham

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Environmental Management Systems

EMS FAQs
Answers to common questions about EMS

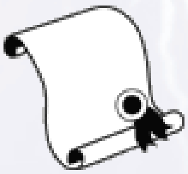
ISO 14000 Information
Detailed information about ISO 14000 including a list and description of the standards, components of ISO 14001 and information on how to purchase the standards

EMS Design Tools
Technical assistance in planning and implementing an EMS

EMS Case Studies
Experiences from companies implementing an EMS

Workshop Presentations
Presentations about EMS

Articles and Reports
Publications regarding EMS



North Carolina ISO 14001 Certified Facilities
Complete list of state facilities certified to ISO 14001

North Carolina Pilot Program
Project involving North Carolina agencies, the EPA and several North Carolina companies that aims to evaluate the effectiveness of an EMS

Links
Links to useful Web sites

Hot Topics
Calendar, upcoming workshops and latest news

An Environmental Management System (EMS) is a tool that provides organizations with a method to systematically manage their environmental activities, products and services and helps an organization achieve its environmental obligations and performance goals. An EMS follows a Plan-Do-Check-Act Cycle, or PDCA, and is a model that can be used by a wide range of organizations from manufacturing facilities to service industries and government agencies. Many organizations have chosen to adopt an EMS based on the international voluntary standard ISO 14001.

This site serves to provide background and technical information regarding the ISO 14000 family of standards, ISO 14001 and Environmental Management Systems.

Please provide your opinion of this site

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Environmental Management Systems

EMS Frequently Asked Questions

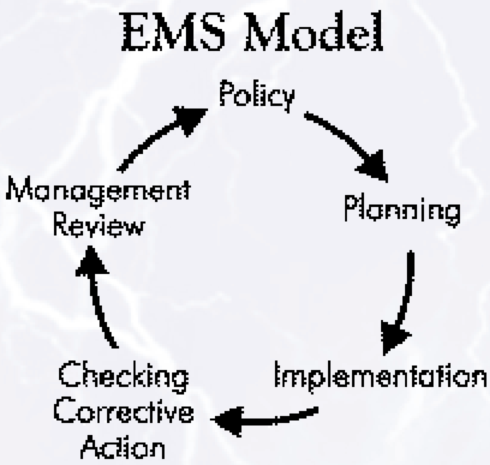
What is the definition of an Environmental Management System (EMS)?
What is the EMS Model?
What are some key elements of an EMS?
What are ISO, ISO 14000 and ISO 14001?
How are these standards developed? What are the 17 elements of the ISO 14001 Standard?
What are some of the potential benefits of an EMS based on ISO 14001?
Can existing environmental management activities be integrated into the EMS under 14001?

What is the definition of an Environmental Management System (EMS)?

- Serves as a tool to improve environmental performance
- Provides a systematic way of managing an organization’s environmental affairs
- Is the aspect of the organization’s overall management structure that addresses immediate and long-term impacts of its products, services and processes on the environment

- Gives order and consistency for organizations to address environmental concerns through the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes
- Focuses on continual improvement of the system

What is the EMS Model?



An EMS follows a Plan-Do-Check-Act Cycle, or PDCA. The diagram shows the process of first developing an environmental policy, planning the EMS, and then implementing it. The process also includes checking the system and acting on it. The model is continuous because an EMS is a process of continual improvement in which an organization is constantly reviewing and revising the system.

This is a model that can be used by a wide range of organizations — from manufacturing facilities to service industries and government agencies.

What are some key elements of an EMS?

- **Policy Statement -** a statement of the organization's commitment to the environment
- **Identification of Significant Environmental Impacts -** environmental attributes of products, activities and services and their effects on the environment
- **Development of Objectives and Targets -** environmental goals for the organization
- **Implementation -** plans to meet objectives and targets
- **Training -** ensure that employees are aware and capable of their environmental responsibilities
- **Management Review**

What are ISO, ISO 14000 and ISO 14001?

ISO stands for the International Organization for Standardization, located in Geneva, Switzerland. ISO promotes the development and implementation of voluntary international standards, both for particular products and for environmental management issues. ISO 14000 refers to a series of voluntary standards in the environmental field under development by ISO. Included in the ISO 14000 series are the ISO 14001 Environmental Management System (EMS) standard and other standards in fields such as environmental auditing, environmental performance evaluation, environmental labeling and life-cycle assessment.

How are these standards developed?

All the ISO standards are developed through a voluntary, consensus-based approach. ISO has different member countries across the globe. Each member country develops its position on the standards and these positions are then negotiated with other member countries. Draft versions of the standards are sent out for formal written comment and each country casts its official vote on the drafts at the appropriate stage of the process. Within each country, various types of organizations can and do participate in the process. These organizations include industry, government (federal and state), and other interested parties, like various non-government organizations (NGOs). For example, EPA and states participated in the development of the ISO 14001 standard and are now evaluating its usefulness through a variety of pilot projects.

What are the 17 elements of the ISO 14001 Standard?

- **Environmental Policy -** develop a statement of the organization's commitment to the environment
- **Environmental Aspects and Impacts -** identify environmental attributes of products, activities and services and their effects on the environment
- **Legal and Other Requirements -** identify and ensure access to relevant laws and regulations
- **Objectives and Targets -** set environmental goals for the organization
- **Environmental Management Program -** plan actions to achieve objectives and targets
- **Structure and Responsibility -** establish roles and responsibilities within the organization
- **Training, Awareness and Competence -** ensure that employees are aware and capable of their environmental responsibilities
- **Communication -** develop processes for internal and external communication on environmental management issues
- **EMS Documentation -** maintain information about the EMS and related documents
- **Document Control -** ensure effective management of procedures and other documents
- **Operational Control -** identify, plan and manage the organization's operations and activities in line with the policy, objectives and targets
- **Emergency Preparedness and Response -** develop procedures for preventing and responding to potential emergencies
- **Monitoring and Measuring -** monitor key activities and track performance
- **Nonconformance and Corrective and Preventative Action -** identify and correct problems and prevent recurrences
- **Records -** keep adequate records of EMS performance
- **EMS Audit -** periodically verify that the EMS is effective and achieving objectives and targets
- **Management Review -** review the EMS

What are some of the potential benefits of an EMS based on ISO 14001?

- Improvements in overall environmental performance and compliance
- Provides a framework for using pollution prevention practices to meet EMS objectives
- Increased efficiency and potential cost savings when managing environmental obligations
- Promotes predictability and consistency in managing environmental obligations
- More effective targeting of scarce environmental management resources
- Enhances public posture with outside stakeholders
- Gives competition/trade advantages
- Increases employee morale
- Enhances the company's image with regulators
- Reduces insurance rates

Workshop presentations discussing the benefits of an EMS - available in PowerPoint and HTML or PDF form:

- Ford Motor Company by Bob Devlin and Gary Davis
- Ford - Norfolk Assembly Plant by Gary Davis
- Mercedes-Benz U.S. International Inc. by Mark L. Warner
- NCI Inc. by Jack Rockstad
- Purolator Products Inc. by Steve Ross
- Benefits of an EMS to a Local Government by Steve Shoaf, et al., City of Burlington
- Eaton - Cutler-Hammer: Gaining Competitive Advantage Through Environmental Management System by Jim Takac

Can existing environmental management activities be integrated into the EMS under 14001?

Yes. The standard is flexible and does not require organizations to necessarily "retool" their existing activities. The standard establishes a management framework by which an organization's impacts on the environment can be systematically identified and reduced. For example, many organizations, including counties and municipalities, have active and effective pollution prevention activities underway. These could be incorporated into the overall EMS under ISO 14001.

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Environmental Management Systems

ISO 14000 Information

General Information

ISO stands for the International Standards Organization, located in Geneva, Switzerland. ISO is a non-governmental organization established in 1947. The organization mainly functions to develop voluntary technical standards that aim at making the development, manufacture and supply of goods and services more efficient, safe and clean.

ISO 14000 refers to a family of voluntary standards and guidance documents to help organizations address environmental issues. Included in the family are standards for Environmental Management Systems (EMS), environmental and EMS auditing, environmental labeling, performance evaluation and life-cycle assessment.

In September 1996, the International Organization of Standardization (ISO) published in final form ISO 14001, the Environmental Management Systems standard. This is an international voluntary standard describing specific requirements for an EMS. ISO 14001 is a specification standard to which an organization may receive certification or registration. ISO 14001 is considered the foundation document of the entire series.

Requirements of the Final Adopted International Standard in the ISO 14000 Family

ISO 14001
Environmental Management Systems - Specification with Guidance for Use

ISO 14004
Environmental Management Systems - General Guidelines on Principles, Systems and Supporting Techniques

ISO 14010
Guidelines for Environmental Auditing - General Principles on Environmental Auditing*

ISO 14011
Guidelines for Environmental Auditing - Audit Procedures - Auditing of Environmental Management Systems*

ISO 14012
Guidelines for Environmental Auditing - Qualification Criteria for Environmental Auditors*

ISO 14020
Goals and Principles of All Environmental Labeling

ISO 14021
Environmental Labels and Declarations - Self-Declaration Environmental Claims - Terms and Definitions

ISO 14024
Environmental Labels and Declarations - Type 1 - Guiding Principles and Procedures

ISO 14025
Type 3 Eco-Profile Labeling Technical Report

ISO 14031
Environmental Management - Environmental Performance Evaluation - Guidelines

ISO 14032
Environmental Management - Environmental Performance Evaluation- Case Studies Illustrating the Use of ISO 14031 Technical Report

ISO 14040
Environmental Management - Life Cycle Assessment - Principles and Framework

ISO 14041
Environmental Management - Life Cycle Assessment - Goal and Scope Definition and Inventory Analysis

ISO 14042
Environmental Management - Life Cycle Assessment - Impact Assessment

ISO 14043
Environmental Management - Life Cycle Assessment - Interpretation

ISO 14049
Environmental Management - Life Cycle Assessment - Examples of Application of ISO 14041 to Goal and Scope Definition and Inventory Analysis Technical Report

ISO 14050 Terms and Definitions - Guide on the Principles for Terminology Work
ISO 14061 Information to Assist Forestry Organizations in the Use of Environmental Management System Standards ISO 14001 and ISO 14004 Technical Report
* It should be noted that a new standard, ISO 19011, is in development and once adopted, will replace ISO 14010, ISO 14011, and ISO 14012. It is anticipated that ISO 19011 will be a final standard by 2001.

How to Purchase the Standard

Within the United States, the American National Standards Institute (ANSI), the American Society for Quality (ASQ), and NSF International make the final published ISO 14000 standards available to the public. All standards are under copyright; therefore you must purchase the standard from one of the organizations below.

- NSF
  ISO 14001 ($42), ISO 14004 ($52)*
- ASQ
  ISO 14001 ($38.50), ISO 14004 ($49.50), set of three including ISO 14001, ISO 14004 and ISO 14010 ($49.75), entire ISO 14000 series ($129)*
- ANSI
  ISO 14001 ($53), ISO 14004 ($85)*

*Prices quoted June 2000

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Environmental Management Systems

EMS Design Tools

Sample Gap Analysis	**Design and Implementation**	**Integrating Your QMS and EMS**
Sample Policy Statement	**Aspects and Impacts**	**Legal Requirements**
Internal and External Communication	**Internal Auditing, Management Review and Corrective Action**	**Sample EMS Manuals and Procedures**
Common Areas of Non-Conformance	**Simplify the EMS**	**Additional Resources**

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Environmental Management Systems

EMS Sector-Specific Information

- Agriculture
  - Pork Production
- Furniture and Wood Finishing
- Fleet Operations
- Metal Finishing
- Publicly Owned Treatment Works (POTWs)

Home | EMS FAQs | ISO 14001 Information | EMS Design Tools | Sector-Specific Information | EMS Case Studies | Workshop Presentations | Articles and Reports | N.C. Certified Facilities | N.C. Pilot Program | Links | Hot Topics

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Environmental Management Systems

EMS Workshop Presentations

This page lists EMS workshops or presentation sponsored by the N.C. Division of Pollution Prevention and Environmental Assistance (DPPEA) or its staff. Each workshop has unique presentations on specific EMS topics. There is a variety of information provided by companies, local governments, auditors, consultants and others involved in design and implementation of an EMS.

- Strategies for Governmental EMS (Environmental Management System) Workshop
  Gastonia, N.C., Jan. 31, 2001
  Topics Include: EMS/ISO 14001 design and implementation, the National Biosolids Partnership, and case studies from two local governments

- Environmental Management Systems and Enforcement
  Raleigh, Jan. 24-25, 2001

- Developing an Environmental Management System (EMS) Approach for Agriculture and Agribusiness
  Raleigh, Dec. 18, 2000
  Topics Include: EMS basics, EMS in agriculture and agribusiness, existing North Carolina management requirements for animal waste systems, and case studies from industry.

- Regulatory Innovation: EMSs as Environmental Regulatory Tools
  presented by Jason Morrison at Roundtable on EMS for Non-Governmental Organizations (NGOs), Raleigh, May 22, 2000

- ISO 14001 EMS: The Nuts and Bolts of Getting It Done
  Asheville, May 10, 2000; Greenville, May 23, 2000; Kernersville, May 25, 2000
  Topics Include: Benefits of an EMS, EMS design, integrating QS/ISO 9000 and ISO 14001, common areas of non-conformancies, continual improvement and cost and benefits of an EMS

- Environmental Management Systems: North Carolina’s Approach
  presented by Gary Hunt at Carolinas Environmental Conference, Charlotte, Sept. 10, 1999

- EMS Models and Strategies: ISO 14001 and Beyond
  Charlotte, Aug. 24, 1999

Topics Include: Benefits of an EMS, EMS design, continual improvement and experiences from industry

- Pilot Project Implementation Workshop
  Cary, May 14-15, 1998
  Topics Include: Information about the Multi-State Working Group and the Pilot Project and information from five different companies that participated in the Pilot Project
- ISO 14001 Environmental Management Systems Workshop for Non-Governmental Organizations and Academic Researchers
  Chapel Hill, May 13, 1998
  - Agenda
  - Speaker's Presentation: Beth Graves, N.C. DPPEA

Home | EMS FAQs | ISO 14001 Information | EMS Design Tools | Sector-Specific Information | EMS Case Studies | Workshop Presentations | Articles and Reports | N.C. Certified Facilities | N.C. Pilot Program | Links | Hot Topics

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Environmental Management Systems

EMS Articles and Reports

General Information
Public Policy and EMS
North Carolina EMS Pilot Program

General Information:

- The ISO 14000 Family of Standards: Environmental Management Systems
  August 1999 - 3 pages
- EMS Can Improve Economic and Environmental Performance
  December 1996 - 2 pages - FOCUS: Waste Minimization
- Environmental Non-Governmental Organizations and Environmental Management Systems: North Carolina Groups Share Their Views
  July 2000
- Implementing ISO 14001 Environmental Management Systems at the Municipal Level
  October 1998 - 3 pages
- Implementation Guide for the Code of Environmental Management Principles for Federal Agencies (CEMP)
  June 1998
- Final Report: The US EPA Environmental Management System Pilot Program for Local Government Entities
  January 2000 - 136 pages

Public Policy and EMS:

- Improving Environmental Performance and Compliance: 10 Elements of Effective Environmental Management Systems

This document represents the first joint statement from Canada, Mexico and the United States on how voluntary EMS designed for internal management purposes can also serve the broader public policy goals of compliance assurance and improved environmental performance in regulated and non-regulated areas. The guidance document focuses on only two public policy issues: compliance assurance and improved environmental performance in regulated and non-regulated areas. - 6/00 - 9 pages

- N.C. DENR Policy on EMS/ISO 14001
  August 1999 - 2 pages
- Second Generation of Environmental Improvement Act of 1999
  This proposed bill, HR 3448, is "an act to improve the management of environmental information and to encourage innovation in the pursuit of enhanced environmental quality, and for other purposes." - Nov. 18, 1999 - 32 pages
- Legal Issues With EMS Implementation & Registration
  What are the legal ramifications of a registered ISO 14001 EMS, vis-á-vis the U.S. Environmental Protection Agency (EPA) and its state counterparts? Will ISO 14001 offer protection, or offer evidence against a company's environmental dealings? By Jim Kolka
- Summary of State Innovation Laws and EMS
  Aug. 16, 1999 - 2 pages
- State Performance Track Programs
  Describes the characteristics of State Performance Track Programs
- Summary of ISO 14001 State Activity
  Provides an overview of state activities relating to EMS. - November 1998 - 14 pages
- EPA Performance Track
  The National Environmental Performance Track is a new program designed to motivate and reward top environmental performance by companies and facilities of all types - public and private.
- EPA Press Release: June 26, 2000
  "Cooperative Effort With Business Will Reward Higher Environmental Performance"
- "EPA Position Statement on Environmental Management Systems and ISO 14001 and a Request for Comments on the Nature of the Data To Be Collected from Environmental Management System/ISO 14001 Pilots"
  Federal Registrar Notice - March 12, 1998
- Six Companies Participate in Environmental Management Systems Pilot Project Program
  November 1998 - 8 pages - FOCUS: Waste Minimization

North Carolina EMS Pilot Program:

- Six Companies Participate in Environmental Management Systems Pilot Project Program
  The N.C. Department of Environment and Natural Resources (DENR), with the Division of Pollution Prevention and Environmental Assistance (DPPEA) as the lead agency, is closely evaluating the effectiveness of an EMS in improving environmental performance and compliance as well as pollution prevention. This evaluation is being performed through an internal DENR EMS working group that has partnered with six companies and one federal facility. 11/98 - 8 pages - FOCUS: Waste Minimization
- Multi-State Working Group on Environmental Management Systems Research Roundtable Process
  Describes the process used to identify a research strategy for the National Database on Environmental Management Systems.
- EPA and State Regulatory Framework for EMS Pilot Projects
  May 14, 1998 - 1 page

- Press Release
  Release of EMS Database and Analysis of Baseline Data from 50 Facilities - 6/5/00

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Environmental Management Systems

ISO 14001 Certified Facilities in North Carolina

The information presented was last updated on June 7, 2001 and is correct as to our knowledge. If you are aware of an organization that is certified to ISO 14001 in North Carolina that does not appear on this list or if you have any corrections to this list, please call Beth Graves, (919) 715-6506 or (800) 763-0136 or e-mail at Beth.Graves@ncmail.net

No.	Facility Name	Site Location	SIC Code	Single or Multiple Site Registration	Date Certified	Registrar
1	New Breed Leasing Corp.	Greensboro	4214	Single	10/10/97	INTERTEK
2	Lockheed Martin Electronics	Fayetteville	3761	Multiple - covered by Orlando, FL office registration	12/4/97	British Standards Institution (BSI)
3	Matsushita Compressor Corp.	Mooresville	3563	Single	12/17/97	ABS Quality Evaluations Inc.

4	ASMO North Carolina Inc.	Statesville	3621	Multiple - includes Mount Airy and Thomasville sites	1/22/98	Det Norske Veritas (DNV)
5	ASMO North Carolina Inc.	Mount Airy	3621	Multiple - includes Statesville and Thomasville sites	1/22/98	DNV
6	ASMO North Carolina Inc.	Thomasville	3621	Multiple - includes Mount Airy and Statesville sites	1/22/98	DNV
7	Allergan Lenoir	Lenoir	3827	Single	2/10/98	National Standards Authority of Ireland (NSAI)
8	IBM	Research Triangle Park	3571	Multiple - covered by global corporate registration	6/9/98	Bureau of Veritas Quality International Inc. (BVQI)
9	Konica Manufacturing USA Inc.	Whitsett	3861	Single	7/29/98	Quality Management Institute (QMI)
10	International Paper – Forest Resources Division, Eastern Region	North Carolina	0811	Multiple	9/1/98	BVQI
11	ABB Combustion Engineering	Kings Mountain	3567	Single	10/20/98	Advanced Waste Management Systems Inc.
12	ASMO Greenville of N.C. Inc.	Greenville	3621	Single	10/28/98	DNV

13	Chicago Rawhide Manufacturing	Franklin	3053	Multiple - covered by registration of parent company in Gothenburg, Sweden	11/1/98	Lloyd's Register Quality Assurance
14	Universal Manufacturing and Logistics (formerly Polygram)	Grover	3652	Single	1/19/99	BSI
15	Kyocera Industrial Ceramics Corp.	Mountain Home	3299	Single	2/12/99	BSI
16	Philips Communication Security & Imaging Inc.	Winston-Salem	3669	Single	4/26/99	NSAI
17	Purolator Products Inc.	Fayetteville	3714	Single	5/8/99	BVQI
18	NCI Inc.	Asheville	3462	Single	6/7/99	Performance Review Institute (PRI)
19	Uniroyal Chemical Co.	Gastonia	2821	Single	6/21/99	QMI
20	Eaton-Cutler Hammer - Asheville Plant	Arden	3613	Single	6/23/99	DNV
21	United Chemi-Con Inc.	Lansing	3675	Single	6/24/99	National Quality Assurance USA Inc. (NQA)
22	Crompton Manufacturing Company Inc.	Gastonia	2821		7/21/99	QMI
23	DJB Construction Group (Beers Construction Company)	Raleigh	1629	Multiple - covered by Atlanta, GA office registration	8/25/99	REMA Registered Quality Inc.

24	Beers Construction Company	Charlotte, Winston-Salem and Raleigh	1629	Multiple - covered by Atlanta, GA office registration	8/25/99	REMA Registered Quality Inc.
25	Eaton Corp. Actuator and Sensor Division	Sanford	3822	Single	9/30/99	NSF-ISR
26	Firestone Fibers and Textiles Co.	Kings Mountain	2296	Single	10/1/99	Lloyd's Register Quality Assurance
27	Bridgestone/Firestone Inc.	Wilson	3011	Single	10/22/99	Lloyd's Register Quality Assurance
28	Hurst Jaws of Life (a unit of IDEX Corporation)	Shelby	3546	Single	11/5/99	Underwriters Laboratories Inc. (UL)
29	Nortel Networks Carrier Solutions	Research Triangle Park	3661	Single	11/19/99	QMI
30	Eaton Corporation Clutch Division	Harrisburg	3714	Single	12/1/99	DNV
31	Nortel Networks: Real Estate - Raleigh	Morrisville	6512	Single	12/3/99	QMI
32	ABB Automation Inc.	Raleigh	3825	Single	1/28/00	UL
33	Mayville Metal Products	Creedmoor	3499	Multiple - with Wisconsin and Arizona facilities	3/1/00	UL
34	Carolmet Cobalt Products	Maxton	2819	Single	3/16/00	BVQI
35	Cutler-Hammer Power and Control Systems	Fayetteville	3625	Single	3/23/00	DNV
36	SCI Systems Inc.	Graham	3672	Single	4/28/00	NSAI

37	Novozymes North America Inc.	Franklinton	2869	Single	5/15/00	UL
38	C-Mac Network Systems Inc.	Creedmoor	3661	Single	6/8/00	QMI
39	Eaton Corporation	Roxboro	3714	Single	6/9/00	DNV
40	Eaton Corporation	Kings Mountain	3714	Single	7/3/00	Perry Johnson Registrars Inc.
41	BASF Automotive OEM and Industrial Coatings	Morganton	2851	Single	9/20/00	ABS
42	Intek Inc.	Aberdeen	2221	Single	10/3/00	UL
43	GKN Automotive Inc., Alamance Facility	Mebane	3714	Single	1/10/01	UL
44	Square D - Schneider Electric	Asheville	3699	Single	1/17/01	UL
45	NACCO Materials Handling Group Inc.	Greenville	3537	Single	1/19/01	UL
46	Saturn Electronics and Engineering	Rocky Mount	3679	Single	1/23/01	Entella Inc.
47	Dana Corporation, Spicer Heavy Axle and Break Division	Morganton	3714	Single	2/21/01	UL
48	Square D Company	Knightdale	3625	Single	2/28/01	UL
49	Carroll’s Foods	Warsaw	2048	Multiple - N.C. company-owned farms covered by division registration	3/21/01	SGS International Certification Services Inc. (SGS ICS)

50	Nortel Networks Central Distribution Center	Cary	3661	Single	4/19/01	QMI
51	Nortel Networks Plaza Distribution Center	Morrisville	3661	Single	4/19/01	QMI
52	Hyster Company	Greenville			4/25/01	UL
53	Yale Materials Handling Cooperation	Greenville			4/25/01	UL
54	The Wesbell Group of Companies Inc.	Durham	5093	Single	5/18/01	QMI

Note: The N.C. Department of Environment and Natural Resources supplies this list of ISO 14001-certified companies as a public service. Inclusion on this list does not represent endorsement by the department.

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Environmental Management Systems

North Carolina EMS Pilot Program

General Information on the Pilot Program

The N.C. Department of Environment and Natural Resources (DENR), with the Division of Pollution Prevention and Environmental Assistance (DPPEA) as the lead agency, is closely evaluating the effectiveness of an EMS in improving environmental performance and compliance as well as pollution prevention.

In addition, DENR's interest in the pilot program is to:

- Determine if EMS implementation results in improved environmental performance
- Participate in public policy discussion
- Encourage pollution prevention
- Investigate leveraging of DENR resources
- Encourage "beyond compliance."
- Develop partnerships between environmental groups, industry, trade associations and academia.

Through this pilot program, DENR hopes to better understand the implementation of an EMS, particularly the ISO 14001 model. DENR's pilot program is being supported by a grant from the U.S. Environmental Protection Agency's Office of Water. Each pilot participant has agreed to provide data on its environmental performance, compliance, pollution prevention, environmental conditions, costs/benefits of EMS implementation, and stakeholders involvement/confidence. These are key areas identified by MSWG for data collection. Baseline data are being collected from North Carolina pilots as well as about 80 other organizations nationwide. Data are being compiled into a national database, maintained by the University of North Carolina at Chapel Hill.

Companies Participating in the EMS Pilot Program

- Konica Manufacturing USA: Whitsett, N.C.
- Novozymes North America Inc. (formerly Novo Nordisk BioChem North America): Franklinton, N.C.
- Duke Power - Buck Steam Station: Salisbury, N.C.
- Marine Corps Base Camp Lejeune: Jacksonville, N.C.
- City of Gastonia - Wastewater Treatment Plant: Gastonia, N.C.
- City of Burlington - Wastewater Treatment Plant: Burlington, N.C.

Articles and Press Releases

- Six Companies Participate in Environmental Management Systems Pilot Project Program
  The N.C. Department of Environment and Natural Resources (DENR), with the Division of Pollution Prevention and Environmental Assistance (DPPEA) as the lead agency, is closely evaluating the effectiveness of an EMS in improving environmental performance and compliance as well as pollution prevention. This evaluation is being performed through an internal DENR EMS working group that has partnered with six companies and one federal facility. 11/98 - eight pages - *FOCUS: Waste Minimization*
- Multi-State Working Group on Environmental Management Systems Research Roundtable Process
  Describes the process used to identify a research strategy for the National Database on Environmental Management Systems.
- EPA and State Regulatory Framework for EMS Pilot Projects
  May 14, 1998 - one page
- Press Release
  Release of EMS Database and Analysis of Baseline Data from 50 Facilities - 6/5/00
- Other EMS Articles not specific to the Pilot Program

Data Collection Information

- Project Summary 2
  The Effects of Environmental Management Systems on the Environmental and Economic Performance of Facilities - 6/5/00 - 81 pages
- Project Summary 1 - National Database on Environmental Management Systems
  The Effects of ISO 14001 Environmental Management Systems on the Environmental and Economic Performance of Organizations
- Data Categories
  Describes the six primary dimensions focused on by data collection protocols and research
- Data Collection Protocols
  Describes the three protocols used to collect and compare data from different facilities
- Glossary for Data Collection
  Provides definitions of terms used in the protocols and data collection

- Voluntary Project Evaluation Guidance
  Identifies the six key research areas for data collection for the EPA and state research efforts
- Environmental Law Institute
  Information about the National Database on Environmental Management Systems (NDEMS).
- Research questions to be addressed through data collected in EMS/ISO 14001 Pilot Projects

Interested in Participating in the National Pilot Program?

Please provide your opinion of this site

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Site question or comment? Send e-mail to: Webmaster@p2pays.org

Environmental Management Systems

EMS Links

General EMS and ISO Information
State EMS Web Sites
EMS and Government
EMS and Agriculture
Corporate Environmental Reports

General EMS and ISO Information

- ISO Support Group
  The ISO Support Group, a chapter of the American Society for Quality (ASQ) Raleigh Section 1113, sponsors programs in the ISO 9000 and ISO 14000 realm. Meetings are in Research Triangle Park between September and May each year. Attendees are typically from nearby companies with similar programs.
- Multi-State Working Group on Environmental Management Systems (MSWG)
  The mission of this voluntary group of states, EPA, non-governmental agencies, and industries is to understand the use of EMS in public policy and its ability to improve the environment.
- EMS-Plus Environmental Management System Evaluation Tool
  Developed by Research Triangle Institute in Research Triangle Park, N.C. to assist facilities in evaluating an EMS based on whether it incorporates components known to promote environmental improvement.
- U.S. EPA Office of Water - ISO 14001 Information
  The Office of Water has funded a number of projects, including an EMS pilot projects with 10 states, an EMS pilot project with municipalities nationwide, and is beginning new projects that focus on EMSs with the biosolids industry and a study of the EMS registration process in the United States.
- ISO 14001 Pilot Projects

Official Web site providing information on the ISO 14001 national pilot projects. The site provides a copy of database protocols used by facilities, links to various state EMS sites, public reports on the pilot project, etc.

- ISO – International Organization of Standardization
  Home page of the international standards body responsible for the development and publication of the ISO 14000 family and other standards.
- American National Standards Institute (ANSI)
  ANSI serves as an administrator and coordinator of the United States voluntary standardization system.
- U.S. Standards Group on Quality, Environment, Dependability and Statistics (QEDS)
  The U.S. Standards Group on Quality, Environment, Dependability and Statistics (QEDS) is concerned with the development and effective use of generic and sector-specific standards for quality management, environmental management, dependability and the application of statistical methods.
- Registration Accreditation Board (RAB)
  Web site that provides accreditation services in the United States on the ISO 14001 standard. Maintains a current list of accredited registrars and accredited course providers to ISO 14001.
- ISO World
  Provides a current total of ISO 14001 registrations by country.
- ISO 14001 list serve
  Designed for the discussion of ISO 14000 and EMS design and implementation. Members of the list serve include organizations certified to ISO 14001, registrars, consultants, academics and other interested parties. To subscribe, send a message to the following address: To subscribe to the ISO14001 list, address an e-mail message ONLY to our automated server: majordomo@quality.org with the following text ONLY in the BODY of the message: subscribe iso14000
- IESU Online
  International Environmental Systems Update is a newsletter that follows issues related to ISO 1400 and EMS in general. The site includes current and past issues of the newsletter. (Requires a subscription)
- CEEM's ISO 14000 Frequently Asked Questions
  Provides answers to frequently asked questions about ISO 14000.
- Globenet
  Site provides EMS Design Tools, News, training resources, and other ISO/EMS information.
- ISO 14000 Infocenter
  Provides lists of Accredited Registrars for ISO 14000, companies registered/certified to ISO 14000, discussion and implementation support groups, and available EMS/ISO 14000 resource books and newsletters.

State EMS/ISO 14001 Sites

- California
  Environmental Protection Agency Web site that provides information on Environmental Management Systems.
- Illinois
  Environmental Protection Agency Regulatory Innovation Pilot Program. Describes voluntary EMS Agreements between the state and Illinois businesses.
- Indiana
  Office of Pollution Prevention and Technical Assistance ISO 14000 site.
- Kentucky
  Pollution Prevention Center Web site with information on the Kentucky EMS Alliance and other EMS

information.

- Minnesota
  Pollution Control Agency site that provides a summary report of federal and state environmental innovations legislation.
- Oregon
  Department of Environmental Quality Web site with information on its green permits and the EMS Incentives Project.
- Pennsylvania
  Web site on ISO 14001/EMS and Pennsylvania.
- Virginia
  Virginia Environmental Excellence Program and EMS efforts Web site.
- Wisconsin
  ISO 14000 and Environmental Cooperation Pilot Program Web site.

EMS and Government

- Sector-Specific EMS Information - Publicly Owned Treatment Works (POTWs)
  Provides information about EMS and POTWs including design tools, articles, reports, case studies, workshop presentations, and related links.
- Charleston Commissioners of Public Works
  Environmental Management System Policy. Policy statement and implementation information regarding the EMS for the city of Charleston, S.C.
- City of Scottsdale Environmental Management System
  Site provides detailed information about the EMS implemented for the city of Scottsdale, Ariz. The site follows the ISO 14001 standard and provides documents for each of the standard's 17 components.
- EPA's Environmental Management System site
  This Web page contains links to key information about EPA's efforts to develop policies and related materials about Environmental Management Systems (EMS).
- GETF's Municipal Environmental Management System Project
  GETF (Global Environment and Technology Foundation) completed a pilot project in partnership with the EPA to implement an EMS in nine local government entities. This site provides information about the pilot project and information about local governments and EMS.
- Implementation Guide for the Code of Environmental Management Principles for Federal Agencies (CEMP)
  Site provides information about the Code of Environmental Management Principles, which is a collection of five principles and performance objectives that provide a basis for federal agencies to move towards responsible environmental management. The site also provides information about EMS.
- National Biosolids Partnership
  The goal of the National Biosolids Partnership (NBP), a not-for-profit alliance formed in 1997 with the Association of Metropolitan Sewerage Agencies (AMSA), Water Environment Federation (WEF), and U.S. Environmental Protection Agency (EPA), is to advance environmentally sound and accepted biosolids management practices. Biosolids producers, service contractors and users — together with stakeholders from regulatory agencies, universities, the farming community, and environmental organizations — will have input into shaping NBP priorities through scientific and technical support and communications linkages relating to biosolids issues.
- LGEAN Toolbox for Local Governments
  The Local Government Environmental Assistance Network (LGEAN) provides environmental management,

planning and regulatory information for local government elected and appointed officials, managers and staff. LGEAN provides this toolbox as a resource to assist local government officials in their efforts to protect the environment and public health. The tools are designed to help users perform operations and calculations necessary to fulfill environmental reporting requirements or guide the development of a helpful environmental program.

EMS and Agriculture

- Sector-Specific EMS Information - Pork Production
  Provides information about EMS and Pork Production including workshop presentations, news, and related links.
- America's Clean Water Foundation's projects page
  Provides a list of agricultural projects at America's Clean Water Foundation, including the National Environmental Dialogue on Pork Production and an On-Farm Assessment and Environmental Review Project. The on-farm assessment techniques are based in part on an On-Farm Odor/Environmental Assistance Program developed by the National Pork Producers Council through the use of "Checkoff" funds. This program is free to pork producers.
- Sustainable Industry Project for the Meat and Poultry Processing Sector
  This project provides an alternative approach to developing environmental policies that impact meat processing. The project has established a cooperative effort to identify factors that drive or are barriers to environmental performance in the meat and poultry processing sector. A basic EMS model for meat processors is to be developed.
- United Egg Producers Project XL Agreement
  The EPA has a national pilot program called Project XL (eXcellence and Leadership) that allows state and local governments, businesses and federal facilities to develop with EPA innovative strategies or more cost-effective ways to achieve environmental and public health protection in exchange for regulatory, program, policy or procedural flexibilities. The EPA has recently signed a Project XL agreement with the United Egg Producers to help participating facilities achieve "superior environmental performance" by implementing an environmental management system (EMS) through a general permit issued by individual states or EPA.
- Farm*A*Syst
  With offices in every state, Farm*A*Syst is a partnership between government agencies and private business that enables farmers to prevent pollution on farms, ranches and in homes using confidential environmental assessments. Farm*A*Syst has also received funding from the Initiative for Future Agriculture and Food Systems (IFAFS) for a four-year project called Partnerships for Livestock Environmental Management Assessment Systems in which it will develop EMS tools for the poultry, dairy and beef industries.
- Adding Value Through Environmental Marketing Conference - ISO 14001 and Agriculture contributed papers
  A listing of papers and articles on EMS/ISO 14001 and agriculture given at a 1999 workshop sponsored by the Institute for Agriculture and Trade Policy. The site contains 10 papers on the topic, including "Environmental Management Systems and ISO 14000 in Australia – On and Off-farm Implementation and Policy Development," "Environmental Management Systems (ISO 14001): A Promising Tool for Farms?," and "Environmental Management Systems in Agriculture."
- N.C. Department of Agriculture and Consumer Services Agronomic Division
  The Agronomic Division provides science-based, land management information to all those who need it—from large-scale farmers to homeowners and weekend gardeners.
- N.C. State University Cooperative Extension Service
  Cooperative Extension works to assist clients in environmentally managing water, waste, nutrients, pesticides and petroleum products by providing research-based information, technical assistance and engineering support.

Corporate Environmental Reports

- Links to corporate environmental reports
  Site provides links to corporate environmental reports for many companies.
- The following are environmental reports from companies with facilities in North Carolina:
  - The Novo Group Environmental and Social Report 2000
  - Environmental Preservation Activities of Matsushita Electric Group
  - IBM'S Environment and Well-Being Report
  - International Paper's Environment, Health, and Safety Annual Report

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Environmental Management Systems

EMS Hot Topics

Upcoming Workshops
Recent News

Press Releases

DPPEA Calendar

Upcoming Workshops and Training Opportunities

Monday - Wednesday, June 4-6, 2001
Learning Together 2001 and Covenanting the Future - Philadelphia, PA
Two consecutive and overlapping events on regulatory innovation, environmental management systems (EMSs), covenants, environmental contracts, natural resources management and sustainability are set for June 4-6, 2001, at the University of Pennsylvania Law School in Philadelphia. Registration for one or both is possible. The first event, June 4-5, is **"Learning Together,"** the premier EMS workshop for industry, government and NGOs that taps the people who have "been there" to share experiences about using EMSs to add value to their organizations and communities. The second event, June 5-6, is **"Covenanting the Future,"** a conference to explore cooperative approaches to environmental regulation and resource management that reconcile separated pollution and conservation laws with science-based ecosystem, watershed and adaptive management principles. Register online through the MSWG web site www.mswg.org. Contact Dawn Jenkins, University of Florida TREEO Center, at (352) 392-9570 ext. 127, or e-mail djenkin@treeo.doce.ufl.edu for general information. Location: Philadelphia, Pa., $235 per person.

Wednesday - Thursday, June 20-21, 2001
Environmental Management Systems Workshop - Mobile, AL

The 1½ day EMS course, designed for industry, business and federal and tribal facilities, defines an Environmental Management System (EMS), provides information on ISO 14001, and includes hands-on exercises to teach about elements of an EMS.

The course includes student handouts. Learning is reinforced through group discussions and exercises, and will include discussion of EMS case studies. Instructors will provide support documents to workshop participants in electronic format for review prior to attending. For more information, please contact Tony Shelton, U.S. EPA, (404) 562-9636.

EMS Development Course for Government and Small Businesses

Beginning Summer 2001
The Division of Pollution Prevention and Environmental Assistance (DPPEA) is offering a free course for local, state and federal government agencies and small businesses to design and implement an EMS, using the ISO 14001 model. DPPEA staff will coordinate training sessions and lead instruction. In addition, guest speakers from government and industry who have implemented an EMS for their operations will be invited to speak. Participants will meet every four to six weeks. No direct financial assistance to participants will be provided. This class is modeled on EPA's program to assist local governments with EMS implementation.

The N.C. Department of Environment and Natural Resources (DENR) supports implementation of EMS by organizations, both private and public, and feels there are benefits to the environment as well as to the organization. DPPEA is the lead agency within DENR working on EMS.

To express interest in becoming a participant in the EMS Development Course, organizations should contact DPPEA or return registration form by **April 30, 2001**. To learn more about EMS and ISO 14001, there will be a free three-hour overview given on **Tuesday, April 10 from 9 a.m. to noon** in the Parker-Lincoln Building, 2728 Capital Blvd., Raleigh, N.C. For more information on this project or the overview class, please contact Julie Woosley, DPPEA, (919) 715-6527 or (800) 763-0136, e-mail Julie.Woosley@ncmail.net.

Recent News

Smithfield and Premium Standard Agreements

North Carolina's largest hog producers have both signed agreements with the Attorney General's office to reduce waste and implement an EMS on company owned hog farms:

- October 2, 2000 - Premium Standard
  Press Release
- July 25, 2000 - Smithfield Foods Inc.
  Press Release
  Full Agreement

United Egg Producers and Project XL -- October 25, 2000
The U.S. EPA signed a Project XL agreement with the United Egg Producers. Through this XL project, the United Egg Producers (UEP), a farmer cooperative that represents egg producers nationwide, has entered into an agreement with EPA to provide a comprehensive program to help participating egg-producing facilities achieve superior environmental performance by implementing an environmental management system (EMS) and complying with the terms of a general permit issued by individual states or EPA. This more comprehensive approach will require participating facilities to comply not only with the terms of a National Pollutant Discharge Elimination System (NPDES) general permit, but also to implement a multi-media EMS that controls a range of significant environmental impacts, including

those not subject to regulation under the Clean Water Act (CWA). The project also includes a third-party auditing component and on-farm management practices most likely to result in superior environmental performance.

Project XL allows state and local governments, businesses and federal facilities to develop with EPA innovative strategies or more cost-effective ways to achieve environmental and public health protection. In exchange, EPA will issue regulatory, program, policy or procedural flexibilities to conduct the experiment.

- Information on the project
- Summary of the project
- Final Project Agreement between the EPA and United Egg Producers

September 1999
Several automotive companies now require their suppliers to be ISO 14001 certified by specific dates:

- Ford Motor Company Press Release
- General Motors Press Release

Press Releases

- Pollution Prevention Agency Receives Funding to Assist Pork Producers in Managing Environmental Activities May 14, 2001
- Release of EMS Database and Analysis of Baseline Data from 50 Facilities
  June 5, 2000
- State Adopts New Policy, Recognizes Companies for Partnership in Environmental Protection Program
  August 23, 1999
- State Partners with Burlington and Gastonia to Reduce Pollution
  March 30, 1999
- National Group Honors North Carolina Agency for Environmental Efforts (ISO 14000)
  September 28, 1998
- North Carolina, Other States to Work on Pollution Prevention Approaches (ISO 14000)
  June 3, 1998
- State Joins in Test of Environmental Management Systems (ISO 14000)
  February 2, 1998

Please provide your opinion of this site

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Environmental Management Systems

Sample Gap Analysis

- ISO 14001 Environmental Management System Self-Assessment Checklist
  This checklist is based on the ISO 14001 standard and allows for a rapid self-assessment of an organization or facility to determine how closely existing management practices and procedures correspond to the elements of the standard. In addition to a brief guide to self-scoring, a fuller description of what is required by the standard's criteria is included in the appendix. 1996. 54 pages.
  Order Form $25 each - Item No. ISO-111

- Environmental Process Self Survey
  Conducting business in an environmentally proactive manner can create many benefits for the company and its stakeholders. Among these benefits are competitive advantages such as cost savings and improved efficiency, but other fringes like favorable public perception may also be enjoyed. This survey incorporates the tenets of ISO 9000 and ISO 14000. TVA encourages you to take the time to complete this survey in order to better judge how your company ranks in environmental competitiveness.

- Mini Gap Analysis
  This mini-gap-analysis presents 16 statements based on the ISO 14001 standard. By indicating your company's degree of compliance with each statement, an overall score, comment about status and next steps are provided. This is a high-level analysis which should not replace a detailed one.

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Environmental Management Systems

Design and Implementation

Workshop Presentations:

- Bridgestone/Firestone by Dennis Hargens
- Uniroyal Chemical Company by Ron Lak
- Philips Communication Security and Imaging Inc. by Joe Fleming
- EMS Design and Performance Beyond Compliance of BMW by Gary Weinreich
- ISO 14001 Structure and Implementation by Uniroyal Chemical Company Inc. by Ron Lak
- Sustainable Community EMS Design Including Pollution Prevention by Michelle M. Wyman, Reed Smith Shaw & McClay LLP
- Environmental Management System Development and Implementation by Don E. Carmichael, City of Gastonia Wastewater Treatment Division
- EMS in Agriculture and Agribusiness by John Thorne, Capitolink LLC

Guidance Documents:

- Integrated Environmental Management Systems: Implementation Guide
  This guide has been designed to help companies integrate environmental concerns into business decision making using the Design for the Environment Program’s Integrated Environmental Management System (IEMS). This guide follows the guidelines of ISO 14001, an international standard for EMS, and it is designed to help businesses set up and implement a simple, straightforward EMS. This guide does not intend to give guidance for ISO 14001 certification. EPA Office of Pollution Prevention and Toxics, Design for the Environment Program, October 2000 - 301 pages.
- Ford Motor Company
  This workbook was developed to aid Ford Motor Company suppliers in implementing ISO 14001. It includes a PowerPoint presentation, procedure documents, work practices and other components of an EMS manual. December 1999 - 161 pages
- Environmental Management Systems: A Guide for Metal Finishers
  This project involved 11 metal finishing companies in a pilot project with the following objectives: 1) to

demonstrate Environmental Management Systems (EMS) implementation in the metal finishing industry, and 2) to better define the resulting costs and benefits. The ISO 14001 (1996) Environmental Management System Standard was used as the basis for defining an environmental management system. December 1998 - 103 pages

- Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations
  This guide is intended to support and facilitate the development of environmental management systems (EMS) among small and medium-sized organizations. The guide explains how you can develop and implement an effective EMS and how it can support your organization's mission and goals. Development of an EMS is a voluntary approach to improving your organization's environmental performance. December 1996 - 166 pages
- A Design for the Environment Approach
  The design for the environment program can help your company or small business build an environmental management system (EMS). The DfE Program has developed a comprehensive how-to manual (March 1999) to help small businesses develop an effective EMS based on a DfE approach. March 1999 - 204 pages
  - DfE Policy Commitments
    Guidance for including DfE commitments in your environmental policy. April 1999 - three pages
  - DfE and Gap Analysis
    A series of questions to help you incorporate DfE into your gap analysis.April 1999 - five pages
- Environmental Management Systems Primer for Federal Facilities
  This guide will be of particular interest to environmental managers responsible for implementing environmental management systems at federal facilities. 1998 - 71 pages
- Implementing an EMS in Community-Based Organizations — Part 1: Project Report
  This report is intended to assist other community-based organizations with EMS development. Implementation advice and guidance is provided in Chapter 1 "Early Warning Signs," Chapter 2 under "What Helps/Hinders Implementation?," "Overcoming Implementation Challenges" in the real world examples in Chapter 3, and in the highlighted text boxes throughout the text. December 1998 - 137 pages

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Environmental Management Systems

Integrating Your QMS and EMS

The following are workshop presentations available in PowerPoint and HTML:

- Novo Nordisk Biochem North America by Jennifer Pierce
- Konica Manufacturing USA by Chris Kappert

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Workshop Presentations | Articles and Reports | N.C. Certified Facilities | N.C. Pilot Program | Links | Hot Topics

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Environmental Management Systems

Sample Policy Statements

Some of these sample policy statements meet the three major requirements as specified in ISO 14001 for commitment to comply with all regulations, support pollution prevention and strive for continual improvement. The others are generic environmental policy statements.

- North Carolina Companies:
  - Beers Construction/Skanska (ISO 14001)
  - Bridgestone/Firestone (ISO 14001)
  - IBM (ISO 14001)
  - International Paper (ISO 14001)
  - Nortel (ISO 14001)
  - Purolator (ISO 14001)
  - Duke Energy
  - Phillips Communication, Security, & Imaging
  - ABB
- Companies outside of North Carolina:
  - Digital Equipment Corporation (ISO 14001)
  - Hewlett -Packard (ISO 14001)
  - Subaru (ISO 14001)
  - Baxter International
  - SGS-Thomson Microelectronics Inc.
  - Xerox
- Environmental Policies of ISO 14000 Certified Companies
  Link to a list of environmental policies for companies that are ISO 14000 certified - Singapore Productivity and Standards Board - March 1999

- Municipalities
  - City of Gastonia Wastewater Treatment Division
  - Charleston Commissioners of Public Works

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Environmental Management Systems

Aspects and Impacts

Bique Pens. This imaginary business was developed by N.C. Division of Pollution Prevention and Environmental Assistance staff as a learning tool. Bique Pens manufactures brass ink cartridges for ballpoint pens and employs 15 workers. They are in compliance with all environmental regulations and seek ISO 14001 certification in order to remain in international markets.

- Sample Flow Chart of Manufacturing Process
- Ranking of Environmental Aspects and Impacts

The following are workshop presentations available in PowerPoint and HTML:

- Flow-Charting Your Process to Identify Your Environmental Aspects and Impacts presented by DPPEA staff
- Environmental Aspects and Impacts of Novo Nordisk by Wendy Laing
- Dames & Moore Ranking of Environmental Health and Safety Aspects and Impacts by Jim Messelbeck

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Environmental Management Systems

Legal Requirements

- N.C. Department of Environment and Natural Resources’ Customer Service Center
  The DENR Customer Service Center has information on its Web site about federal and state laws and regulations for all media programs from air and water quality to dam safety, erosion and sedimentation control and hazardous and solid wastes. The Customer Service Center serves as a central clearinghouse of information for DENR and also has links to information on permit fees and division fact sheets. Contact CSC toll free at 1-877-623-6748.

- Environmental Regulations Checklist
  The National Environmental Achievement Track Application includes a list of environmental regulations to help facilities identify the major federal, state, local and tribal environmental requirements that are applicable to them. The National Environmental Achievement Track is a component of EPA’s National Environmental Performance Track.

The following are workshop presentations available in PowerPoint and HTML:

- Knowing Your Legal Requirements workshop presentation by Beth Graves, N.C. Division of Pollution Prevention and Environmental Assistance
- Duke Power EMS and Legal Requirements by Mark Hollis
- Regulatory Innovation: EMSs as Environmental Regulatory Tools presented by Jason Morrison at Roundtable on EMS for Non-Governmental Organizations (NGOs), Raleigh, May 22, 2000
- Existing North Carolina Management Requirements for Animal Waste Systems by Carroll Pierce, N.C. Division of Soil and Water Conservation

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Environmental Management Systems

Internal and External Communication

The following is a workshop presentation available in PowerPoint and HTML:

- Peter Wise, Kestrel Management Services LLC and Jason Morrison, Pacific Institute

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Environmental Management Systems

Internal Auditing, Management Review and Corrective Action

The following are workshop presentations available in PowerPoint and HTML:

- ASMO Greenville Inc. by Jim Laney
  This presentation shows corrective action taken by ASMO Greenville in its emergency preparedness and procedure following Hurricane Floyd.
- ASMO North Carolina Inc. by Danny Yount
  Environmental performance and the process of findings and corrective action in post-certification surveillance audits are explained in this presentation.
- Eaton Cutler-Hammer by Scott Plemmons
  This presentation covers general internal auditing and reporting to management topics.
- United States Marine Corp EMS: An Auditing Perspective by Capt. David Cook

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Environmental Management Systems

Sample EMS Manuals and Procedures

Sample EMS Manuals:

- Uniroyal Chemical Company
  Gastonia, N.C., May 2000
- Alcoa-Mt. Holly
  May 1999
- City of Gastonia Wastewater Treatment Division

Sample Procedures:

- The Ford Motor Company Workbook
  provides excellent procedure documents and explanations for their use.
- Pfizer, Inc.
  - Documentation of Compliance with Regulations
  - Administration of Environmental Programs
  - Operation and Control of the Environmental
  - Management System
  - Aspect and Impact Determinations
  - Identifying Legal and Other Requirements
  - Developing Objectives and Targets
  - Developing Environmental Management Programs
  - Environmental Training, Awareness and Competence
  - Internal and External Communications
  - Addressing Operational Control
  - Emergency Preparedness and Response

- Monitoring and Measurement
- Corrective and Preventive Action
- Auditing Management Systems
- Management Review

- City of Gastonia Wastewater Treatment Division
  - EMS Review
  - Document Control
  - Aspect and Impact Analysis
  - Corrective Preventive Action
  - Employee Training
  - Roles and Responsibilities
  - Objectives and Targets
  - External Communication
  - Environmental Management System Audit
  - Monitoring and Measuring
  - Legal and Other Requirements

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Environmental Management Systems

Common Areas of Non-Conformance

The following are workshop presentations available in PowerPoint and HTML:

- BVQI by Karen Czor
- NSF International by Rick Gehrke
- Underwriters Laboratories Inc. by Steve Freeman

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Environmental Management Systems

Simplify the EMS

The following are workshop presentations available in PowerPoint and HTML:

- Simplify/Visualize Your EMS
  This is a presentation by Suzanne Sessoms, an auditor from Excel Inc. The presentation includes a participation portion using the following two excel spreadsheets:
  - Spreadsheet 1
  - Spreadsheet 2
- EMS — Keep it Simple!
  Susan Graff, Environmental Resources Services Inc.

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Environmental Management Systems

Additional Resources

- Sector-Specific EMS Information
  Provides information about EMS in different industry sectors, such as Furniture and Wood Finishing, Fleet Operations, Metal Finishing, Pork Production, and Publicly Owned Treatment Works (POTWs).
- EMS-Plus
  Environmental Management Systems Evaluation Tool helps users evaluate an EMS based on whether it incorporates components known to promote environmental improvement. EMS-Plus leads the users through a series of questions about his or her EMS, and then provides a report based on the key EMS components, such as whether the EMS is oriented towards regulatory compliance and control technologies, and whether it is more comprehensive and pollution prevention -oriented.
- Information by Industry Sector
  This is the online collection of pollution prevention core references for selected industry sectors. The core references collection includes technical references, fact sheets and case studies on pollution prevention for these industry sectors. These documents are deemed to be the “best” by the entities that compiled them.
- Vendor Database
  This database lists consultants for ISO 14001 implementation and vendors for pollution prevention equipment. It is fully searchable and contains useful resources.
- Workshop Presentations
  Presentations from N.C. Division of Pollution Prevention and Environmental Assistance workshops on other EMS topics
- Articles and Reports
  Articles and reports on several EMS Topics

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Environmental Management Systems

EMS Sector-Specific Information - Agriculture

Workshop
Sub Sectors
Links

Workshop - Developing an Environmental Management System for Agriculture and Agribusiness, December 18, 2000

Speaker Presentations:

- EMS Basics
  Beth Graves, Division of Pollution Prevention and Environmental Assistance
- EMS in Agriculture and Agribusiness
  John Thorne, Capitolink LLC
- Existing North Carolina Management Requirements for Animal Waste Systems
  Carroll Pierce, N.C. Division of Soil and Water Conservation
- Covered Anaerobic Digester: Case Study from Barham Farm
  Julian Barham, Barham Farms Inc.

Sub Sectors

- Pork Production

- Meat Processing - coming soon

Links

- Adding Value Through Environmental Marketing Conference - ISO 14001 and Agriculture contributed papers
  A listing of papers and articles on EMS/ISO 14001 and agriculture given at a 1999 workshop sponsored by the Institute for Agriculture and Trade Policy. The site contains 10 papers on the topic, including “Environmental Management Systems and ISO 14000 in Australia – On- and Off-farm Implementation and Policy Development,” “Environmental Management Systems (ISO 14001): A Promising Tool for Farms?” and “Environmental Management Systems in Agriculture.”
- Environmental Management Systems and Agriculture and Agribusiness Related Initiatives

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Environmental Management Systems

EMS Sector-Specific Information - Agriculture: Pork Production

News
Workshop
Links

News

Pollution Prevention Agency Receives Funding to Assist Pork Producers in Managing Environmental Activities, May 14, 2001 PDF HTML

North Carolina's largest hog producers have both signed agreements with the Attorney General's office to reduce waste and implement an EMS on all of their hog farms:

- Smithfield Foods Inc., July 25, 2000
  Press Release
  Full Agreement
- Premium Standard, October 2, 2000
  Press Release

Workshop

Developing an Environmental Management System (EMS) Approach for Agriculture and Agribusiness
Raleigh, Dec. 18, 2000

Links

- America's Clean Water Foundation's projects page
  Provides a list of agricultural projects at America's Clean Water Foundation, including the National Environmental Dialogue on Pork Production and an On-Farm Assessment and Environmental Review Project. The on-farm assessment techniques are based in part on an On-Farm Odor/Environmental Assistance Program developed by the National Pork Producers Council through the use of "Checkoff" funds. This program is free to pork producers.
- N.C. Department of Agriculture and Consumer Services Agronomic Division
  The Agronomic Division provides science-based, land management information to all those who need it—from large-scale farmers to homeowners and weekend gardeners.
- N.C. State University Cooperative Extension Service
  Cooperative Extension works to assist clients in environmentally managing water, waste, nutrients, pesticides and petroleum products by providing research-based information, technical assistance and engineering support.

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EMS Sector-Specific Information - Furniture and Wood Finishing

EMS information coming soon; see our Core Sector Page

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Environmental Management Systems

EMS Sector-Specific Information - Fleet Operations

EMS information coming soon; see our Core Sector Page

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Environmental Management Systems

EMS Sector-Specific Information - Metal Finishing

- Environmental Management Systems: A Guide for Metal Finishers
  This project involved 11 metal finishing companies in a pilot project to 1) demonstrate environmental management systems (EMS) implementation in the metal finishing industry, and 2) to better define the resulting costs and benefits. The ISO 14001 (1996) Environmental Management System Standard was used as the basis for defining an environmental management system. December 1998 - 103 pages
- North Carolina’s Strategic Goals Program for Metal Finishers
- see our Core Sector Page

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EMS Sector-Specific Information - Publicly Owned Treatment Works (POTWs)

EMS Development Course for Government and Small Businesses

The Division of Pollution Prevention and Environmental Assistance (DPPEA) is offering a free course for local, state and federal government agencies and small businesses to design and implement an EMS, using the ISO 14001 model. DPPEA staff will coordinate training sessions and lead instruction. In addition, guest speakers from government and industry who have implemented an EMS for their operations will be invited to speak. Participants will meet every four to six weeks. No direct financial assistance to participants will be provided. This class is modeled on EPA’s program to assist local governments with EMS implementation.

The N.C. Department of Environment and Natural Resources (DENR) supports implementation of EMS by organizations, both private and public, and feels there are benefits to the environment as well as to the organization. DPPEA is the lead agency within DENR working on EMS.

To express interest in becoming a participant in the EMS Development Course, organizations should contact DPPEA or return registration form by **April 30, 2001**. For more information on this project, please contact Julie Woosley, DPPEA, (919) 715-6527 or (800) 763-0136, e-mail: Julie.Woosley@ncmail.net.

Design Tools

- Sample Procedures: City of Gastonia Wastewater Treatment Division
  - EMS Review
  - Document Control
  - Aspect and Impact Analysis
  - Corrective Preventative Action
  - Employee Training
  - Roles and Responsibilities
  - Objectives and Targets
  - External Communication
  - Environmental Management System Audit
  - Monitoring and Measuring
  - Legal and Other Requirements
- Sample Policy Statements
  - Charleston Commissioners of Public Works
  - City of Gastonia Wastewater Treatment Division
- Sample EMS Manual: City of Gastonia Wastewater Treatment Division

Articles, Reports, and Case Studies

- Implementing ISO 14001 Environmental Management Systems at the Municipal Level
  10/98 - 3 pages
- Final Report: The US EPA Environmental Management System Pilot Program for Local Government Entities
  1/00 - 136 pages
- Case Study: Gastonia Wastewater Treatment Division
  January 2001 - 2 pages

Workshops

- Strategies for Governmental EMS (Environmental Management System) Workshop
  Gastonia, N.C., Jan. 31, 2001.
- Benefits of an EMS to a Local Government
  by Steve Shoaf, et al., City of Burlington

Links

- See our Core Sector Page for Local Governments and POTWs

- Charleston Commissioners of Public Works
  Environmental Management System Policy. Policy statement and implementation information regarding the EMS for the city of Charleston, S.C.
- City of Scottsdale Environmental Management System
  Site provides detailed information about the EMS implemented for the city of Scottsdale, Ariz. The site follows the ISO 14001 standard and provides documents for each of the standard's 17 components.
- EPA's Environmental Management System site
  This Web page contains links to key information about EPA's efforts to develop policies and related materials about Environmental Management Systems (EMS).
- GETF's Municipal Environmental Management System Project
  GETF (Global Environment and Technology Foundation) completed a pilot project in partnership with the EPA to implement an EMS in nine local government entities. This site provides information about the pilot project and information about local governments and EMS.
- Implementation Guide for the Code of Environmental Management Principles for Federal Agencies (CEMP)
  Site provides information about the Code of Environmental Management Principles, which is a collection of five principles and performance objectives that provide a basis for federal agencies to move towards responsible environmental management. The site also provides information about EMS.
- National Biosolids Partnership
  The goal of the National Biosolids Partnership (NBP), a not-for-profit alliance formed in 1997 with the Association of Metropolitan Sewerage Agencies (AMSA), Water Environment Federation (WEF), and U.S. Environmental Protection Agency (EPA), is to advance environmentally sound and accepted biosolids management practices. Biosolids producers, service contractors and users — together with stakeholders from regulatory agencies, universities, the farming community, and environmental organizations — will have input into shaping NBP priorities through scientific and technical support and communications linkages relating to biosolids issues.
- LGEAN Toolbox for Local Governments
  The Local Government Environmental Assistance Network (LGEAN) provides environmental management, planning and regulatory information for local government elected and appointed officials, managers and staff. LGEAN provides this toolbox as a resource to assist local government officials in their efforts to protect the environment and public health. The tools are designed to help users perform operations and calculations necessary to fulfill environmental reporting requirements or guide the development of a helpful environmental program.

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Environmental Management Systems

EMS Workshop Presentations - Strategies for Governmental Environmental Management System Workshop

Speaker Presentations:

- EMS Basics
  Beth Graves, N.C. Division of Pollution Prevention and Environmental Assistance
- National Biosolids Partnership EMS Program
  Rebecca West, Western Carolina Regional Sewer Authority
- Environmental Management System Development and Implementation
  Don E. Carmichael, City of Gastonia Wastewater Treatment Division
- ISO 14001 Management Perspective
  Bob Danhauser, Charleston Commissioners of Public Works

See our Sector-Specific EMS page on Publicy Owned Treatment Works (POTWS)

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Environmental Management Systems

EMS Workshop Presentations - ISO 14001: The Nuts and Bolts of Getting It Done

Speaker Bios

Pictures from the Workshop

Workshop Topics and Speaker Presentations:

- Why Seek Certification? What Do You Get Out of Having an EMS?
  - Mercedes-Benz U.S. International Inc. by Mark Warner
  - Purolator Products Inc. by Steve Ross
  - Ford Motor Company by Bob Devlin
  - Ford - Norfolk Assembly Plant by Gary Davis
- Flow Charting Your Process To Identify Your Environmental Aspects and Impacts
  - Division of Pollution Prevention and Environmental Assistance staff
- Simplify Your EMS
  - Environmental Resources Services Inc. by Susan Graff
  - Excel by Suzanne Sessoms
- Integrating Your QS/ISO 9000 and ISO 14001 Programs
  - Uniroyal Chemical Company Inc. by Ron Lak
  - Novo Nordisk Biochem North America by Jennifer Pierce

- Konica Manufacturing USA by Chris Kappert
- Common Areas of Non-Conformancies — A Registrar's Perspective
  - NSF International by Rick Gehrke
  - BVQI by Karen Czor
  - Underwriters Laboratories Inc. by Steve Freeman
- Cost and Benefits of an EMS Including Pollution Prevention
  - NCI Inc. by Jack Rockstad
  - Bridgestone/Firestone Inc. by Dennis Hargens
  - Philips Communication Security and Imaging Inc. by Joe Fleming
- Internal and External Communication
  - Peter Wise, Kestrel Management Services LLC and Jason Morrison, Pacific Institute
- Internal Auditing, Management Review and Corrective Action
  - Eaton Cutler-Hammer by Scott Plemmons
  - ASMO Greenville Inc. by Jim Laney
  - ASMO North Carolina Inc. by Danny Yount
- Knowing Your Legal Requirements
  - Beth Graves, Division of Pollution Prevention and Environmental Assistance

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Environmental Management Systems

EMS Workshop Presentations -
EMS Models and Strategies: ISO 14001 and Beyond
August 24, 1999

- Agenda
- Speaker Profiles
- N.C. ISO 14001 Certified Facilities - As of April 18, 2000
- Summary of State Innovation Laws and EMS - 8/16/99
- The ISO 14000 Family of Standards: Environmental Management Systems
- Web Address Resource List

Speaker Presentations:

- Linking Economic and Environmental Performance: Translating an EMS Into the Language of Business by Edward L. Quevedo, Pillsbury Madison & Sutro LLP
- Benefits of an EMS to a Local Government by Steve Shoaf, et al., City of Burlington
- Ford Motor Company Quest for EMS by Chris Porter
- Nortel Networks Strategic Planning on EMS policy by Shyam Banik
- Environmental Aspects and Impacts of Novo Nordisk by Wendy Laing
- Dames & Moore Ranking of Environmental Health and Safety Aspects and Impacts by Jim Messelbeck
- EMS Design and Performance Beyond Compliance of BMW by Gary Weinreich

- ISO 14001 Structure and Implementation by Uniroyal Chemical Company Inc. by Ronald J. Lak
- Eaton-Cutler-Hammer: Gaining Competitive Advantage Through Environmental Management System by Jim Takac
- Sustainable Community EMS Design Including Pollution Prevention by Michelle M. Wyman, Reed Smith Shaw & McClay LLP
- Employment Involvement in EMS at Konica Manufacturing USA Inc. by John E. Moore
- Duke Power EMS and Legal Requirements by Mark Hollis
- United States Marine Corp EMS: An Auditing Perspective by Capt. David Cook
- How to Approach Registration and Auditing by Suzanne Sessoms
- Upgrading and Sustaining the EMS: Western Digital Case Study by Edward L. Quevedo, Pillsbury Madison & Sutro LLP
- IBM's Environmental Management System by Susan Clarke

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Environmental Management Systems

EMS Workshop Presentations - Environmental Management System Implementation Workshop May 14-15, 1998

First national workshop on environmental management systems sponsored by the Multi-State Working Group and the United States Environmental Protection Agency

- Agenda
- Proceedings
- Speakers' Presentations:
  - Dawn B. Sudmeyer, Camp Lejeune
  - David Rachels, Exide Electronics Large System Group
  - Doug Gaylord, Honda Power Equipment Manufacturing Inc.
  - Matt Caton, Lufkin/CooperTools, Apex, N.C.
  - Sean Bir, Konica Manufacturing USA Inc.

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Environmental Management Systems

Data Categories

The research conducted with information from the database will seek to answer a fundamental question: To what extent does the implementation of an environmental management system change a facility's behavior? To answer this question, the data collection protocols and research will focus on six primary dimensions:

- Environmental Performance: Does adoption of an EMS improve environmental performance and/or change a facility's use of environmental performance indicators? Is there a difference if the EMS conforms with ISO 14001?
- Environmental Condition Indicators: How are indicators of local, regional, and global environmental conditions incorporated into the design of a facility's EMS?
- Pollution Prevention: Does the adoption of an EMS change a facility's use of pollution prevention techniques? Do significant changes in environmental performance after EMS adoption result from greater use of pollution prevention practices?
- Regulatory Compliance: Does a facility's record of regulatory compliance change as a result of the adoption of an EMS? How does an EMS affect a facility's regulatory status and its ability to identify or prevent instances of non-compliance?
- Economic Performance (Costs and Benefits): What economic costs and benefits — both direct and indirect — does a facility accrue as a result of EMS adoption? Does the adoption of an EMS change a facility's use of economic performance indicators and/or advanced environmental and materials accounting techniques?
- Interested Party Involvement: How does a facility's involvement of outside parties, such as environmental Non-Governmental Organizations (NGOs) and the general public, change as a result of the adoption of an EMS? How does this involvement benefit a facility or influence its decisions?

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Class Reference Materials for EMS Workshop June 20-21, 2001 in Mobile, Alabama

The following is a list of reference materials regarding Environmental Management Systems (EMS) for use by participants attending the EMS Workshop on June 20-21 in Mobile, AL. The U.S. Environmental Protection Agency (EPA), Region 4 and the Alabama Department of Environmental Management are sponsoring the workshop. Instruction and reference materials are provided by staff from the N.C. Division of Pollution Prevention and Environmental Assistance. For questions related to the workshop, please contact Tony Shelton, U.S. EPA, (404) 562-9636.

Participants do not need to review all materials prior to the workshop. Materials are provided for informational purposes only. However, cursory review of some of the information will provide some basic EMS knowledge to participants unfamiliar with the topic. In addition, participants should find some reference materials of use following the course or of use when developing their own EMS.

An Introduction to EMS

- The ISO 14000 Family of Standards: Environmental Management Systems
  August 1999 - 3 pages
- Short EMS Case Studies
- EMS Design Tools

What is an EMS? Good Overview Documents

- Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations
  This guide is intended to support and facilitate the development of environmental management systems (EMS) among small and medium-sized organizations. The guide explains how you can develop and implement an effective EMS and how it can support your organization’s mission and goals. Development of an EMS is a voluntary approach to improving your organization’s environmental performance. December 1996 - 166 pages
- Integrated Environmental Management Systems: Implementation Guide

This guide has been designed to help companies integrate environmental concerns into business decision making using the Design for the Environment Program's Integrated Environmental Management System (IEMS). This guide follows the guidelines of ISO 14001, an international standard for EMS, and it is designed to help businesses set up and implement a simple, straightforward EMS. This guide does not intend to give guidance for ISO 14001 certification. EPA Office of Pollution Prevention and Toxics, Design for the Environment Program, October 2000 - 301 pages

- Ford Motor Company
  This workbook was developed to aid Ford Motor Company suppliers in implementing ISO 14001. It includes a PowerPoint presentation, procedure documents, work practices and other components of an EMS manual. December 1999 - 161 pages

EMS Models

- Environmental Management Systems: A Guide for Metal Finishers
  This project involved 11 metal finishing companies in a pilot project with the following objectives: 1) to demonstrate Environmental Management Systems (EMS) implementation in the metal finishing industry, and 2) to better define the resulting costs and benefits. The ISO 14001 (1996) Environmental Management System Standard was used as the basis for defining an environmental management system. December 1998 - 103 pages

- Improving Environmental Performance and Compliance: 10 Elements of Effective Environmental Management Systems
  This document represents the first joint statement from Canada, Mexico and the United States on how voluntary EMS designed for internal management purposes can also serve the broader public policy goals of compliance assurance and improved environmental performance in regulated and non-regulated areas. The guidance document focuses on only two public policy issues: compliance assurance and improved environmental performance in regulated and non-regulated areas. June 2000 - 9 pages

- Implementation Guide for the Code of Environmental Management Principles for Federal Agencies (CEMP)
  Federal reference tool – EMS template. June 1998

- Environmental Management Systems Primer for Federal Facilities
  This guide will be of particular interest to environmental managers responsible for implementing environmental management systems at federal facilities. 1998 - 71 pages

Other

- EPA Performance Track
  The National Environmental Performance Track is a new program designed to motivate and reward top environmental performance by companies and facilities of all types – public and private

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To all employees at Skanska,

Our vision is that Skanska shall become the world's leading company in construction-related services and in project and real estate development. This requires, among other things, that all of us take environmental issues seriously.

What we do today affects the environment of both current and future generations. Caring about people and the environment must therefore permeate all of our work. This responsibility rests with all of us. Our environmental awareness will help us prevent and minimize adverse environmental impact and improve our operations, thereby generating new business opportunities. We must be open-minded in our dialogue with others. In order to be successful, we need knowledge and commitment.

We shall always follow these principles in our work at Skanska:

" Think ahead about how your work will affect the environment.
" Ask questions and obtain help if you are unsure. Use common sense.
" Be cautious and avoid materials or methods if you cannot properly assess their environmental risks.
" Bear in mind that there are circumstances where, due to environmental risks, we should not participate.
" Choose or propose environmentally better alternatives when this makes sense.
" Conserve natural resources.

Every operative unit must build up an environmental management system and set its own environmental goals in order for our environmental policy to yield results in our daily work. Legislation and the environmental demands of our clients provide a foundation for our environmental ambition. Beyond this, we shall endeavor to make continuous improvements. All operations shall have environmental management systems in place no later than December 31, 1999 and be certified no later than December 31, 2000.

By letting responsibility for the environment and the future permeate our day-to-day work, we will gain the confidence and respect of others.

Danderyd, April 1998

Claes Björk
President and CEO

This Environmental Policy document replaces the Policy adopted in 1995.

BRIDGESTONE/FIRESTONE WILSON PLANT HEALTH, SAFETY, QUALITY & ENVIRONMENTAL POLICY

HEALTH AND SAFETY POLICY

Bridgestone/Firestone Wilson Plant management is committed to providing a safe, healthy workplace for our associates. To meet this commitment, our health, safety, and loss control programs must be: CONTINUING, AGGRESSIVE, & EFFECTIVE.

The purpose of these programs will be to:

- Protect employees from occupational illness or injury
- Protect BFS equipment and property from loss or damage

These programs will be actively conducted within all departments and will support the guidelines of the BFS Wilson Health and Safety Program.

QUALITY POLICY

We will maintain our quality systems, processes and standards to meet the changing needs of our customers and to assure the quality of our products.

We will strive for continuous improvement through teamwork and the education of our people.

ENVIRONMENTAL POLICY

We will produce competitive products to meet customer requirements while operating in an environmentally responsible manner. The Plant Manager and his management team are committed to implementing an effective environmental management system designed to accomplish our strategic business objectives and fulfill our responsibility as a good industrial employer and neighbor in the Wilson community. We shall:

- Conduct business so that environmental challenges are managed as an integral part of current and changing business strategies.
- Communicate about environmental issues.
- Comply with applicable federal, state, and local environment laws, and meet other environmental commitments we make.
- Promote pollution prevention.
- Continually improve the environmental management system.

John M'Quade

John McQuade
5/3/99

IS014001 Key Phrase:

COMMUNICATE, COMPLY AND CONTINUALLY IMPROVE!

We will:
COMMUNICATE about environmental issues
COMPLY with federal, state and local laws that are appropriate to the environment
CONTINUALLY IMPROVE our environmental management system and prevent pollution

Environmental Engineer:

Dennis Hargens

Revision # __**0**__	Effective Date: # _**06/98**_	Document Type: __**Level 1**__
Document Title __**Eastern Region Land and Timber Environmental Policy**__		
Approved: __(Signature – Morris C. Wright)__		Page 1 of 1

INTERNATIONAL (logo here) PAPER

CORPORATE POLICY
Environment, Health and Safety

An essential part of our business strategy is to make products in a safe and healthful work place, to manage natural resources wisely, and to continually improve our environmental performance. We are committed to removing the conditions and behaviors that cause personal injury or environmental impact. Therefore, we will:

- Comply with all applicable environmental, health and safety laws and regulations, with the company's own environmental, industrial hygiene and safety policies and commitments and with the Sustainable Forestry Initiative (SFI™) and with the Environmental, Health and Safety principles of the American Forest and Paper Association.

- Undertake with our employees the creation and maintenance of an accident and injury-free workplace.

- Emphasize prevention of pollution, elimination of process excursions and continual improvement through employee diligence as the best practicable means to improve the environmental performance of our operations.

Business site managers have the responsibility to assure that their business site:

- Complies with applicable environmental, health and safety laws, regulations and corporate policy and to certify to this requirement.

- Develops, implements and maintains effective systems, procedures and training to achieve and maintain an accident-free, injury-free and healthful workplace.

- Integrates continual environmental, health and safety improvement, pollution prevention and employees diligence into daily operations.

- Develops site-specific annual objectives for environmental, industrial hygiene, safety and worker's compensation improvements that support these goals, policies and statements.

___(Signature)_________________________
John T. Dillon
Chairman & Chief Executive Officer

April, 1997
Supporting Documents
International Paper Environment, Health and Safety Principles
International Paper Forest Management Principles

Environmental Policy

Carrier Solutions RTP Area Operations (RAO) commits to demonstrate environmental leadership in the telecommunications industry and to protect and enhance the environment through sound management decisions.

Carrier Solutions RAO commits to:

- Comply with all relevant environmental legislation and other standards to which we subscribe.
- Prevent Pollution by minimizing resource consumption, waste generation and adverse environmental impacts whenever technologically and economically viable.
- Set and review objectives and targets to ensure continual improvement of the EMS and our environmental performance.
- Participate in efforts to share with suppliers, customers, industry and the community, appropriate knowledge and technology that benefit the environment.

(from Nortel Networks, RTP, NC Carrier Solutions Operations, Issue Date: 6/30/1999)

0.2 Environmental, Health, and Safety Policy

Purolator, Fayetteville Plant, is committed to develop and operate an Environmental, Health, and Safety (EHS) System to provide:

* Compliance with relevant environmental, safety and health legislation and regulations
* Compliance with Purolator's safety and health program and other requirements
* Continual improvement through the achievements of targets and objectives
* Prevention of pollution through the reduction of environmental emissions and waste disposal

The framework for establishing, implementing, and maintaining our Environmental, Health, and Safety System provides the following activities:

* Communication of this policy to all employees
* Making this policy available to the public
* Setting and reviewing EH&S objectives and targets

Linked procedures apply to all Plants unless specifically noted.

Revision: 5	Effective Data: 10/29/98
Last Rev. Date: 07/14/98	Author: Wes Thomas

Bique Pens Ranking System

Severity – The potential effect of an environmental aspect on the environment.

1. No Impact
2. Minor
3.
4. Moderate
5. Serious / Environmentally Regulated

Quantity – The amount of the material generated / used

1. Minimal quantities generated
2.
3.
4.
5. Large quantities generated

Worker Safety – The health risk to facility employees

-

1. No Health Risk
2.
3.
4.
5. Serious health risk – major concern for worker safety

Ranking

Aspect	Severity	Quantity	Worker Safety	TOTAL RANK
Ex. Off spec material	2	3	1	6

Scores should be multiplied. Total Rankings over 10 points are considered **Significant** Impacts.

Environmental Management Systems

National Environmental Achievement Track - Environmental Regulations Checklist

The following checklist is a component of the EPA National Environmental Achievement Track Application. It serves to help facilities identify the major federal, state, tribal, and local environmental requirements that are applicable to them. This is not necessarily an exhaustive list of environmental regulations and requirements.

Air Pollution Regulations

1. National Emission Standards for Hazardous Air Pollutants (40 CFR 61)
2. Permits and Registration of Air Pollutant Sources
3. General Emission Standards, Prohibitions and Restrictions
4. Control of Incinerators
5. Process Industry Emission Standards
6. Control of Fuel Burning Equipment
7. Control of Volatile Organic Compounds
8. Sampling, Testing, and Reporting<
9. Visible Emissions Standards

10. Control of Fugitive Dust
11. Toxic Air Pollutants Control
12. Vehicle Emissions Inspecting and Testing
13. Other Federal, State, Tribal, or Local Air Pollution Regulations not listed above

Hazardous Waste Management Regulations

1. Identification and Listing of Hazardous Waste (40 CFR 261)
    a. Characteristic Waste
    b. Listed Waste
2. Standards Applicable to Generators of Hazardous Waste (40 CFR 262)
    a. Manifesting
    b. Pre-transport requirements
    c. Record keeping/reporting
3. Standards Applicable to Transporters of Hazardous Waste (40 CFR 263)
    a. Transfer facility requirements
    b. Manifest system and record-keeping
    c. Hazardous waste discharges
4. Standards for Owners and Operators of TSD Facilities (40 CFR 264)
    a. General facility standards
    b. Preparedness and prevention
    c. Contingency plan and emergency procedures
    d. Manifest system, record keeping, and reporting
    e. Groundwater protection
    f. Financial requirements
    g. Use and management of containers
    h. Tanks
    i. Waste piles
    j. Land Treatment
    k. Incinerators
5. Interim Status Standards for TSD Owners and Operators (40 CFR 265)
6. Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities (40 CFR 267)
7. Administered Permit Program (Part B) (40 CFR 270)
8. Other Federal, State, Tribal, or Local Hazardous Waste Management Regulations not listed above

Hazardous Materials Management

1. Control of Pollution by Oil and Hazardous Substances (33 CFR 153)
2. Designation of Reportable Quantities and Notification of Hazardous Materials Spills (40 CFR 302)
3. Hazardous Materials Transportation Regulations (49 CFR 172-173)
4. Worker Right-to-Know Regulations (29 CFR 1910.1200)
5. Community Right-to-Know Regulations (40 CFR 350-372)
6. Other Federal, State, Tribal, or Local Hazardous Waste Management Regulations not listed above

Water Pollution Control Requirements

1. Oil Spill Prevention Control and Countermeasures (40 CFR 112)
2. Designation of Hazardous Substances (40 CFR 116)
3. Determination of Reportable Quantities for Hazardous Substances
4. NPDES Permit Requirements (40 CFR 122)
5. Toxic Pollutant Effluent Standards (40 CFR 129)
6. General Pretreatment Regulations for Existing and New Sources
7. Organic Chemicals Manufacturing Point Source Effluent Guidelines and Standards
8. Inorganic Chemicals Manufacturing Point Source Effluent Guidelines and Standards
9. Plastics and Synthetics Point Source Effluent Guidelines and Standards (40 CFR 416)
10. Water Quality Standards
11. Effluent Limitations for Direct Dischargers
12. Permit Monitoring/Reporting Requirements
13. Classifications and Certifications of Operators and Superintendents of Industrial Wastewater Plants
14. Collection, Handling, Processing of Sewage Sludge
15. Oil Discharge Containment, Control, and Cleanup
16. Standards Applicable to Indirect Dischargers (Pretreatment)
17. Other Federal, State, Tribal, or Local Hazardous Waste Management Regulations not listed above

Drinking Water Regulations

1. Underground Injection and Control Regulations, Criteria, and Standards (40 CFR 144, 146)
2. National Primary Drinking Water Standards (40 CFR 141)
3. Community Water Systems, Monitoring and Reporting Requirements (40 CFR 141)
4. Permit Requirements for Appropriation/Use of water from Surface or Subsurface Sources
5. Underground Injection Control Requirements
6. Monitoring, Reporting, and Record Keeping Requirements for Community Water Systems
7. Other Federal, State, Tribal, or Local Hazardous Waste Management Regulations not listed above

Solid Waste Management

1. Criteria for Classifications of Solid Waste Disposal Facilities and Practices (40 CFR 257)
2. Installation of Systems of Refuse Disposal
3. Solid Waste Storage and Removal Requirements
4. Disposal Requirements for Special Wastes
5. Other Federal, State, Tribal, or Local Hazardous Waste Management Regulations not listed above

Toxic Substances

1. Manufacture and Import of Chemicals, Record Keeping and Reporting
2. Import or Export of Chemicals (40 CFR 707)
3. Chemical Substances Inventory Reporting Requirements (40 CFR 710)
4. Chemical Information Rules (40 CFR 172)
5. Health and Safety Data Reporting (40 CFR 716)
6. Pre-Manufacture Notifications (40 CFR 720)
7. PCB Distribution Use, Storage, and Disposal (40 CFR 761)
8. Regulations on Use of Fully Halogenated Chlorofluoroalkanes (40 CFR 762)

9. Storage and Disposal of Waste Material Containing TCDD (40 CFR 775)
10. Other Federal, State, Tribal, or Local Hazardous Waste Management Regulations not listed above

Pesticide Regulations

1. FIFRA Pesticide Use Classification (40 CFR 165)
2. Procedures for Disposal and Storage of Pesticides and Containers (40 CFR 165)
3. Certification of Pesticide Applications (40 CFR 171)
4. Pesticide Licensing Applications (40 CFR 171)
5. Labeling of Pesticides
6. Pesticide Sales, Permits, Records, Application, and Disposal Requirements
7. Disposal of Pesticide Containers
8. Restricted Use and Prohibited Pesticides
9. Other Federal, State, Tribal, or Local Hazardous Waste Management Regulations not listed above

Environmental Clean-up, Restoration, Corrective Action

1. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Superfund)
2. RXRA Corrective Action
3. Other Federal, State, Tribal, or Local Hazardous Waste Management Regulations not listed above

Site hosted by the NC Division of Pollution Prevention and Environmental Assistance.
1639 Mail Service Center - Raleigh NC 27699-1639
(919) 715-6500/(800) 763-0136 - fax (919) 715-6794
Pollution prevention or EMS question or comment? Send e-mail to: Beth Graves
Site question or comment? Send e-mail to: Webmaster@p2pays.org

Environmental Management Systems/ISO 14001 Frequently Asked Questions

- What are ISO, ISO 14000, and ISO 14001?

  ISO stands for the International Organization for Standardization, located in Geneva, Switzerland. ISO promotes the development and implementation of voluntary international standards, both for particular products and for environmental management issues. ISO 14000 refers to a series of voluntary standards in the environmental field under development by ISO. Included in the ISO 14000 series are the ISO 14001 Environmental Management System (EMS) Standard and other standards in fields such as environmental auditing, environmental performance evaluation, environmental labeling, and life-cycle assessment.

- How are these standards developed?

  All the ISO standards are developed through a voluntary, consensus-based approach. ISO has different member countries across the globe. Each member country develops its position on the standards and these positions are then negotiated with other member countries. Draft versions of the standards are sent out for formal written comment and each country casts its official vote on the drafts at the appropriate stage of the process. Within each country, various types of organizations can and do participate in the process. These organizations include industry, government (Federal and State), and other interested parties, like various non-government organizations (NGOs). For example, EPA and States participated in the development of the ISO 14001 standard and are now evaluating its usefulness through a variety of pilot projects.

- What are some of the potential benefits of an EMS based on ISO 14001?
  - Improvements in overall environmental performance and compliance
  - Provides a framework for using pollution prevention practices to meet EMS objectives
  - Increased efficiency and potential cost savings when managing environmental obligations
  - Promotes predictability and consistency in managing environmental obligations
  - More effective targeting of scarce environmental management resources
  - Enhances public posture with outside stakeholders

Can existing environmental management activities be integrated into the EMS under 14001?

Yes. The standard is flexible and does not require organizations to necessarily "retool" their existing activities. The standard establishes a management framework by which an organization's impacts on the environment can be systematically identified and reduced. For example, many organizations, including counties and municipalities, have active and effective pollution prevention activities underway. These could be incorporated into the overall EMS under ISO 14001.

Questions from EPA Office of Wastewater Management

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EMS Workshop Presentations - ISO 14001: The Nuts and Bolts of Getting It Done

Speaker Bios:

Terry Albrecht is the program director of Waste Reduction Partners, which works in partnership with the N.C. Division of Pollution Prevention and Environmental Assistance (DPPEA). For the past nine years, Albrecht has provided industries with on-site pollution prevention audits, training and outreach. He has co-authored numerous publications and manuals including: *Waste Reduction Programs for Commercial/Industrial Solid Waste* and *Water Efficiency Manual for Commercial, Industrial and Institutional Facilities*. He was a member of the N.C. DENR Working Group on ISO14001 and has received ISO 14001 lead auditor training. Terry holds both bachelor’s and master’s degrees from N.C. State University in civil and environmental engineering and is a professional engineer in North Carolina. Albrecht has also worked as a manufacturing engineer for Eaton Corporation, as an environmental consulting firm engineer, and as a sanitation/water supply engineer in Ecuador, South America - totaling 12 years in environmental experience.

John Burke is an environmental engineer with DPPEA. Burke has been involved in more than 100 on-site industrial waste assessments, providing assistance in areas ranging from toxicity reduction and solid waste recycling to production efficiency improvements. He has also worked with several companies and municipalities to implement the ISO 14001 Environmental Management System and developed a number of seminars related to industrial wastewater issues.

Karen Czor is a Registrar Accreditation Board (RAB) approved lead auditor and a member of the American Society for Quality. Czor has completed the ISO 14000 Lead Auditor Training course. She has developed and implemented corporate-wide ISO 9000 and ISO 14000 management systems for clients in the construction, hazardous waste and explosives industries. Czor also is an experienced consultant in the fields of environmental management, hazardous waste treatment and safety engineering. She received a B. S. in physics from Eastern Kentucky University and an M.S. in physics from the University of Tennessee.

Gary Davis is an environmental engineer with the Ford Norfolk Assembly Plant. Davis has been with Ford since 1990 and has worked on the production floor as an hourly and production supervisor, and currently serves as the ISO 14001 coordinator for the plant. Davis has also been involved with ISO 9001 since 1995 and worked collaboratively with three colleagues at other Ford Plants in developing an Environmental Quality Operating System (QOS) in 1994, as part of an effort to develop an Environmental Management System to be utilized throughout Ford. Prior to joining Ford, he worked for three years at the N.C. Department of Marine Fisheries as a marine biologist, based in Elizabeth City. While still in college, Davis worked as a hazardous waste technician for the UNC-Chapel Hill Health and Safety office. Gary holds a B.A. in biology from UNC-Chapel Hill.

Bob Devlin is currently manager of the environmental management group with Ford Motor Company's Environmental Quality Office. The environmental management group is responsible for Ford's Corporate Citizenship program, ISO 14001 global certification, and supplier environmental requirements. Devlin has been with Ford's Environmental Quality Office since 1977, and has a diverse environmental background in environmental stack sampling, odor analysis, compliance assurance auditing and compliance assurance program development. He is an accredited ISO 14001 lead auditor and a certified hazardous waste manager (CHMM).

Steve Freeman is the registration program leader for Underwriters Laboratories Inc. Freeman has seven years experience in management systems auditing and currently serves as program manager for Underwriter Laboratories' ISO 14001 program. He is an ISO 14001 lead auditor, ISO 9000 lead auditor, RAB lead auditor, certified environmental auditor and has performed over 300 audits. Freeman has 20 years of industrial experience, including serving as technical director and quality assurance manager at ITT and serving as technical director and manufacturing manager at Litton.

Joe Fleming currently serves as environmental coordinator and safety officer and oversees the ISO 14001 program at Philips Communications Security & Imaging Inc. Fleming is a quality manager with certification from the American Society of Quality and has held quality responsibilities for various firms over the past 30 years. He has been the quality representative for Philips since 1993. Fleming received a B.S. in metallurgical engineering from Grove City College.

Rick Gehrke serves as Southeast regional account executive for NSF-ISR's quality and environmental management system registration program. His background is primarily in diversified management and environmental science applications, including consulting, auditing, training and project management. Gehrke is an experienced environmental auditor who has led ISO 14001 registration audits since the standard was first released in 1996.

Susan Graff is president of Environmental Resource Services, a company she started in Atlanta, Ga., in 1997 with a commitment to providing clients sound environmental strategies that enhance business performance. Graff has 20 years of experience in environmental management and regulatory compliance. Her areas of expertise include corporate policy analysis, training, environmental auditing and assessments, stakeholder outreach and system implementation. Graff's most recent projects involve consulting on strategic environmental management programs, including ISO 14000, for a diverse group of industries in the United States and South America. Prior to starting her company, she worked for the U.S. Environmental Protection Agency (EPA), managing waste management programs at over 5,000 facilities throughout the southeastern United States. Graff led teams to conduct site assessments, RCRA corrective action, and community relations at controversial hazardous waste cleanup sites. Her accomplishments include implementing EPA's regulatory reinvention through use of team-based approaches for use in environmental project management and also leading design of the Superfund Accelerated Cleanup Model for integrated assessment. Graff is a member of the U.S. Technical

Advisory Group to ISO Technical Committee 207, and a registered environmental auditor with the UK EARA. She is a graduate of the Georgia Institute of Technology, where she conducted interdisciplinary research on environmental risk and technology assessment. Graff obtained an M.S. in technology and science policy and received a Public Fellowship Award. Susan also holds a B.S. in biology from Western Illinois University.

Beth Graves serves as Environmental Management Systems (EMS) project coordinator in the N.C. Division of Pollution Prevention and Environmental Assistance (DPPEA). Graves oversees the EMS Pilot Program as well as participates in the Multi-State Working Group (MSWG) and the U.S. Technical Advisory Group to ISO Technical Committee 207. She provides technical assistance to industry, local governments and other staff in the Department of Environment and Natural Resources (DENR) on EMS and coordinates DPPEA's EMS Web site and workshops. Graves began working for DPPEA in 1993 first with the Community and Business Assistance section providing technical assistance to local governments and businesses regarding integrated solid waste management programs, and providing research and materials development support, particularly in the areas of composting and source reduction.

Denis Hargens is the senior environmental engineer for Bridgestone/Firestone-Wilson, N.C., and has served in this role for eight years. Prior to joining Bridgestone/Firestone, Hargens has 14 years of plant and project engineering experience in the roofing industry. Hargens has a B.S. in mechanical engineering from the South Dakota School of Mines and Technology.

Chris Kappert is currently employed at Konica Manufacturing U.S.A., where he is the information systems team leader. In this role, he is pushing the company's management systems for environment and quality to being paperless. Back in 1998, he was the lead in the two-person team that implemented ISO 14001 at Konica, and in 1996 he completely revised the company's ISO 9002 system. Prior to working at Konica, Kappert was responsible for the Nuclear Quality Assurance Program aboard the navy aircraft carrier U.S.S. Nimitz.

Ron Lak has worked with Uniroyal Chemical Company for 27 years, spending the last 17 years in Gastonia, N.C. While at Uniroyal, Lak has held various positions in project engineering, process engineering and environmental engineering. Currently, he is the operations manager in the urethane department for the Gastonia plant. Lak's duties include assurance that all new or improved processes introduced into the plant meet all environmental requirements, overseeing legal aspects of environmental programs and regulations, and serving as a team member on the facility's ISO 14001 steering committee. He has a B.S. in chemical engineering from Worcester Polytechnic Institute and an MBA from the University of New Haven.

Jim Laney is assistant manager of ASMO Greenville of North Carolina Inc. Laney serves as safety, environment & facilities registered environmental manager (REM). He has 15 years of experience in manufacturing, with eight years in the automotive supplier industry. Laney has five years of experience in the environmental & safety field. He is a graduate of East Carolina University.

Jason Morrison is a senior associate of the Pacific Institute. He heads the Institute's Economic Globalization and the Environment Program, where he is currently studying the public policy implications of private sector environmental initiatives and voluntary international standards, with a focus on the environmental management standards — ISO 14000. Morrison is the lead author of a recent Pacific Institute report, entitled "Managing a Better Environment: The Opportunities and Obstacles for ISO 14001 in Public Policy and Commerce." He is a member of the U.S. Technical Advisory Group to ISO Technical Committee 207, as well as a U.S. delegate to Subcommittee 3 (Ecolabeling), and to Subcommittee 5 (Life Cycle Assessment). Morrison is a non-governmental organization (NGO) participant of the Multi-State Working Group on Environmental Management Systems, and a founding member of the NGO Working Group on ISO 14000. He holds a B.A. in philosophy from the University of California, San Diego, and a master's degree from Boston University's Center for Energy and Environmental Studies. Morrison was a fellow with the Americans and World Affairs Fellowship Program in Berkeley, Calif. In addition to heading the Institute's Trade, Economic Globalization and the Environment program, he works on issues relating to water and sustainability.

Norma Murphy joined the N.C. Division of Pollution Prevention and Environmental Assistance in 1993 as an environmental chemist. She now serves as the Industrial Section outreach and training team leader. Murphy's primary responsibilities include coordinating workshops and training sessions on pollution prevention and environmental management for industries, commercial establishments and other government agencies. Her areas of significant experience include food processing, water conservation, employee training and ISO 14000. Murphy has a B.S. in chemistry from Meredith College.

Jennifer Pierce is responsible for maintaining Novo Nordisk's ISO 9001 certification, along with other quality assurance functions related to ensuring "customer quality assurance" including customer complaints and product specifications. She became involved in implementing ISO14001 at Novo's site mainly to ensure integration of the two systems.

Scott Plemmons is quality manager for Cutler-Hammer in Asheville. The Asheville facility was awarded ISO 14001 certification in July 1999, and Plemmons was instrumental in assisting the company to obtain certification.

Ron Pridgeon joined the N.C. Division of Pollution Prevention and Environmental Assistance in 1991 as an environmental engineer. He now serves as the Industrial Section technical assistance team leader. Pridgeon's primary responsibilities include coordinating technical assistance to North Carolina industries in pollution prevention and environmental management. His areas of significant experience include furniture manufacturing, coatings applications, boat building and ISO 14000. Pridgeon holds a B.S. in industrial engineering from N.C. State University.

Jack Rockstad is the Dowty Aerospace North American environmental director and also serves as the operations manager at NCI Inc. in Asheville. Rockstad has previous experience with facilities management and plant engineering; has served as purchasing manager, electronic technician and safety director; and is a licensed electrician. He has his OSHA 80-hour certification.

Steve Ross is the environmental manager for Purolator Products, a 700,000 sq. ft. manufacturing facility in Fayetteville, N.C. The facility is QS 9000 and ISO 14001 certified. Ross was one of the core team members instrumental in the ISO certification process.

Barb Satler is an environmental specialist with the N.C. Division of Pollution Prevention and Environmental Assistance (DPPEA). She has 10 years experience in the field of waste reduction. Satler's focus is on outreach and training, providing technical assistance and coordinating the Governor's Award for Excellence in Waste Reduction. She is a member of the Department of Environment and Natural Resources quality guidance team and is a certified Baldridge Examiner.

Suzanne Sessoms is with Excel Partnership in Wilmington, N.C., and has over 15 years of experience in engineering and business management. Sessoms is a RAB-certified lead auditor for ISO 1400, with expertise is developing environmental management systems including compliance strategies, risk management and pollution prevention. Prior to working with Excel, she worked for Corning Inc. in Wilmington where she was involved with implementation of Total Quality Management (TQM) and ISO 9000. Sessoms received a degree in chemical engineering from the Georgia Institute of Technology. She is also a licensed professional engineer in North Carolina, South Carolina and Florida.

Rahul Thaker currently reviews state and federal air permits in his work at the North Carolina Division of Air Quality. Thaker is a professional environmental engineer and holds both bachelor and masters degrees in civil and environmental engineering. He has completed the lead auditor training course on ISO 14001. Thaker has nine years of environmental engineering experience, encompassing multimedia environmental regulatory and technical issues. Prior to his work with state government, he worked for consulting engineering companies.

Mark Warner is a registered environmental manager and is in charge of the environmental engineering department at the Mercedes-Benz plant in Tuscaloosa, Ala., which was certified to the ISO 14001 standard in September 1999. He has been with Mercedes since January of 1996. Warner started his career at the Chemical Manufacturers Association (CMA) in Washington, D.C., as manager of air programs, and was heavily involved in the development of the Clean Air Act Amendments of 1990. Since CMA, he has held corporate environmental coordinator positions at American Standard Inc. (New Jersey/New York City) and Vulcan Chemicals (Birmingham, Ala.) and has had general corporate oversight responsibility for approximately 35 domestic manufacturing plants during that time. Mark received his B.S. degree from The Catholic University of America (Washington, DC) where his major areas of study were chemical engineering and biochemistry.

Peter Wise is a senior consultant and principal of Kestrel Management Services LLC. He has over 30 years of experience as an environmental professional in the private sector and in state and federal government. At Kestrel, he assists clients with consulting, training and facilitation in the areas of environmental management systems, regulatory affairs, strategic planning and environmental systems optimization. Wise serves as vice chair of the Multi-State Working Group on Environmental Management Systems (MSWG), where he chairs MSWG's research task team on environmental management systems. He chaired the National Research Summit on Environmental Management Systems hosted by the Brookings Institution in 1999. Wise has written several published articles on environmental innovation. Prior to joining Kestrel, he was the associate director of the Illinois EPA, where he managed the agency's pollution prevention program, the EMS pilot program, public affairs, community relations, the Office of Small Business, the total quality management effort and the environmental education program. Wise also worked as group senior vice president for Science Applications International Corporation (SAIC). With the EPA for more than 10 years, he directed the water planning program and oversaw the water quality standards program and the effluent guidelines program. Wise also directed the agency's Great Lakes National Program Office and served as acting deputy regional administrator for Region V.

Danny Yount has been with ASMO North Carolina Inc. for 10 years and serves as an environmental engineer. Yount was part of a five-member team that implemented ISO 14001. Before working at ASMO, Yount worked for Thonet in Statesville for five years as an industrial engineer and safety, health and environment personnel.

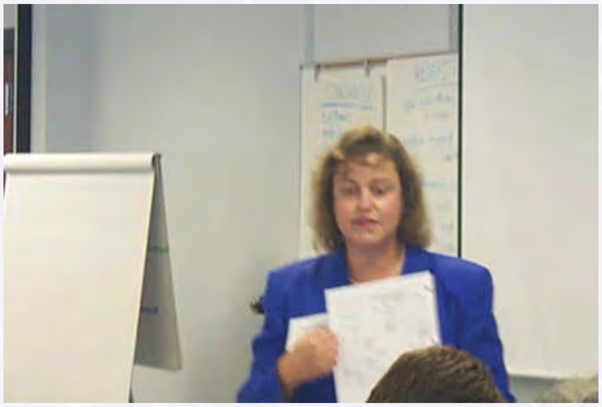
Environmental Management Systems

EMS Workshop Presentations - ISO 14001: The Nuts and Bolts of Getting It Done - Workshop Pictures

Beth Graves, N.C. Division of Pollution Prevention and Environmental Assistance

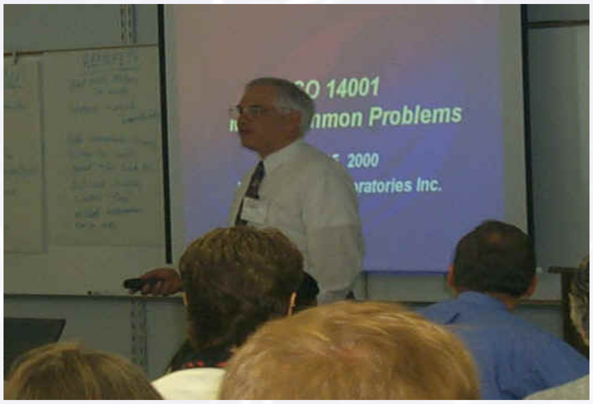
John Burke, N.C. Division of Pollution Prevention and Environmental Assistance

Suzanne Sessoms, Excel



Chris Kappert, Konica Manufacturing USA

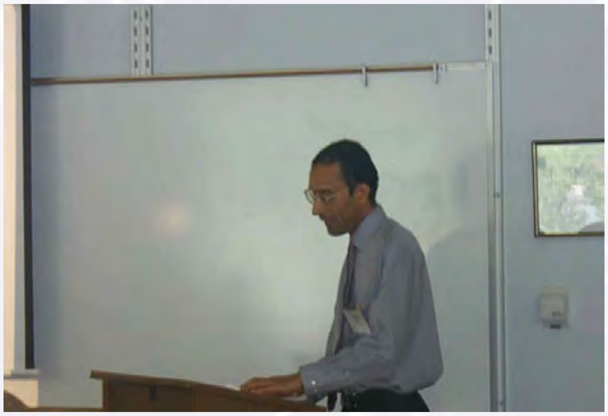
Steve Freeman, Underwriters Laboratories Inc.



Jason Morrison, Pacific Institute

Danny Yount, ASMO North Carolina Inc.

Rahul Thaker, Division of Air Quality



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Pollution prevention or EMS question or comment? Send e-mail to: Beth Graves
Site question or comment? Send e-mail to: Webmaster@p2pays.org

Multi-State Working Group on Environmental Management Systems
and the United States Environmental Protection Agency

Pilot Project Implementation Workshop

AGENDA

Thursday, May 14, 1998

Embassy Suites Hotel, Cary, North Carolina

9:00 a.m. - 4:30 p.m.

Opening Remarks
Henry Lancaster, Deputy Secretary, North Carolina Department of Environment and Natural Resources

Welcome
Ravila Gupta, North Carolina Department of Environment and Natural Resources
Jay Benforado, United States Environmental Protection Agency Office of Reinvention
Robert Stephens, California Environmental Protection Agency

Multi-State Working Group (MSWG):
Mission and Future Activities
Robert Stephens, California Environmental Protection Agency and Chair of MSWG

BREAK

National Database and Data Collection Efforts
Jim Horne, United States Environmental Protection Agency
John Villani, University of North Carolina - Chapel Hill

North Carolina Pilot Projects
Beth Graves, Division of Pollution Prevention and Environmental Assistance, Moderator
Sean Bir, Konica Manufacturing USA
Peter Self, Motorola
Matt Caton, Lufkin/Cooper Tools

LUNCH 12:30 - 1:45

Dawn Sudmeyer, Marine Corps Base, Camp Lejeune
Doug Gaylord, Honda Power Equipment
David Rachels, Exide Electronics

Pilot Project Panel Discussion

BREAK

MSWG Regulatory Framework
Dave Ronald, Arizona Attorney General's Office

North Carolina Permit Reform Project
Dan Bius, Environmental Permit Reform Team Leader

Multi-State Working Group on Environmental Management Systems
and the United States Environmental Protection Agency
Pilot Project Implementation Workshop

AGENDA

Friday, May 15, 1998

Embassy Suites Hotel, Cary, North Carolina

9:00 a.m. - Noon

Other State Perspectives - EMS Pilot Projects / EMS Programs
Marianne Fitzgerald, Oregon
Stacy Richards, Pennsylvania
Lynda Wiese, Wisconsin
Peter Wise, Illinois

EPA Position on ISO 14001/EMS
Mary McKiel, United States Environmental Protection Agency
Jim Horne, United States Environmental Protection Agency

Non-Governmental Organizations' Views

Jerry Spier, Tulane Law School
Jason Morrison, Pacific Institute
Erik Meyers, Environmental Law Institute

Industry Views
Jim Connaughton, Coalition for ISO Implementation
John Harris, Chemical Manufacturer's Association

Green Zia Environmental Excellence Program

The Nothing to Waste Program: Incorporating Pollution Prevention

into Small Businesses

The Green Zia Environmental Excellence Program is a voluntary program of the New Mexico Environmental Alliance designed to assist all New Mexico businesses, from the largest facility to the smallest corner business, achieve environmental excellence by implementing pollution prevention and energy efficiency programs.

Acknowledgements

Special thanks to….

Dr. Robert Pojasek for his assistance in developing the Green Zia Environmental Excellence Program.

The Nothing to Waste Program was developed as a project of Working Capital, Grove Hall NDC, Green Island/Vernon Hill CDC, Tufts University New England Environmental Network and Dr. Robert Pojasek with funding provided by the US Environmental Protection Agency.

Manual printed with funds provided by the US Environmental Protection Agency in a grant to the New Mexico Energy, Minerals and Natural Resources Department and the New Mexico Environment Department.

For more information on the Systems Approach tools used in the Green Zia Environmental Excellence Program, please call Dr. Pojasek at (781) 641-2422

Introduction: Incorporating Pollution Prevention

The "Nothing to Waste Initiative introduces pollution prevention as a core component of business management. The minimization of waste and the maximization of efficiency are important to micro-business viability and to protecting the environment.

The following six tutorials have been developed to demonstrate the key principles of pollution prevention. Entrepreneurs are encouraged to immediately and continuously apply these pollution prevention concepts toward their businesses,

The process of applying pollution prevention includes examining the business process, identifying material loss, identifying the cause of the loss, generating possible solutions, selecting an alternative and implementing an action plan to prevent material loss and reduce costs. The tutorials walk through the process, each building upon the strategy presented in the previous tutorial. After you complete all six tutorials, you will be asked to answer several summary questions to determine whether the tutorials develop the critical skills intended.

The six pollution prevention tutorials are briefly outlined below:

1. Process mapping: Process mapping determines the steps materials pass through as they are transformed into the final product. These maps allow for the identification of all inputs to and outputs from a process, making wastes, or losses, evident.

2. Activity-based costing: This method helps you identify key losses and total dollar value of these losses. The Pareto principle suggests that 80% of the problems in a business come form 20% of the machines, raw materials, or operators. (The same is true for any facet of business. For example, 80% of sales come from 20% of customers, etc.) We will

demonstrate this principle by assigning costs to each loss in the process, a technique known as activity-based costing.

3. Root cause analysis: The underlying reason for a loss is known as its “root cause”. A cause and effect diagram is one way of determining the root causes for losses. By producing a diagram participants can see why and where losses occur in the process. Once the diagram is complete, a group “Dear Abby” letter will be written as a definitive statement of the problem to ensure that all participants are in agreement and can identify the reason for the loss.

4. Brainwriting: Because there are many ways to address a problem, this exercise is designed to help participants generate as many alternatives as possible to minimize loss. Each participant writes two ideas on a sheet of paper, the papers are exchanged, and two more ideas are written. This process continues until all ideas are exhausted. The team then discusses the ideas and produces a viable list of alternatives.

5. Bubble-up/bubble-down: Bubble-up/bubble-down is just one of the many evaluation methods available for ranking alternatives to determine the optimal solution. The list of alternatives is ranked by comparing the first two items, arranging them by order of preference, and continuing the process for the second and third items, etc., until the entire list is ordered. Considering each option with such factors as cost, implementability, and effectiveness will help identify the best alternative.

6. Action Plan: Now that the pollution prevention opportunity/opportunities have been identified and alternatives have been discussed, it is time to develop an action plan. This plan details the steps that need to be taken to implement the alternative and reduce or remove the loss from the process.

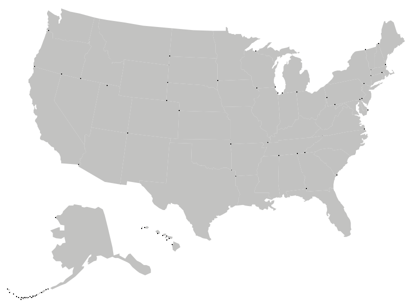
Each of these tutorials will take approximately 60 to 90 minutes to complete. We hope you will find the tutorials enjoyable and useful in your future management practices.

Table of Contents

Tutorial 1: Process Mapping

To begin incorporating pollution prevention into your business, you must first get a full understanding of where wastes are being generated. This tutorial will discuss the advantages of using process maps to logically evaluate each step of your process.

Warm-up Exercise



Maps have been used throughout the ages for many purposes from helping sailors navigate the seas to providing a safe route for climbers hiking to the tallest peaks. You have probably drawn maps to your home or office so that someone could visit. It is important that the information on this map is complete and accurate or, as you may have found, your guest will get lost!

Take a minute now and think of a coffee shop or restaurant nearby that everyone in the group knows. Draw a map from the building you are currently in to this establishment - include traffic lights, landmarks, and any other important features along the way. Now compare maps with the other members of your group. Are they the same? If a person not familiar with the area was to use your map, would they have found their way?

Introduction

Are you aware of the amount of waste that your business generates? Could this waste be turned into profit? By considering methods of reducing wastes, recycling used and unused raw materials, and reusing lost material you could not only help the environment but also reduce your raw material and waste disposal costs.

This tutorial discusses process mapping, a method of analyzing a process in order to catalogue all the materials used and lost in the process. With process mapping, you will systematically identify the series of steps materials pass through as they are transformed into the final product. Evaluating your process in this manner will allow you to recognize the opportunities to prevent losses and possibly streamline operations. Each loss identified during the process mapping is an opportunity to prevent that loss.

During this exercise you will:

Objectives

- Fully understand the functionality of each step of a process.
- Identify the inputs and outputs/losses within the process.
- Communicate findings in a clear and concise manner.

Basic Instructions

This tutorial should be completed by your Green Zia Group.
Please read aloud from here on.
Allow 60minutes to complete.

Process mapping and *Discount Signs*

Jim Davis, a Green Zia participant, arrived at his Green Zia Group meeting full of enthusiasm. He had attended a training session on pollution prevention the previous evening and was surprised to discover the many opportunities for pollution prevention in his business. He was excited to share his findings with the group and help them discover opportunities in their businesses.

“Last night I attended a session on pollution prevention and I would like to repeat an exercise we did on process mapping,” said Jim. “Process mapping,” he continued, “is a method of identifying and documenting every input and output in a process by logically evaluating each process step.”

“Let's start by looking at my sign business,” said Jim. Jim has been operating *Discount signs* for five years and has recently been able to expand. His customers range from other small businesses in the area to consumers looking for unique gifts. The metal signs he produces come in a variety of standard colors and sizes. Jim stressed the importance of asking many questions during the exercise to be sure not to miss any losses.

“When I receive an order, I first cut a piece of metal to fit the specifications,” Jim began.

“Do you have a lot of scrap metal?” asked Cecilia.

“Well,” said Jim, “that's a good question. Sometimes I do have a lot of scrap metal. It depends on the size of the sign I'm making. Normally I just throw the scrap metal away.”

“Next I clean the metal to remove any dirt and oil,” he continued.

“What exactly do you use to clean the metal?” asked John.

“Just soap and water,” he answered.

“Next I brush on a primer to get the part ready for painting and, once that dries, I rinse it in the sink. The paint doesn't stick if I leave out these steps.”

“Finally, I paint the signs to meet the customer s specifications. Sometimes I have bottles of half-used dried-up paint that I throw away: this is one of my losses that I would like to reduce.”

“Do you package the signs for your customers,” asked another group member.

“I used to package all the signs in bubble wrap and then place them in a box, but I stopped doing that. Finding the right size boxes was difficult and expensive, and half the boxes would end up in the garbage in front of my store. Now I use my delivery company to package the few signs that I have to mail out to customers. I guess you could say I already identified that opportunity!”

“What about defects? Do you have a lot of defects? And do you reuse the metal if you can?”

“Do you have many spills? With the paint and paint thinner laying around I would think you have spills from time to time.” asked members of the group.

“I never thought about those things,” replied Jim. “You’re right I do have an occasional defect that makes its way into the trash. Normally the defects are due to cutting the metal too small or making a mistake with the lettering. If it's just a lettering mistake I remove the paint with some thinner and salvage the part, but if I cut the metal to the wrong specifications, I throw it out. I should really think of that some more. As for the spills, I try to keep a clean shop to keep spills at a minimum but I do have an occasional spill.”

Now that the group talked about the process in detail and discussed all the inputs and outputs, the next step was to create the process map.

“Let's present all this information pictorially by creating a process map,” said Jim. “Make a box and define the first step with a one or two word identifier such as *Cut Metal*. Put an arrow into the top of the box for each input and put an arrow coming from the bottom of the box for each loss. Then draw an arrow from the right side of this box into the next box, defined by the second step. Continue this procedure until the entire process is defined."

The group began mapping the process. *(See Figure 1)*

"As you can see," said Jim, "my inputs are metal, soap, rags, water, paint, and paint thinner, and my losses are scrap metal, soapy water, used rags, paint, and paint thinner. Each of these losses is actually costing me money so reducing them will translate into additional profits. Plus if I can reduce these losses I will be helping the environment. Definitely a win-win situation."

"I can see how you can benefit from pollution prevention," said Benito, "but I own a small restaurant. I don't see how pollution prevention can help me make sandwiches."

Jim replied, "Don't you have any losses? Stale bread, napkins, or maybe cleaning products?"

"Yes," responded Benito.

"Well, where there is a loss, there is an opportunity to prevent that loss. Let's look at your operation next time."

Discussion Questions/Activities

1. What did Jim discover by creating a process map?

2. How was Jim preventing pollution in his business? How was he benefiting from it?

3. What did Jim discover by discussing his process with his Green Zia Group?

4. Use the attached form to create a process map of your operation. You may need to modify this map by adding or removing more boxes, arrows, etc. Explain your operation to the group by walking them through your process map.

5. Bring your process map to your business. Go through your process step-by-step ensuring that you have not left out any steps or materials. Update your process map, if necessary, and bring it to the next meeting: you will need to refer to it.

6. Did you find this tutorial useful? Why or Why not?

7. Were the tutorial exercises clear? If not, please specify which ones were unclear and why.

At the next meeting, Activity Based Costing will be presented to examine the value of material losses.

Process Map

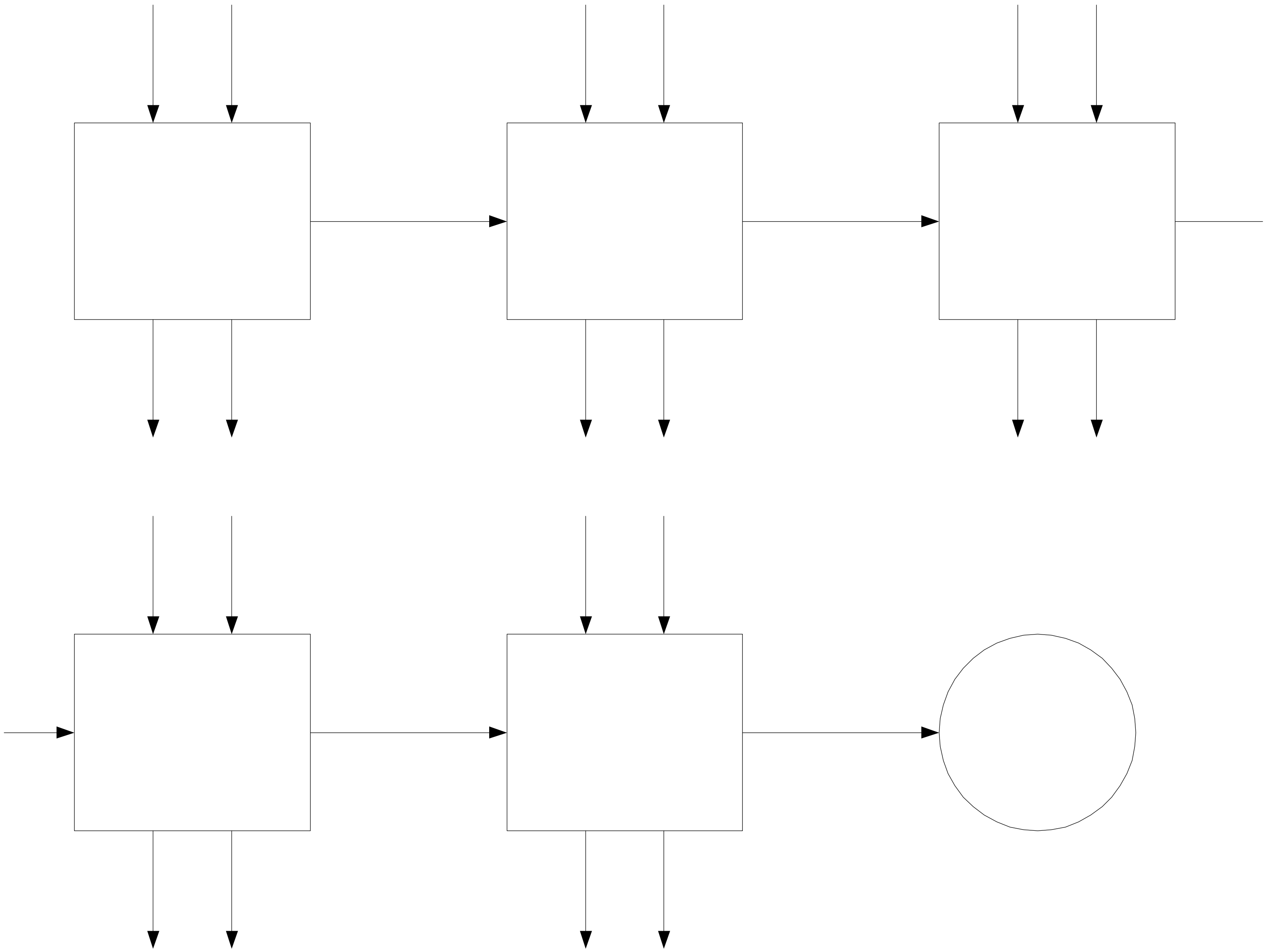
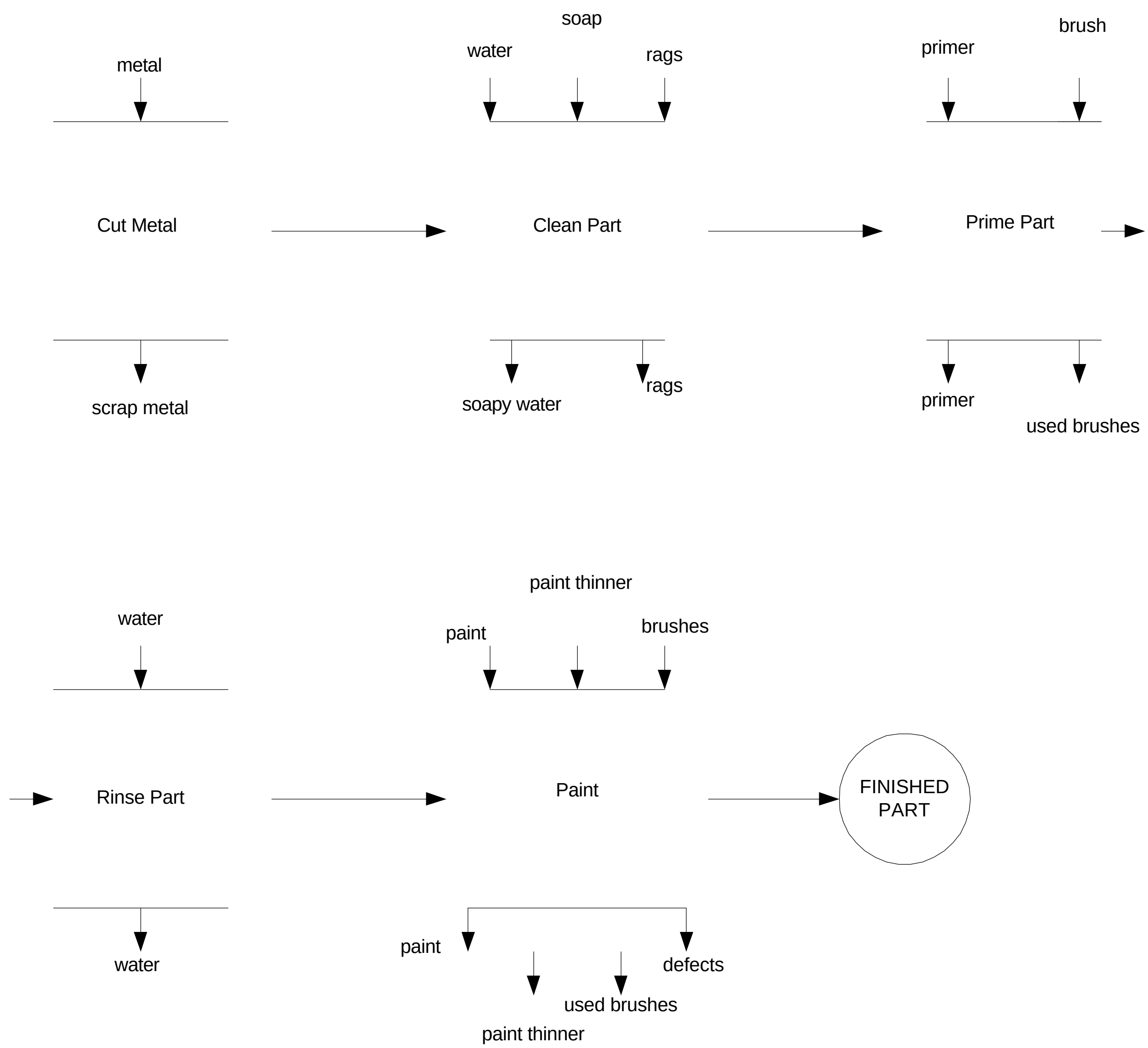


Figure 1: Discount Signs Process Map



Tutorial 2: Activity Based Costing

Every waste or environmental loss costs you money. By determining the activities that cause waste, you can focus your pollution prevention efforts to minimize the cost to your business and protect the environment. This tutorial will introduce you to a method of evaluating your waste.

Warm-up Exercises

Your daughter approaches you one evening and says that she is planning to buy a car. With the $400 she has left over each month, after paying all of her bills, she is sure she will be able to afford the $220 monthly car payment.

What are the other costs of operating and maintaining a car that she is forgetting? Consider not only the annual costs, such as insurance, but also the intermittent (once in a while) costs. Can she really afford this car?

Introduction

Once you have determined the losses in your process, you can begin to discover how these losses are affecting your "bottom line". How much does it cost you to discard 10% of your raw materials, or 2% of your finished products? Which activities have losses that most hurt the profitability of your company? In this exercise we will take a look at the cost of the losses in your business and see how much these losses are costing you. The results may surprise you!

Activity based costing, or ABC, is a method of accounting for a certain type of cost by assigning each cost to the activity that generates it. In the warm-up exercise you used ABC to account for all the costs associated with operating a car, now you will use ABC to account for all the costs associated with the losses in your business, also called your environmental costs. Environmental costs include the costs of raw materials that are discarded, fees paid for hazardous materials disposal, and regulatory fines associated with a loss to name a few. As you saw in the warm-up exercise, there are many hidden costs that should not be overlooked.

Which losses should you be most concerned about? The Pareto principle, or 80/20 Rule, suggests that 80% of the problems in a business come from 20% of machines, raw materials, or operators. (The same is true for any facet of a business, for example, 80% of sales comes from 20% of the customers, etc.) Once you have assigned costs to your activities, you can figure out which 20% of your activities are contributing 80% of your costs. A Pareto diagram visually depicts total costs for each activity, making the biggest cost-drivers very apparent. The most prominent pollution prevention opportunities can then be targeted for improvement.

During this exercise you will:

Objectives

- Identify all the environmental costs in a process (that is, the costs associated with your losses).
- Assign each cost to an activity.
- Create a Pareto diagram depicting the total cost for each activity.

Basic Instructions

- This tutorial should be completed by your Green Zia Group.
- Please read aloud from here on.
- Complete all exercises as they appear.
- Allow 90 minutes to complete.
- Please have the process map you created in the last exercise readily available. You will need to refer to it.

New Terms

Activity based costing (ABC) - An accounting method used to assign the cost of your losses to the activities that generate these losses. By assigning costs to activities, you will discover the activities should be targeted for prevention.

Environmental costs -The costs associated with the losses in your process.

Pareto principle - A principle that suggests that 80% of anything can be attributed to 20% of the factors involved. For example, 80% of your environmental costs can be attributed to 20% of your activities.

Intermittent operations - Operations that occur once in a while.

Activity Based Costing in a Restaurant

Benito runs a small restaurant in downtown Farmington. After attending the session on process mapping, he is still unsure of how pollution prevention can work in his business. Benito decided to create a process map of his most popular lunch item, a chicken sandwich, to see if he could identify the losses. *(see Figure 1)*

“I mapped out the process of making a chicken sandwich,” said Benito at his Green Zia Group meeting, “and I found several losses. Most of my losses have to do with food being spilled, such as bread and chicken. But I also have several losses associated with cleaning the restaurant. I'm not sure how this ties into my process. But these losses are very important to me because they cost me a lot of money.”

“That activity,” said Jim, “is called an “intermittent operation”, or an operation that occurs once in a while. Intermittent operations can be mapped separately.”

“I see. The preparation area is visible to all the customers. Having food and ketchup all over this preparation area, as well as on the floors where the customers wait, and below the tables where people eat, is very unappetizing. Preventing spills will go a long way towards keeping these areas clean. Keeping the floors clean is very difficult, especially when we are at our busiest between 11:30 am and 1:30 pm. The other reason I like to maintain a clean restaurant is because I never know when the Farmington Health Department will be coming in to do its annual inspection. The inspection always goes better if the restaurant is tidy.”

“What do I do next?” asked Benito.

“The next step,” said Jim, “is to determine the losses (and thus the activities where these losses occur) that drive your costs. You will assign dollar values to each loss by the activity that generates it. Then we can evaluate the activities that are costing you the most. First you need to summarize all your activities and all your losses. List all your activities as they appear on your process map and any intermittent activities that may be important. Then you can summarize your losses."

Benito listed his activities:

List of Benito's activities:
Clean working surface
Take order
Cut bread
Make sandwich
Wrap sandwich
Clean restaurant

Exercise

Make a list of all the activities in your operation. Be sure to include the activities from your process map as well as any intermittent operations (such as cleaning or maintaining equipment.)

Benito then began to look at his losses. Again he referred to his process map. Benito's losses include soapy water, paper, bread wrappers, improperly cut bread, crumbs, odd pieces, etc., food wrappers, chicken, cheese, etc., mistakes, containers, condiment spills, and sandwich wrappers. Other losses not on Benito's process map include cleaning agents, dirty rags, etc.

Exercise

List all of the losses in your operation. Look on your process map and add any others that you think of.

"Great," said Jim. "Now start to think about all the types of costs that are associated with these losses. When you think about the mistakes you have when you make a sandwich, don't just include the cost of the raw material that gets thrown away. There are other costs too. For example, the cost of the time spent making the sandwich and the cost of the unhappy customer that waits too long."

Benito summarized his cost categories. "Well, there are many costs associated with the wasted raw materials; bread, chicken, cheese, vegetables, condiments etc. I have to store these products this also costs me money. The other costs that are associated with the mistakes are the cost of my time spent making a sandwich that then gets thrown away, as you just mentioned. The further down the line a mistake is made, the more valuable the sandwich is, since additional foods are being added and additional time is being spent on its preparation. This concept is known as the "value added" to a product. I also have the cost of a potential lost customer: they may go away dissatisfied if I make them wait too long or give them the wrong order. Finally, there are the costs of the paper that I use to take orders and pieces of wrap that get thrown away."

"What about the cleaning you do?" asked Cecilia. "You said earlier that this is a big concern of yours."

"Yes, you are right. There are costs associated with the cleaning. The more cleaning I need to do, the more cleaning agents I must use. Excessive cleaning also leads to an excessive laundry bill from all the aprons and towels that must be cleaned. This takes up a lot of my time. By preventing spills, I could reduce these costs."

"Then there are costs associated with inspections and other health issues. If the regulators come in and the restaurant is not clean, the inspection will not go well. I will need to spend a great deal of time with the regulators and I could end up with a few fines and a lot of paper work. In fact, this just happened a couple of weeks ago. An inspector came in at 1:30 right when the place looks the worst. I spent the entire afternoon with him and ended up with a fine because I didn't have the storage room in order. I know if the place looked better, he wouldn't have issued the fine because I didn't have any major violations."

"If a customer gets food poisoning, such as salmonella, because the food is not properly stored or handled I could potentially be shut down. I'm careful not to allow this to happen. My other big concern is if mice get into the building they could get into the bread I keep in storage. The Health Department always checks for signs of mice, and the lost bread costs me a lot," Benito continued.

"Make a summary list of all of your cost categories that are associated with the losses in your operation," said Jim. "Next to each cost category, write the activity that the cost can be attributed to. Think about the steps, or activities, in your process when you waste your time because of the losses that occur during this activity.”

Benito listed all his costs categories.

List of the cost categories and. activities associated with these costs:
Raw materials (Take order, cut bread, make sandwich, wrap sandwich)
Lost customers (Clean working area, make sandwich)
Time (Cut bread, make sandwich)
Regulatory Fines (Clean working area, clean restaurant)

Exercise

Create a list of the cost categories associated with the losses in your operation. Next to each cost, write the activities that the cost can be attributed to.

“Now that you've listed your activities, your losses, and your cost categories, with the activities that cause these costs, you should set up a table with this information we'll fill it in later,” said Jim. List all the different costs in the first column, such as the cost of raw materials etc., and across the top of the table list all the different activities, such as taking orders,” he continued. *(see Table 1)*

Exercise

Use the attached table for your costs and activities. Put all your cost categories in the first column, and all of your activities in the first row.

“Your activities and your costs are summarized,” said Jim. “Now your need to assign a dollar value to each cost by the activity. For example, in the second row, second column, you will enter the cost of the raw materials lost when you take an order.” *(see Table 1)*

“At this point, though, because you don't have all the information for all of your costs, divide $100 among all of your cost categories based on their relative weight. Think about all your costs (due to the losses in your operation) from last month,” said Jim.

“So I should take $100 and divide it up based on how much I think raw materials, lost customers, time, and regulatory fines cost me last month,” said Benito.

“That's right,” said Jim. “And these values should be based on the costs of your losses. That is, you wouldn't include the costs of all of the time spent by you and your employees, just the cost of the time required to cleanup or the time wasted when a mistake is made. This will give you a pretty good estimate.”

“Well, I would have to say when considering these costs from last month, the regulatory fine I received is my biggest expense. Probably close to half. I'll call it $47.50,” Benito began. Benito continued to estimate his costs. “I also noticed that some of my regular customers haven't been around as much lately. This is my next biggest costs. I'll call it $25.” Benito finished assigning his total costs.

“Place these values in the row marked TOTAL COST,” instructed Jim. “And then continue to assign costs by dividing up the TOTAL COST value for each cost into costs per activity. For example, if the total cost of raw materials lost is $15, how much of this cost is due to lost bread during the “Cut Bread” activity? Fill all these values into the table. Add up all the costs by activity (i.e. each column) and calculate the percent.” *(see Table 2)*

Benito considered each cost. He broke down the $47.50 for the regulatory fines into the two activities that had to do with cleaning the restaurant. After all, if the restaurant was clean, he would not have received this fine. Next he divided up the $25 for the cost of lost customers. A small part of this cost, he figured, may have been due to mistakes. Thus, he assigned $2.50 to the make sandwich activity. The rest of this amount ($22.50) he divided among the two cleaning activities. Benito continued until all the costs were divided.

Exercise

Fill in the column marked TOTAL COST in your table. Take $100 and estimate the relative amounts of this total that should be attributed to each cost category. Once you have finished entering TOTAL COST values, divide up the totals to the individual activities in each cost category. Fill these values in as well. Total each column.
Note: If you wish, see how well you estimated these costs by updating this table based on your actual expenses.

“Reading a graph is always easier than trying to interpret a table, so we are going to use the information from the table and create a Pareto diagram. It is easy to do. Along the horizontal line, list all your activities. The vertical line will represent the relative cost represented by each activity." *(see Figure 2*

Exercise

Using the attached graph to create a Pareto diagram. Write all your activities, as they appear in your table, in the boxes marked activity 1, etc. Now, for each activity, draw a bar up to the total cost for that activity (again as they appear in your table.)

"As you can see from the graph a majority of the costs associated with the losses from Benito's restaurant are from the cleaning operations, or just two of the activities. The Pareto principle suggests that 80% of the problems in a business come from 20% of machines, raw materials, or operators. This example demonstrates this principle. From this information, Benito now knows that he should focus on his cleaning operations. If he does this, he can increase his profitability by reducing his environmental costs."

Discussions Questions/Activities

1. What is the Pareto Principle? Think of an example of how this principle holds true in your life (business or personal).

2. What advantages are there to graphing the results of your analysis?

3. What activity drives the environmental costs in your operation? Share this information with the group using your Pareto diagram.

4. As an optional exercise, spend some time between now and the next meeting and determine your actual costs. Some of these costs may be hidden or hard to determine. For example, how do you put a dollar value on your time? To put a value on your time, or the time of your employees, you need to consider what is called the "fully burdened rate". When you calculate the fully burdened rate, consider not only the hourly rate you pay, but also the cost of all benefits. For example, if you pay someone $7 an hour to work the counter and you also provide some health benefits and sick time, they are probably costing you as much as $10 an hour. Now consider the cost of your time. If you pay yourself $20 an hour, with all your benefits this number is probably more like $30 an

hour. This brings up a couple of points. First, if someone is needed to perform tasks like cleaning the floor, you should assign the least specialized person on your staff - the person you are paying the least. Second, consider these fully burdened costs when you determine the total cost of a person’s time since this is what the person's time is actually costing you.

The next tutorial will present Root Cause Analysis - a method to identify the factors which are causing material loss.

Figure 1: Chicken sandwich - Process Map

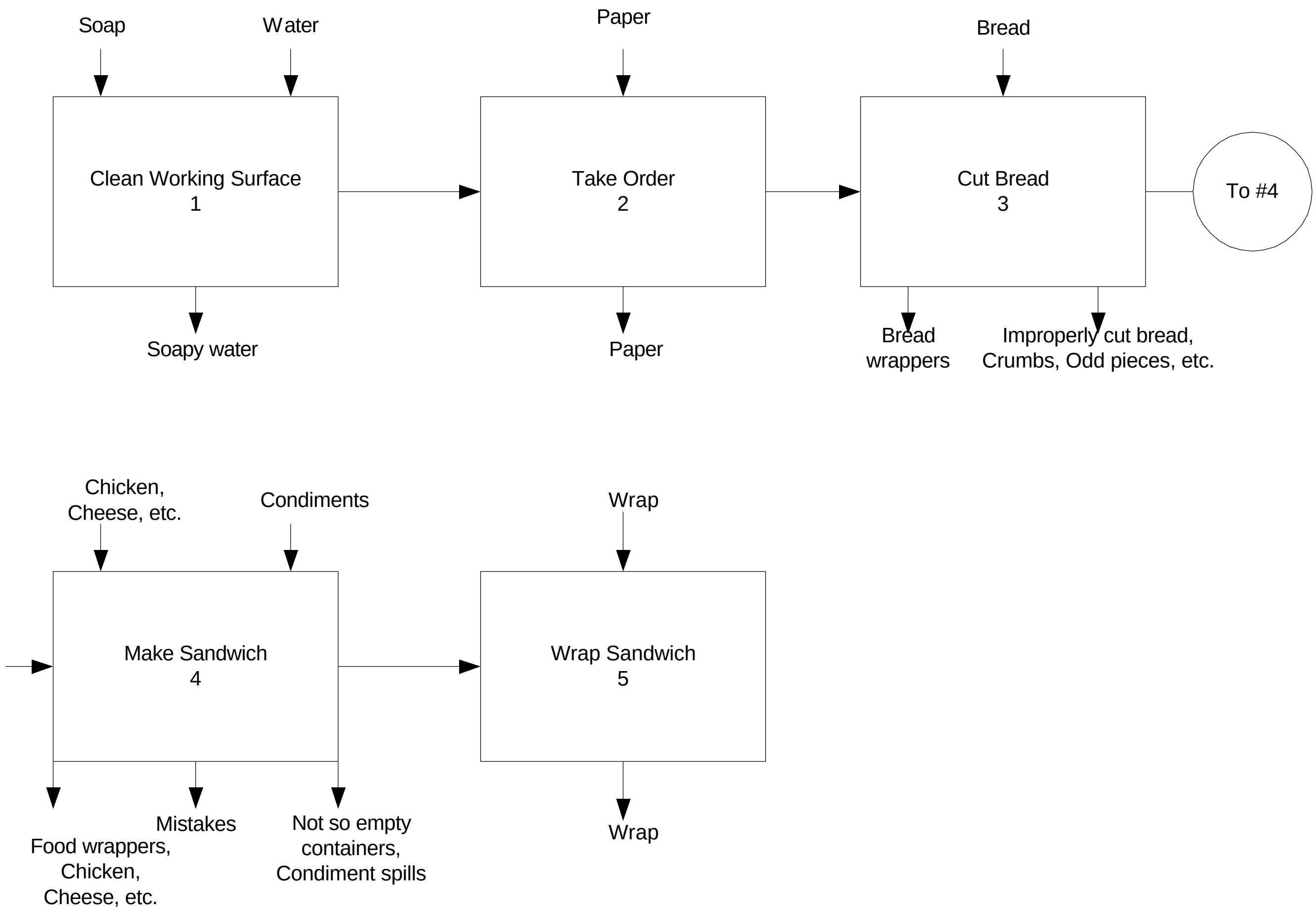


Table 1

Cost	**TOTAL COST**	**Take Order**	**Clean Working Area**	**Cut Bread**	**Make Sandwich**	**Wrap sandwich**	**Clean Restaurant**
Raw Materials							
Lost Customers							
Time							
Regulatory							
TOTAL By Activity							
Percent							

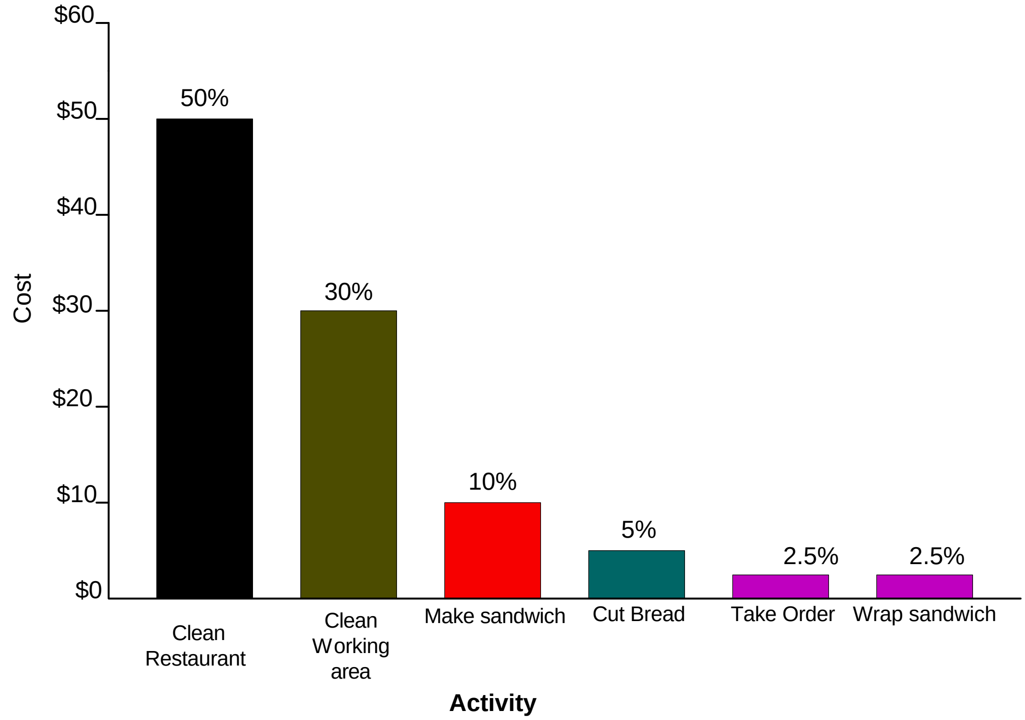
Table 2

Cost	**TOTAL COST**	**Take order**	**Clean Working area**	**Cut bread**	**Make Sandwich**	**Wrap sandwich**	**Clean Restaurant**
Raw Materials	15	2.50	0	2.50	5	2.50	2.50
Lost Customers	25	0	10	0	2.50	0	12.50
Time	12.50	0	0	2.50	2.50	0	7.50
Regulatory Fines	47.50	0	20	0	0	0	27.50
TOTAL By Activity	100	2.5	30	5	10	2.50	50
Percent		2.5%	30%	5%	10%	2.5%	50%

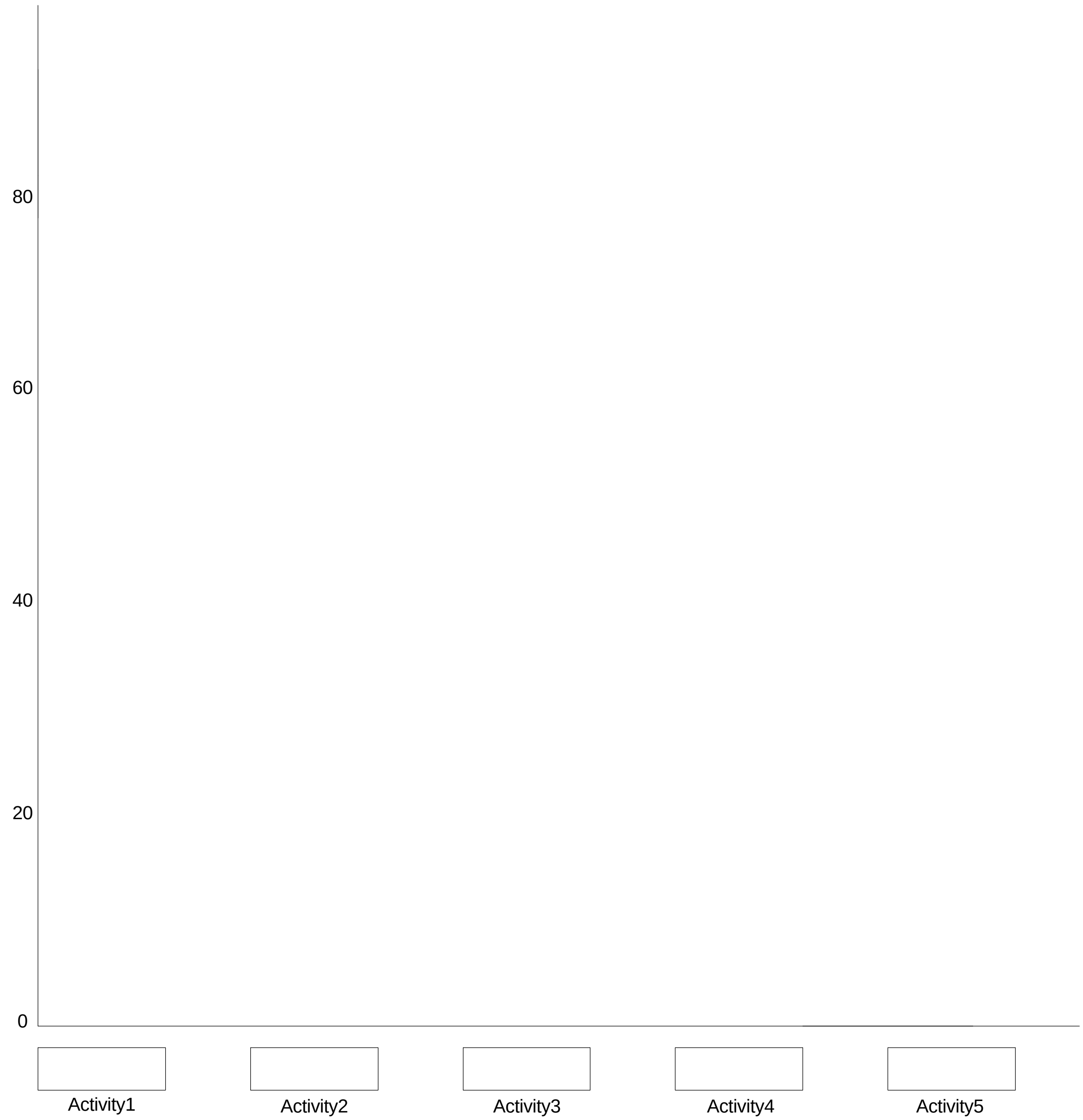
Activity Based Costing

Cost	TOTAL COST						
TOTAL By Activity							
Percent							

Figure 2: Chicken sandwich - Pareto diagram



Activity Based Costing: Paredo Diagram



Tutorial 3: Root Cause Analysis

Now that you have recognized the activities in your process that are costly or expensive to your business, you can begin to focus your efforts on pollution prevention. This tutorial presents a method of detecting the underlying reason for an environmental loss so that the loss can be prevented.

Warm-up Exercise

Think of all of the times that you have been late for work and list the different reasons for your delay. Maybe your alarm clock did not go off, or perhaps your child was sick and you needed to arrange for a sitter. Did you spend too much time reading the newspaper or did you need to run to the store to pick up milk.

Arrange all these reasons in the categories listed below, or create an additional category. Some of the items on your list may be entered more than once.

Now consider the last time you were late for work. Why were you late? Circle the reason.

MACHINES broken alarm clock	PEOPLE sick child
METHODS reading the newspaper	MATERIALS out of milk

Introduction

In the last tutorial you determined the key losses responsible for the greatest amount of environmental costs. In order to try to prevent a loss, you must first understand why it is occurring. The underlying reason for a loss is also known as its "root cause". The root cause will answer the question: What *ultimately* caused the loss? Determining the root cause of an environmental loss is very similar to determining the root cause of being late for work

A cause and effect diagram is one method of determining the root cause for a loss. This tool provides a visual description of all possible causes for a specific loss. Once all the possible causes are depicted on the diagram, the most plausible cause or causes are identified. It is imperative that all persons involved in determining the root cause are in agreement. Having each team member construct a "Dear Abby" letter summarizing the cause or causes for a loss will ensure that all participants see the problem in the same way.

During this exercise you will:

Objectives

- Construct a cause and effect diagram with all potential causes for a loss.
- Discuss the most probable cause or causes.
- Write individual Dear Abby letters describing the reason for the loss.
- Write a group Dear Abby letter taking the best ideas from each letter.

Basic Instructions

- This tutorial should be completed by your Green Zia Group.
- Please read aloud from here on.
- Allow 60 minutes to complete.

Root cause analysis and *Belen Jewelry*

Cecilia Williams owns and operates a jewelry business, *Belen Jewelry*, specializing in beaded earnings and necklaces. With four to six part-time employees, she produces up to one-hundred items each day that she then sells to department stores.

After participating in process mapping and activity based costing exercises, Cecilia determined that her largest loss, the high-quality beads she purchases, accounts for approximately 80% of all her environmental costs. Cecilia was anxious to discuss this loss with her group and hoped that by talking through her problem she could discover the root cause of this loss.

“I knew I was throwing away some of the raw materials that I purchase,” Cecilia began, “but I could not believe how much this one waste is costing me. The result of my process mapping and activity based costing exercises indicated that the majority of my costs associated with wastes come from beads that are lost during all stages of the process. I really would like to spend some time getting to the bottom of this problem.” *(see Figure 1)*

Cecilia had done some research on methods of determining a root cause, including the use of cause and effect diagrams. She went on to explain the use of cause and effect diagrams.

“Let's spend some time discussing root cause analysis. To determine the root cause of a loss, you must ask “Why is the loss occurring?” I read about one way of gathering information concerning the generation of a loss called a cause and effect diagram, or fish bone diagram, since it resembles a fish bone. Major categories of possible causes for the loss are first defined and entered on the diagram as an off-shoot from a main horizontal line. Next, all possible causes of the waste are assigned to a category and entered on the diagram. Once all the causes are defined, an agreement is made as to the most plausible reason for the loss.”

“I have divided the causes into four major categories - Methods, Machines, Materials, and People - and what we need to do is write down all the possible reasons why I could lose beads in my process and assign them to a category," she continued. "I started the diagram and wrote down some of the things that immediately came to mind."

"The first thing I thought of is my supplier. Normally the shipments are very good, but occasionally I get a shipment of beads that aren't very consistent. Some of the beads are different sizes and sometimes the shapes and the hues are slightly different and I can't use them. I also can lose beads when the chains break, but this doesn't happen very often. The other things I wrote down are that beads can get damaged when they are in storage either because the heat causes them to get deformed or because they are not stored properly: we don't really have any storage policies in place. Also the shop is a little small and sometimes it gets cluttered, so beads are easily spilled. Finally, I have a pretty high rate of turnover in my employees especially due to the cyclical nature of the business and I don't think I have been able to convey how important it is to prevent losses."

"Those are the main issues I thought of, can anyone think of anything else?" asked Cecilia.

"Yes," Jim replied, "You didn't mention anything about training. I know in my business when I put a formal training program in place, I saw a large improvement in the way raw materials were being used."

"That's a good point. Currently I don't do any training," said Cecilia.

Other ideas were also mentioned. One person brought up the importance of inventory control, after all, you would not have losses associated with parts being damaged in storage if there were no parts to be stored! Someone talked about the surroundings such as the importance of proper lighting in the workplace. Still another issue raised was process control, or the movement of material throughout the process. All these ideas were entered onto the diagram. *(see Figure 2)*

"Now that all the possible causes of beads being lost during the process of making beaded jewelry were categorized, it is time to determine the most probable cause. Let's go back to the diagram and circle the most probable causes. One of these should be the root cause. After much discussion, the team reached their conclusion. The lack of employee knowledge and training has lead to the excessive losses of beads. Cecilia suggested that each member of the group write a short "Dear Abby" letter describing their interpretation of the problem to ensure that each person sees the problem the same way. After each letter was read to the group, a joint letter was written with the best ideas from each. Once the letter is in place, the group becomes Abby and seeks to solve the problem. *(see Figure 3)*

Discussion Questions/Activities

1. What is meant by the "root cause" of an environmental loss and why is it important to identify it?

2. Why is it important that all members of a group see a problem the same way?

3. Recall the activity that you identified as driving the environmental costs in your business. Write down all the possible reasons for this loss on the attached fish bone diagram.

4. Discuss your diagram with the group. Add any additional causes based on this discussion.

5. Circle the most probable cause and write a Dear Abby letter describing the problem. Read your Dear Abby letter aloud.

6. If other people work with you ask them to write down how losses occur in your business. Examine whether there are additional factors causing the loss that you did not think of.

7. Please give feedback on this exercise:
   - Was it useful?
   - Was the group response to Dear Abby productive?
   - Will you repeat this exercise to examine business losses in the future?

8. Were the tutorial exercises clear? If not, please specify which ones were unclear and why.

The next tutorial will present brainwriting - a method to generate ideas.

Figure 1: Beaded jewelry - Process Map

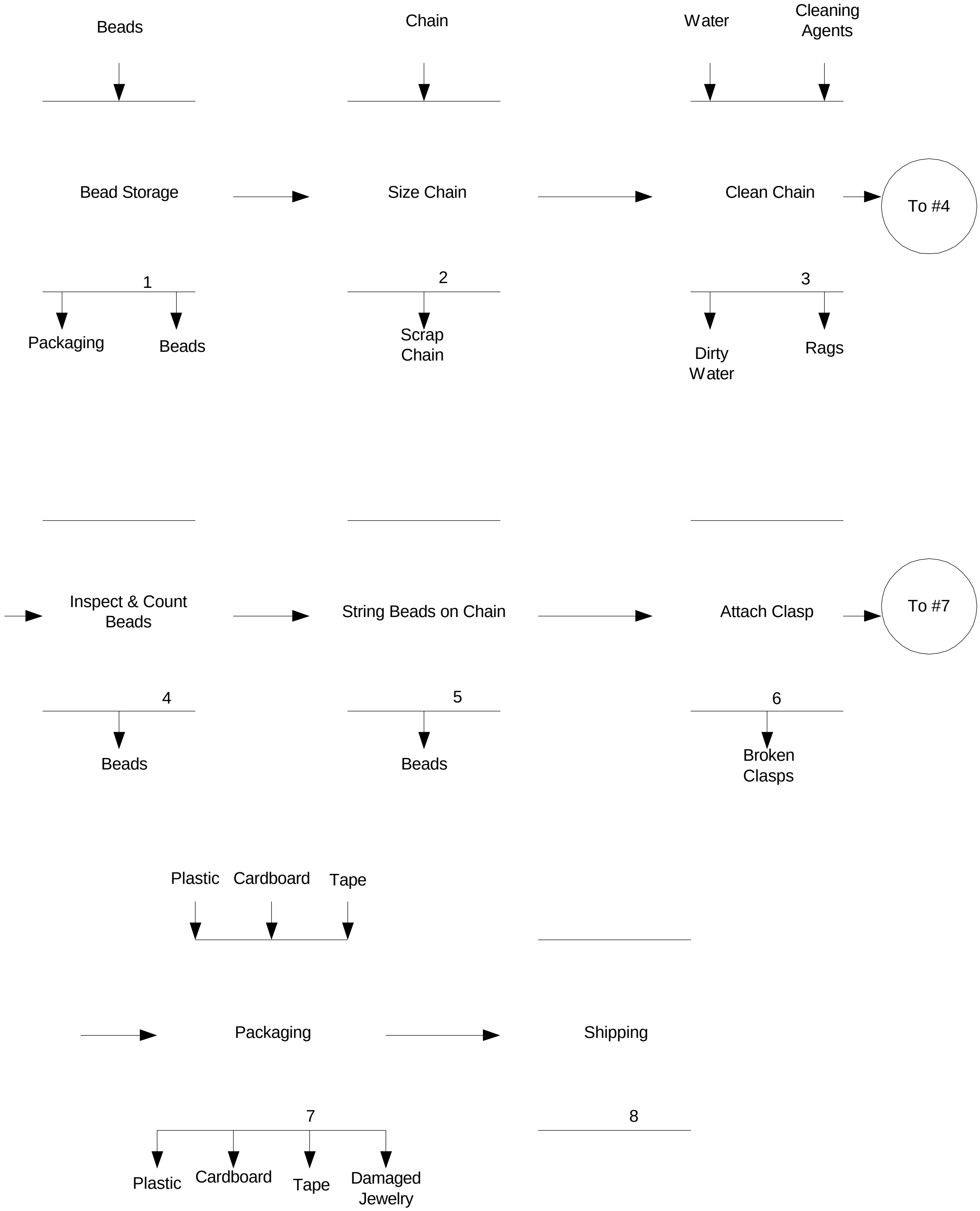


Figure 2: Cause and Effect Diagram

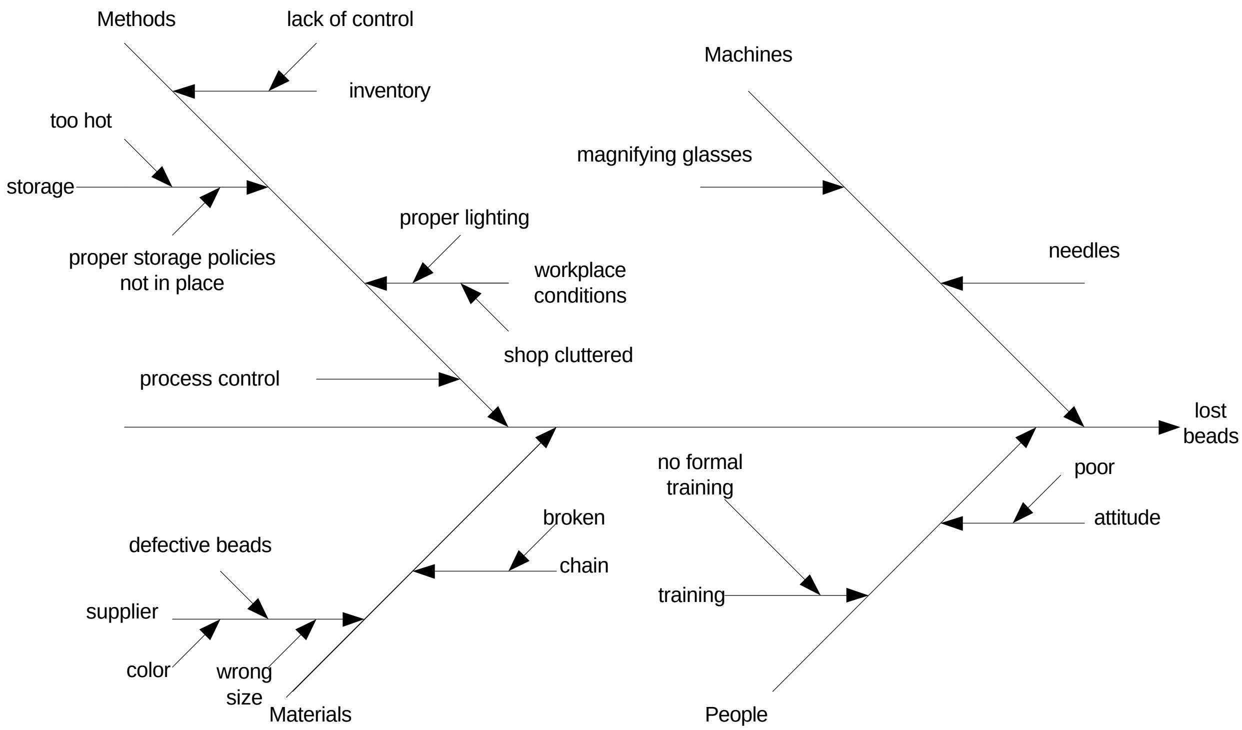


Figure 3: Dear Abby *Letter*

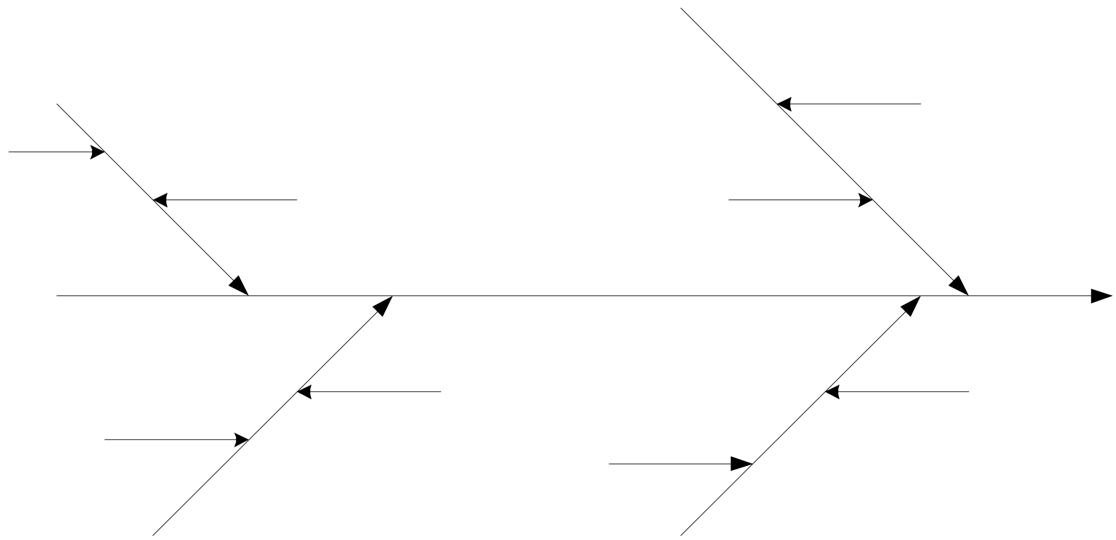
Dear Abby,

I'm losing my beads!! I make and sell high quality beaded jewelry. The cost of the beads keeps rising and my profits keep going down. I'm afraid more beads are landing on the floor and being thrown away than are going into the jewelry. I'm losing a lot of money especially when the shop is busiest. Finding well trained employees is very difficult. My employees work very hard but they do not realize the importance of being cautious when working these high-priced items. I guess I'm not communicating this to them effectively. Maybe I need to conduct training sessions to really make them understand. I hope you can give me some advice.

Sincerely,

Beadless in Belen

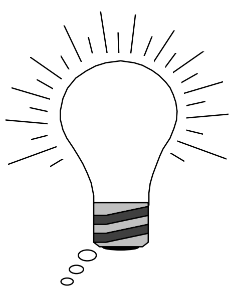
Root cause analysis: Fishbone Diagram



Tutorial 4: Brainwriting

To address an opportunity effectively, it is important to recognize all alternatives. Very rarely is there one "right" way of preventing pollution. Instead, there are many different potential solutions. This tutorial presents a technique of listing many different alternatives for an opportunity.

Warm-up Exercise



You know the old adage “two heads are better than one”. This is especially true when trying to come up with new ideas. When you generate ideas in a group you will notice that each member of the group brings their unique set of experiences and strengths to the table.

Try the following exercise with your group. Look at the picture below (turn it on it's side and upside-down). What does it remind you of? Write down all the images that come to mind-even images that seem crazy should be included. Now go around the room, each person sharing one image with the group. One person should volunteer to keep a list of all the images. Repeat this step until every member of the group is out of images. How many images did the group come up with? How does this compare with the number of images you generated alone?

Introduction

In the last tutorial you evaluated all the probable causes of a loss and determined the underlying reason, or root cause. Once the root cause has been identified, you may be tempted to jump to a premature solution. When you address a loss without considering all the alternatives of prevention you may be overlooking the most appropriate option(s).

Looking for alternatives for pollution prevention by addressing its root cause is the next step towards addressing an opportunity. There are several tools available to help groups develop alternatives. You already explored one tool during the warm-up exercise. In this exercise you will explore another method-brainwriting. Brainwriting requires maximum interaction and creativity between group members. All possible alternatives, regardless of how far-fetched they appear, are considered by the group. Alternatives raised by the group may seem contradictory, or they may build on one another making them better. A comprehensive list of alternatives can then be compiled.

During this exercise you will:

Objectives

- Conduct a brainwriting session.
- Develop a list of all possible alternatives for an opportunity.

Basic Instructions

- This tutorial should be completed by your Green Zia Group.
- Please read aloud from here on.
- Allow 90 minutes to complete.

Brainwriting and *Sam's Garage*

Sam Rogers, the owner of *Sam's Garage*, provides automobile maintenance at his shop. One of the regular, most profitable services he provides is oil changes. Looking for ways to further increase the profitability of this operation, Sam mapped out this process, indicating all losses. *(see Figure 1)* Sam discovered that 80% of the environmental costs associated with changing oil were due to oil spillage. Not only is oil expensive, but because it is considered a hazardous waste, Sam must handle these spills very carefully.

The largest spills take place when the oil is being added. After evaluating all of the possible causes for oil spillage during the "Add Oil" stage of the process, Sam determined the root cause for this loss. The quart-size containers that are currently used are difficult to pour into the small fill cap.

Sam shared this information at his Green Zia Group meeting.

“As you can see,” Sam said after explaining the process to the group, “during the “Add Oil” stage of this process, a lot of oil is being lost. This loss translates into less profit for the Garage. I created a cause and effect diagram with the mechanics and we decided that the oil containers are awkward and hard to pour from. We thought of a few things we could do to reduce spills, and I already think I know the best solution, but I was hoping the group could help me think of some additional alternatives.”

“I have an idea,” said Cecilia. “I was reading about a method of listing alternatives called brainwriting. The goal is to write down as many ideas as possible regardless of how crazy they seem. In fact, to make it more interesting we can give a prize to the person that comes up with the craziest idea. Since there are five of us here today, I will use six sheets of paper. Each sheet is divided into two columns and five rows, making a total of ten boxes on each sheet. Each box is numbered. I'm going to place these sheets in the center of our circle. Each person should take a sheet and write two alternatives on it and then place the sheet back in the center. Then take another sheet of paper and write two more alternatives on it. Every time you pick up a sheet of paper read what others have written and try to make improvements to the alternatives listed. You can even say you think someone's idea is completely out in left field, if you try to make it better. Keep repeating this process until everyone runs out of ideas."

The group performed this exercise. A lot of laughing and talking took place during the free flow of ideas. This is a key sign of a successful brainwriting session. *(see Figure 2)*

"Now we can list all the alternatives that were discovered," said Sam.

The alternatives on each sheet of paper were read and discussed. Many of the ideas were the same and some had small variations. The group debated these small variations and eliminated the impossible alternatives. One comprehensive list was developed-each idea was only written once, although all variations of the same idea were included.

"We talked about a couple of these alternatives at the Garage," said Sam, "but this definitely helped me come up with some additional things. I really like the idea of ordering the oil in bulk and running a fill line overhead. That will help keep the shop clean too. Employee training is also a good thought. I was hoping that by including the mechanics in this exercise I could also be providing some training."

"That gave me a thought for another alternative," said Cecilia. "Maybe you could provide some sort of incentive for employees who achieve pollution prevention."

"I'll add that to the list of things to consider," said Sam. "Any by the way, who thinks I could get Ford to change the way they design their engines!?! That gets my vote for the craziest idea." *(see Figure 3)*

Discussion Questions/Activities

1. Why is it important for Sam to consider alternative methods for preventing an oil spill (even though he thinks he knows the best alternative)?

2. What are the advantages of an exercise like brainwriting? How does it help members of a group work together?

3. Make "brainwriting sheets" for each member of the group plus one extra, using the attached example as a model.

4. Review the root cause for your loss discovered in the last exercise and state it aloud.

5. Conduct brainwriting sessions for each business represented. Spend at least 5 minutes on each session.

6. When all the brainwriting sessions are completed compile a list of alternatives for your business.

7. Did you find this tutorial useful? Why or why not?

8. Were the tutorial exercises clear? If not, please specify which ones were unclear and why.

The next tutorial will present 'bubble-up-bubble-down' a method for selecting the best option to prevent loss.

Figure 1: Oil change-Process Map

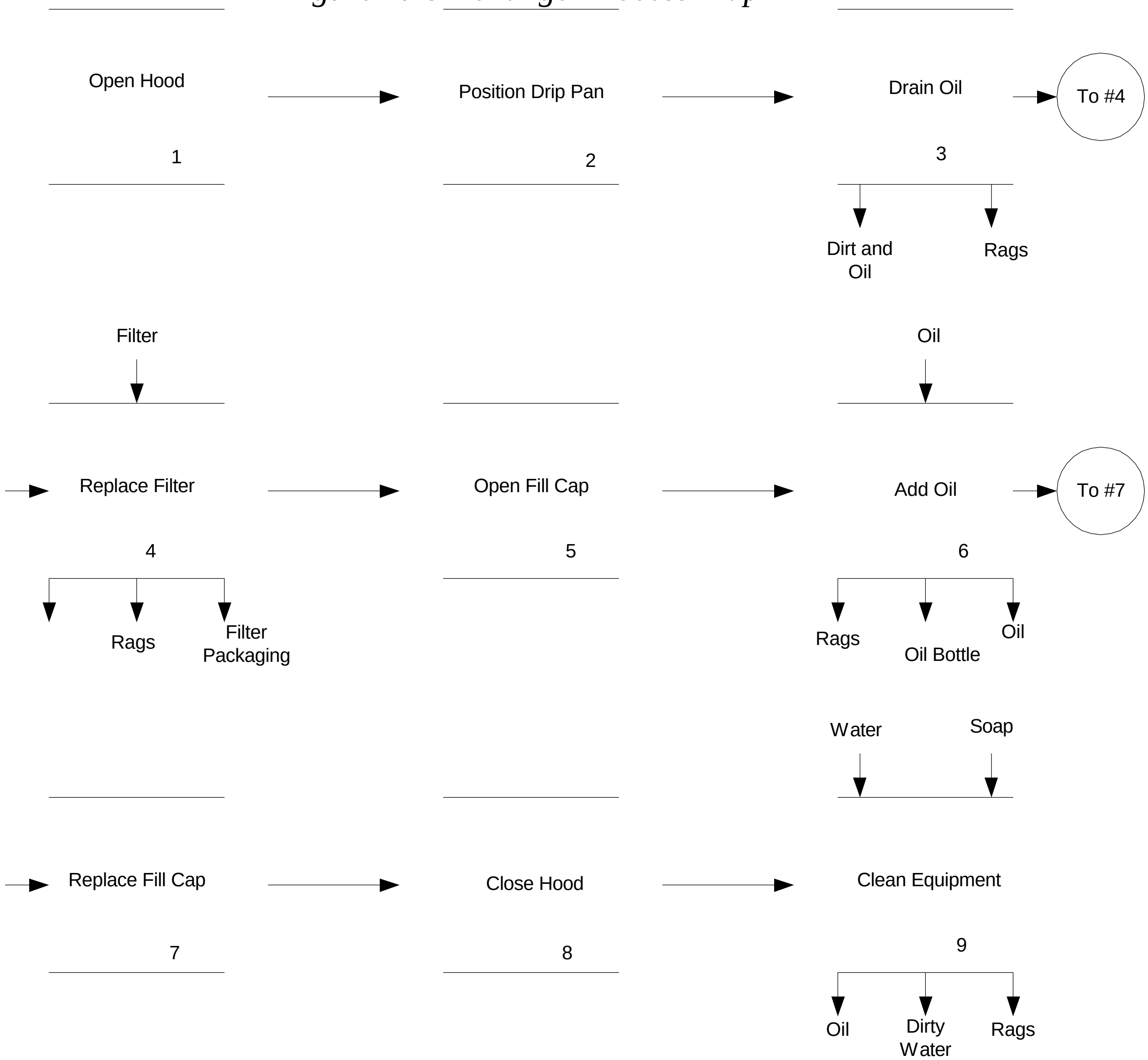


Figure 2: Sample of brainwriting

1. Use smaller oil containers that are easier to maneuver.	2. Buy oil containers that have a spout.
4. Place a drip pan under the engine to reclaim the oil that is lost.	5. Use larger oil containers so there is less residual wastes.
6. Put a spout on the container before you pour the oil.	7. No longer provide oil changes at the Garage.
8. #6 You would lose a lot of customers how about attracting more business so you can afford better equipment?	8.
9.	10.

Figure 3: List of alternatives

- Contact companies that package oil and request a different lip or spout on the quarts of oil.
- Fit a reusable spout onto the quarts of oil.
- Use smaller containers of oil that can be used more carefully.
- Buy larger containers to avoid residual waste.
- Pump oil from 100 gallon containers.
- Fill oil using an overhead line.
- Stop providing the oil change service in garage.
- Use a drip pan to reclaim spilled oil.
- Place a funnel on the fill cap.
- Write the automobile manufactures requesting that the location of the fill cap be moved to a more approachable area in the engine.
- Place suction hoses around the fill cap to reclaim spilled oil.
- Meter oil dispensing only what is needed.
- Train workers on pollution prevention and ways to reduce and reclaim spills.
- Provide incentives for employees who reduce losses.
- Measure thickness of oil ensuring oil is not changed unless it needs to be.
- Attract more customers for oil changes and invest in better equipment.

Figure 4: Brainwriting Sheet

1.	2.
3.	4.
5.	6.
7.	8.
9.	10.

Tutorial 5: Bubble-up-bubble-down

You have now generated a list of alternatives for preventing an environmental loss in your business. But how do you choose the best alternative? This tutorial presents one method of prioritizing alternatives to ensure that the most appropriate alternative is selected.

Warm-up Exercise

Most of us use lists from time to time to make sure that we don't forget to do the things that we need to get done. Without a shopping list, for example, we may return from the store without milk, the reason why we went in the first place. Certain limitations, like time or money, may cause us to drop things off our list. We often need to prioritize and make sure that the most important things get done.

Make a list of the things that you need to get done tomorrow (try to list at least ten things). List these items in the order that they come to mind. Now prioritize this list by putting the most important items on the top of the list and the least important items on the bottom. You should now have a “rank ordered” list. If you only have time to complete one of the items on your list, which would it be? You should have answered the item on the top of the list the most important item.

Introduction

A comprehensive list of pollution prevention alternatives was developed in the last tutorial using a technique called brainwriting. The alternatives generated during this tutorial can range from operational changes, such as employee training and inventory control, to technology changes, such as automating a process. The next step is to choose one alternative that is capable of being worked with successfully. Additionally, it is important to select the optimal solution for your business. To accomplish this, you must consider the *feasibility* of each alternative. Such factors as effectiveness, implementability, cost, and potential ramifications of each alternative should be discussed. Personal preferences and biased information should not enter into the decision-making process.

There are several tools available to aid a group in selecting an alternative and avoid bias. These tools allow a group to rank and prioritize alternatives using a systematic approach. When all the alternatives are listed, suggestions are made by the group to improve even the worst alternatives. At this point, many of the alternatives may be eliminated: every realistic alternative remains on the list. These remaining alternatives can then be sorted based on the factors presented above and any other factors that may effect a particular business. The method of selection presented in the exercise is the bubble-up-bubble-down. This tool uses a forced pair comparison to rank alternatives. Using this method you will be able to find the most effective solution to the selected loss.

During this exercise you will:

Objectives

- Evaluate all alternatives.
- Use the bubble-up-bubble-down method to reach a decision on the best alternative.

Basic Instructions

- This tutorial should be completed by your Green Zia Group.
- Please read aloud from here on.
- Allow 60 minutes to complete.

Bubble-up-bubble-down and *Creative Cabinets*

Lany Weaver has been operating *Creative Cabinets* for ten years. To remain competitive in this business, she has been forced to cut prices on her line of colored cabinets. In order to realize greater profit margin, Lany has been evaluating her process attempting to reduce losses and improve process efficiency. Streamlining and cost containment will counteract the squeeze on profit margin. Lany presented her case at her Green Zia Group meeting.

"The competitive environment for colored cabinets has been increasing," Lany began. "I was forced to drop my prices and watch my profit margin decrease. I hope I can put these pollution prevention tools to work in my operation and improve the efficiency of my operation without jeopardizing the quality of the cabinets."

Lany described the process of making these cabinets to her group. She receives precut cabinet doors from a vendor. The cabinets are then cut, sanded, and routed to meet customer's specifications. Components are loaded onto a conveyor where they move through open primer and painting booths and enclosed driers. Finally, the cabinets are assembled, packaged, and shipped. *(see Figure 1)*

"After evaluating my losses, I was able to demonstrate that 80% of all the environmental costs were due to one part of my operation-painting. I use a series of wet spray booths to apply the paint. Operators apply the paint using a spray gun. Over spray, or the paint that does not land on the cabinet, ends up in a washwater system; the resultant paint sludge gets shipped offsite for disposal."

"There are many costs associated with this activity. First, there is the cost of the paint that is wasted. This paint waste is considered hazardous waste under RCRA federal law so disposal fees are very high. Plus, I have to spend a great deal of time completing paper work. I also have high cleaning costs and associated down time. My washwater system often gets clogged with excess paint, interrupting the process. I have to keep the spray guns clean to

keep them from getting clogged. There are several other costs too-I've just listed the major ones," said Lany.
"Have you determined the root cause for this loss?" asked Jim

"Yes," replied Cecilia, "I held a meeting with all the employees working in the paint process and we constructed a cause and effect diagram. We determined that the method of paint application was the root cause for the paint loss. We also held a brainwriting session and developed a list of alternatives for achieving pollution prevention in this process. We already eliminated the ideas that were not feasible. Now all that is left is choosing the best alternative. I really want to be cautious when I chose a solution since picking the wrong alternative could cost me a lot of valuable time and money, and could also damage employee morale." *(see Figure 2)*

Lany presented the alternatives to the group and explained the pros and cons of each. Some of the alternatives such as converting to a dry filter system, required a sizable capital expenditure. Other alternatives, such as contracting out the painting would put several of her employees out of work and may also end up costing her more.

Jim provided a suggestion on how to proceed. "You need to use a tool for rank ordering these alternatives," said Jim. "Try using the bubble-up-bubble-down method. Take the list of alternatives and compare the first two alternatives. Decide which of the two is the best and move this alternative to the top of the list. Go to the next, or third alternative and compare it to the second. If it is better than the second, move it up and compare it to the first, if not, leave it in the third position. Continue this process until all the alternatives are rank ordered. Make sure you listen to everyone's opinions and objections."

"I suggest you include all of the members of the paint group just as you have up to this point. That way you will be able to reach a decision that all the key players agree upon. In order to get an alternative to work you must have their buy-in. You may need to compromise in order to reach a solution that will be successful."

Lany held another meeting with all the employees of the paint process. She explained the bubble-up-bubble-down method of rank ordering alternatives. Forced comparisons were made between the alternatives. A great deal of discussion and even some arguments were heard. The painters, some with up to ten years experience, were insulted at the suggestion that they may need to be trained on the best method of applying paint. The manager, Sal, was upset at the suggestion of moving to aqueous based paint. Sal had tried switching paint once before and it was a disaster. He let his objections be heard and did not let the other members of group forget that if there was a problem, he would be the one that would take the blame for it. Sal did agree that perhaps they were behind on the technology and using a dry filter system would be a lot more efficient.

The decision was reached. The group determined that the best alternative was to convert to using a dry filter system. They also decided that they would conduct another brainwriting and bubble-up-bubble-down session after the new system was installed in order to continually improve the painting process.

Discussions Questions/Activities

1. What are some of the potential problems associated with choosing the wrong alternatives?

2. Why was it important for Lany to include all the members of the paint group in the bubble-up-bubble-down exercise? Why is it necessary to compromise?

3. How did Lany's Green Zia Group help her work through selecting the best alternative?

4. Refer to the list of alternatives generated during the brainwriting session.

5. Take turns listing the alternatives on the board (or on a piece of paper).

6. Perform a bubble-up-bubble-down exercise for each list of alternatives. As you proceed with this ranking method, explain in detail the positive and negative attributes of each alternative.

7. Did the bubble-up-bubble-down method work for you? How did your business group help?

8. Were the exercises clear? If not, please specify which ones were unclear and why.

The next step is to develop an action plan.

Process Map

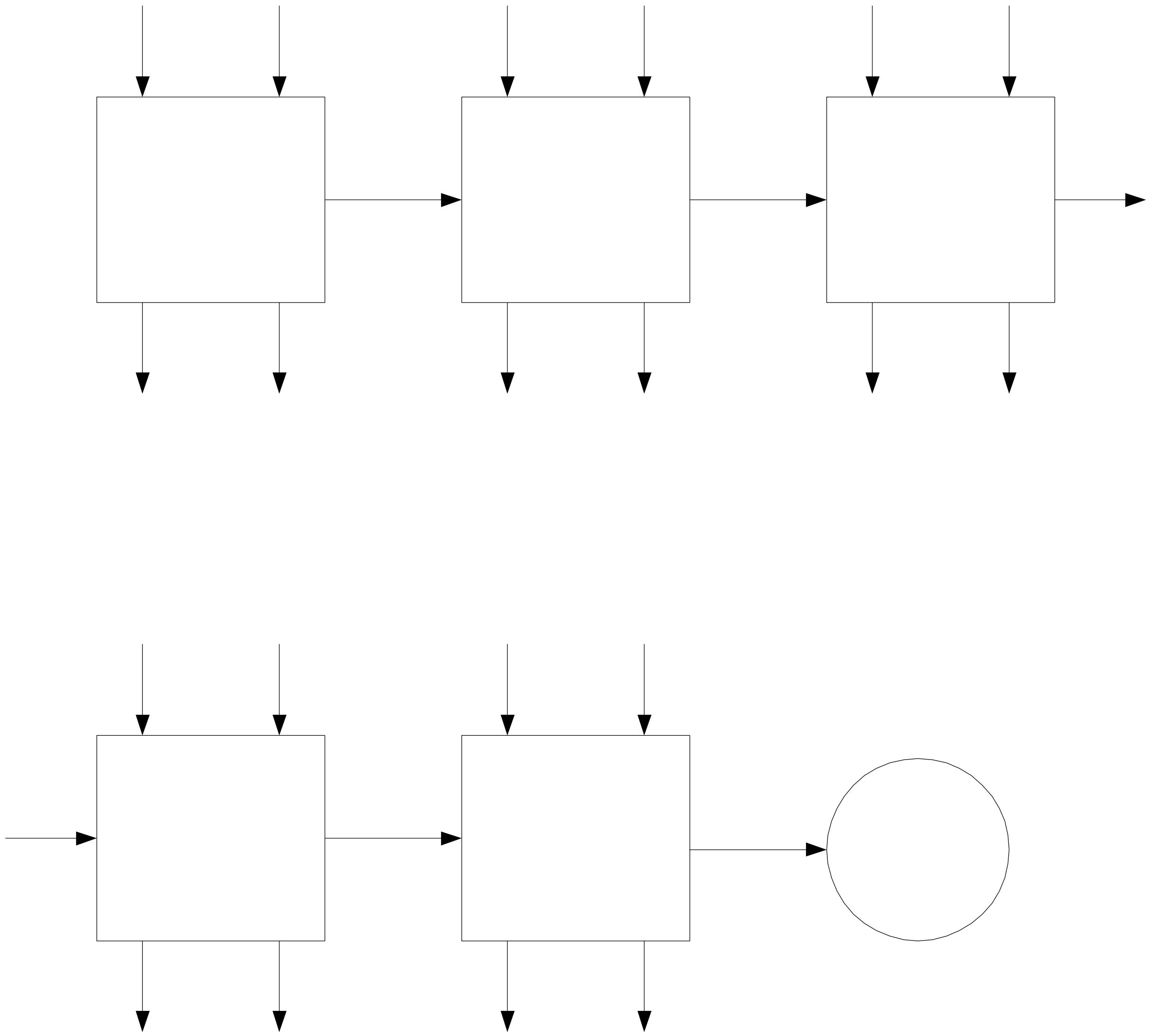


Figure 1: Cabinet making-Process map

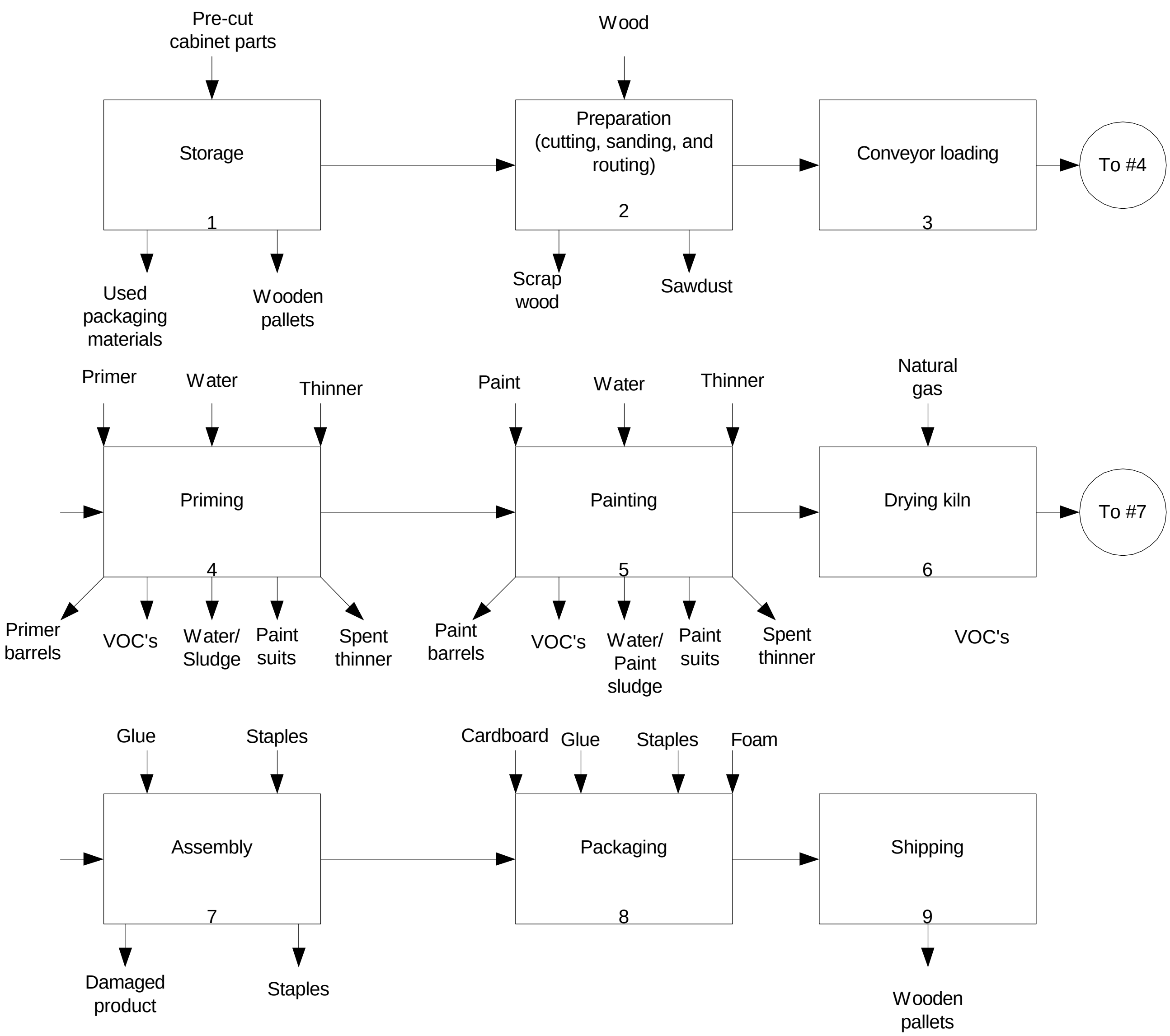


Figure 2: List of alternatives

1. Switch to an aqueous-based paint.
2. Use more efficient spray guns.
3. No longer provide painted cabinets.
4. Contract a professional painting facility to paint the cabinets.
5. Convert to a dry filter system.
6. Train employees on the best methods of applying paint.
7. Dewater the paint sludge to decrease the volume of sludge being disposed.
8. Enclose the painting booth preventing the paint from entering into the work area.
9. Dip cabinets into a tub of paint for cleaner application.
10. Recover the overspray and reuse.

Tutorial 6:Action Plan

Being able to successfully manage a project is important when trying to accomplish a task, especially when you are under a deadline. You need to set up a schedule, ensure that you have the necessary resources, and assign the right person to each part of the job. In this tutorial you will create an "action plan" for the implementation of an alternative to prevent pollution.

Warm-up Exercise

Your group has been assigned the task of making chocolate chip cookies. The cookies need to be ready in one hour and the cooking time is twelve minutes. Pick a person to manage this project. The manager must then assign the ten tasks listed below to individuals in the group.

You will need to know how much time is required for each task, what tasks need to be accomplished before others, what resources (i.e. bowls, flour etc.) are required, and what the most efficient way of organizing these tasks (and remember the clock is ticking). Create a schedule.

<u>Making chocolate-chip cookies:</u>

Mix dry ingredients
Mix wet ingredients
Add chips
Put the batter on the pan and put pan into the oven
Combing wet and dry ingredients
Turn on the oven
Taste cookies
Wash tools and utensils
Grease pan
Take cookies out of the oven

An Action Plan for *Prints by Marcy*

Marcy's screen printing business has been in operation for 25 years. Her largest client, the Nature Conservancy, has questioned her on the environmental impact of her business. When their contract came up for renewal, the Nature Conservancy asked Marcy to demonstrate her commitment to preserving the environment. Marcy had been attending the Pollution Prevention sessions with her Green Zia Group. She identified the loss in her process responsible for the greatest amount of environmental costs, and determined the best alternative for dealing with this loss. Although Marcy has not yet defined an action plan for implementing this change, she is confident that the Nature Conservancy would look favorably on this effort.

The process map for Marcy's business *Prints by Marcy*, Inc. is shown in Figure 1. Marcy determined that by incorporating a more sophisticated cleaning process she could reduce the chemical loss associated with screen reclamation. She was not sure how to proceed with the implementation. Marcy discussed her concern at her Green Zia Group meeting.

“I have a new reason to implement a pollution prevention change in my business. My biggest client wants me to demonstrate my commitment to preserving the environment. I'm going to send them all the output from our previous meetings on pollution prevention from my process map to the bubble-up-bubble-down exercise. But I still need to develop a concrete plan to implement the process change,” Marcy explained. “I'm having a problem getting started.”

“Why don't you briefly describe the process and how you intend to modify it,” said Jim.

“I use screen printing techniques to print images on fabrics to make clothing, bags, and tapestry. It's really a simple process. First, mesh is placed over a frame, making a screen. Then a stencil is used to block parts of the screen, producing the image. The screen is placed on the fabric and a squeegee, or rubber blade, is drawn over the screen forcing ink into its porous portions.

Since the screens are expensive, I reuse them. The screen reclamation technique that I currently employ is a three step process. The ink is removed first by wiping an ink remover over the screen and then rinsing it with water. Next, the emulsion, or stencil, is removed. The emulsion remover is sprayed on, rubbed in with a brush, and rinsed off with water Finally, the haze, which is the ghost image that remains on the screen, is eliminated. The haze remover is brushed on the surface and then the screen is rinsed one last time." said Marcy.

"I contacted the Screen Printing Association International (SPAI) for some cleaning alternatives and after discussing these and many other approaches with members of the staff, we decided we were going to introduce a high-pressure screen washer. An emulsion remover will be applied to the screen. Ink and stencil will then be removed by a high pressure water blaster. Ink remover will no longer be needed. A haze remover will then be applied, only if needed. We have read about other companies' successes using this system and believe we can drastically reduce our chemical use and reduce the risk of chemical exposure to employees. Our reclamation costs will decrease due to the reduction in the amount of chemicals used and safety measures that need to be taken. Labor costs associated with this task will also be less, and this will free up the staff to complete other tasks, thus, increasing our production rate. I also expect my cleaning costs will go way down since I will be using at least one-third less rags."

"Before you begin to implement your alternative you should complete this questionnaire," said Jim. "It will ensure that you are being thorough in your planning and have considered all the important issues that may arise such as the resources that are needed and the problems that could may occur." *(see Figure 2)*

Marcy took a few minutes to answer all the questions and read her responses to the group. *(see Figure 3)* When she finished she emphasized the important considerations. "My schedule is pretty flexible and I have already ensured that I will have all the resources that I need. But I do have two major concerns about implementing this new washer. First, I must maintain consistent high quality cleaning. If the screens are not completely clean, I could end up with an entire batch of defective products. My senior employee, Doug, is responsible for checking the quality of the screens so he will be monitoring this closely. Second, it's important that I have the cooperation of all my employees. Currently, I employ three additional full-time people, Pat, Jean, and Paul, plus my husband, John, and sisters, Donna and Carol, help out when we get busy. There may be some problems in beginning-change always brings resistance. I will be ready to answer all questions and concerns. I think the training session and the group meetings will help ensure open communication."

"Can you explain how you intend on tracking the success of this new technology?" asked Bob.

"Well, I'll be keeping a record of the amount of chemicals and water that are used each day. I can compare these numbers to the resource usage required using the current cleaning system. I will also monitor the service life of each screen to make sure that the water blaster does not cause excessive damage to the screens. If I find a problem, I can adjust the water pressure, temperature, or the chemicals used. Additionally, I intend to compare production rates and per screen reclamation costs. I expect my production rate to go up and my costs to decrease, after the capital expense of the new system is paid off, of course."

"It sounds like you have thought it all out. Now put all this information in an Action Plan Form. Most of the information you need should come from your answers to the questionnaire. The specific task, or step, to be accomplished is written in the first column under "Action." In the following column list the person who is responsible for completing this task. A performance standard should then be provided. This standard is a way of establishing how well a task needs to be performed. Under "monitoring technique" enter a measurable goal or target used to track the plan's implementation. A firm deadline should then be set, and finally, indicate the resources that are needed to perform each task. This form will help you organize your thoughts, keep track of all the actions that need to be completed, and ensure that the proper quality is being maintained" said Jim. *(see Figure 4)*

"I can definitely see how this form will help me keep track of the implementation of the high-pressure washer," said Marcy. "I'm sure once this washer is in full operation I'll notice a significant reduction in the amount of chemicals I use. My demand on other resources, such as laundry services, will also decrease. The Nature Conservancy will certainly be happy about that, and it makes me feel good about my Company. Plus, I'm sure it will save me a lot of money!"

“That's great,” said Jim. “Since pollution prevention is a continual process, do you have any thoughts on future pollution prevention projects?”

“You're right,” Marcy responded. “I'm sure I can decrease my process losses even further. The alternative that came in second during the bubble-up-bubble-down exercise is prompt cleaning of screens. If the screens are washed before the ink dries, much less water and chemicals are needed to clean them. Once the first alternative is in place, I intend to start implementing a “Timely Screen Washing” Program.”

Discussions Questions/Activities

1. Why is it important to develop an action plan?

2. What are some of the key issues that are addressed in the action plan?

3. Recall your selected alternative from the previous exercise.

4. Answer all questions on the Activity Planning Questionnaire

5. Fill in the attached Action Plan Form

6. What do you see as the biggest problems in implementing this alternative? When this alternative is fully implemented, what are you expecting to accomplish?

7. How has developing an action plan improved your ability to prevent loss?

8. Did you find developing an action plan useful? Why or why not?

9. Were the exercises clear? If not, please specify which ones were unclear and why.

Congratulations!!! You have completed the Pollution Prevention Training. Now it is time to put these tools to work and remember pollution prevention is an ongoing process. If you continue to implement pollution prevention in your business, you will increase the efficiency of your process while helping the environment.

Figure 1: Screen Printing-Process map

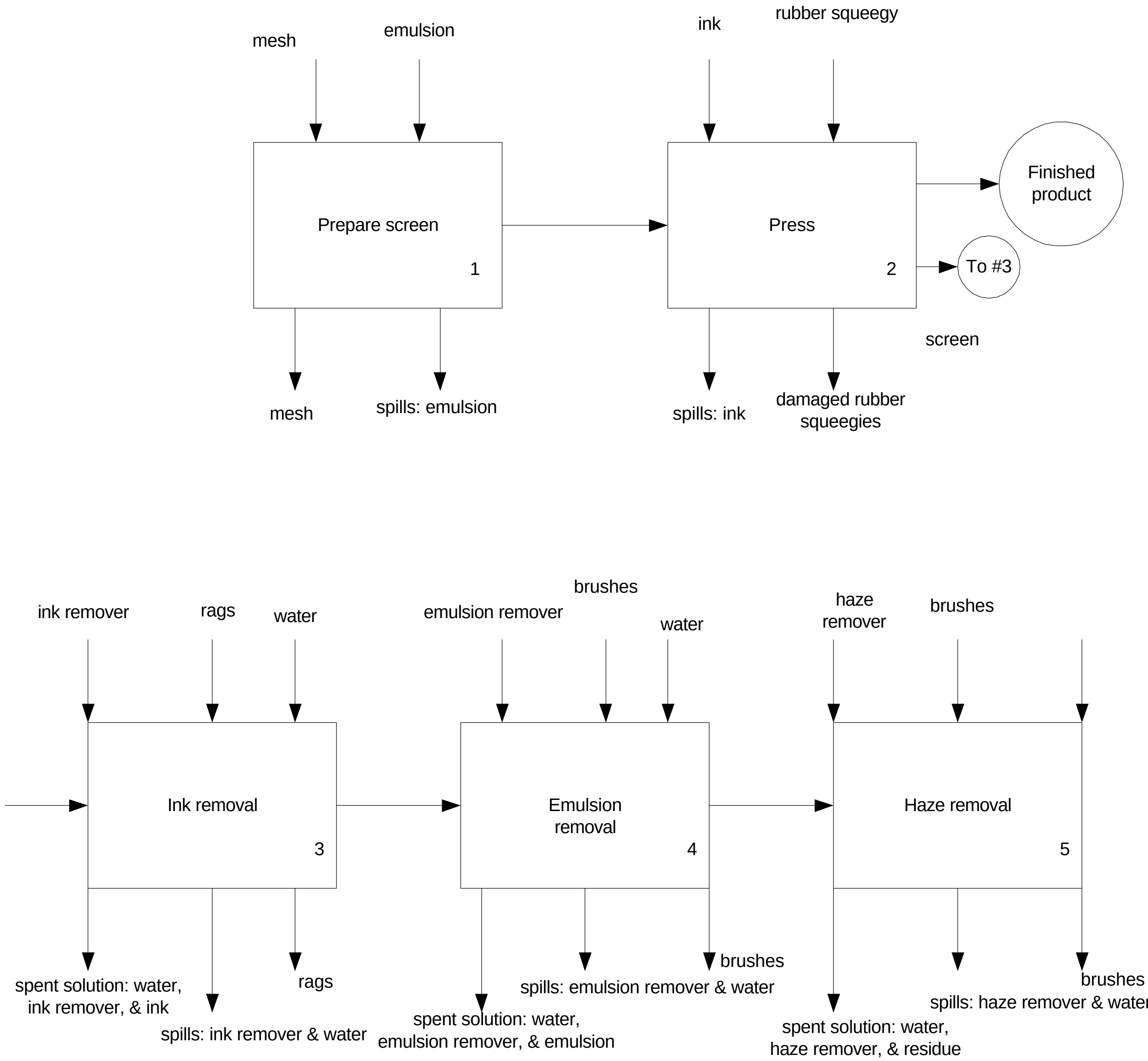


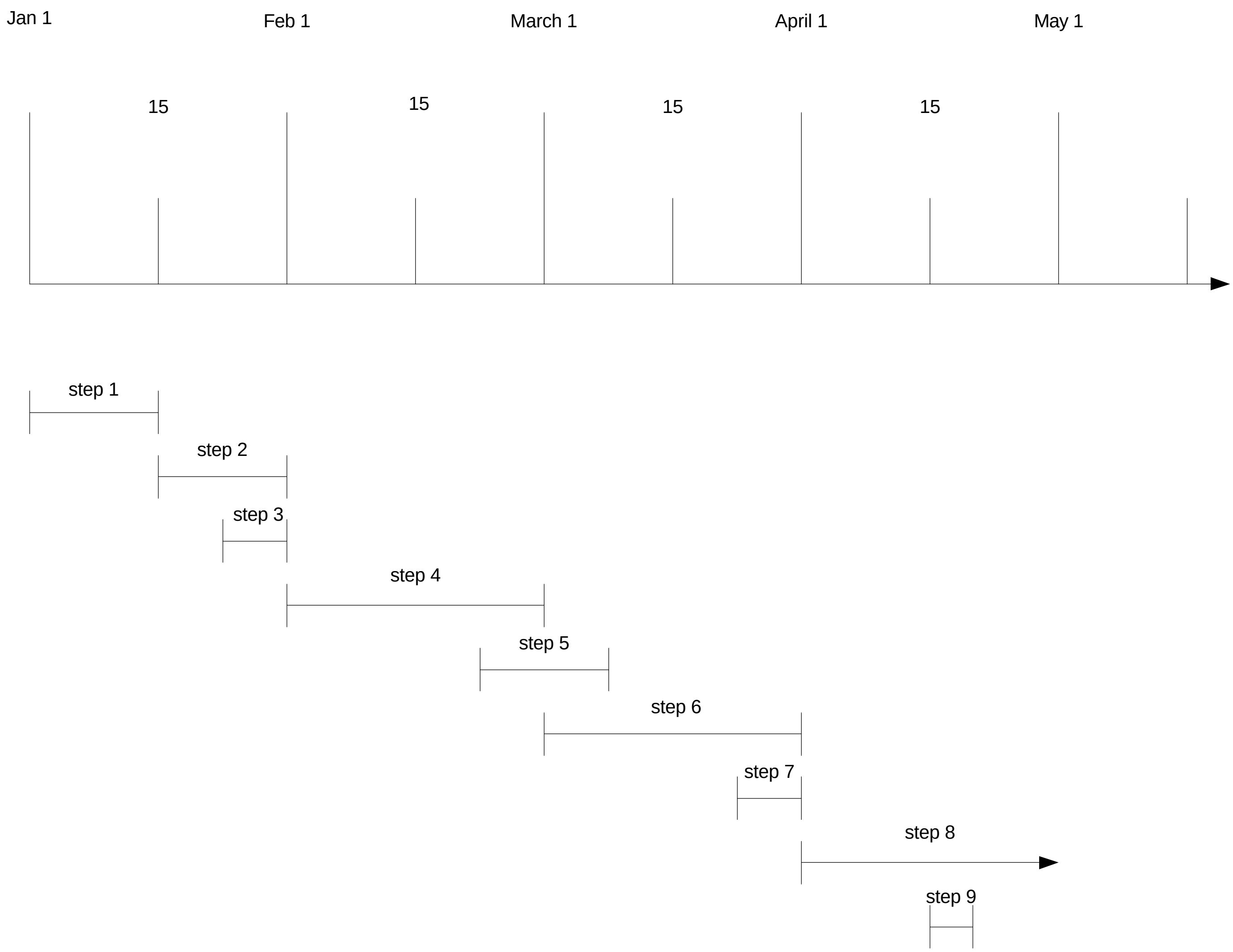
Figure 2: Action Planning Questionnaire

1. What is the overall objective and ideal situation'
2. What steps are needed to get there from here?
3. What actions need to be done?
4. Who will be responsible for each action?
5. What is the best sequence of action?
6. How long will each step take and when should it be done?
7. How can we be sure that earlier steps will be done in time for later steps that depend on them?
8. What training is required to ensure that all staff have sufficient know-how to execute each step in the plan?
9. What standards do you want to set?
10. What volume or quality is desirable?
11. What resources are needed and how will you get them?
12. How will you measure results?
13. How will you follow up each step and who will do it?
14. What checkpoints and milestones should be established?
15. What are the make/break vital steps and how can you ensure they succeed?
16. What could go wrong and how will you get around it?
17. Who will this plan affect and how will it affect them?
18. How can the plan be adjusted without jeopardizing its results for the best response and impact?
19. How will you communicate the plant to generate support?

Figure 3: Responses to Action Planning Questionnaire

1. To install a high-pressure screen washer, reducing per unit production costs and chemical use.
2. Install the high-pressure screen washer and train employees on its use.
3. 1) Call suppliers of this technology for equipment and installation costs;
   2) Identify vendor that will be used and draw up contract;
   3) Meet with employees to discuss the new cleaning process-understand concerns and any hesitation-address outstanding issues;
   4) Perform installation;
   5) Perform employee training;
   6) Test new cleaning system and work out any problems;
   7) Contact vendor of current cleaning products and make necessary changes in orders;
   8) Monitor water use and chemical use;
   9) Schedule pickup of unused ink remover.
4. Step # 1 Carol
   2 Marcy
   3 Marcy & Doug
   4 Vendor
   5 Vendor & Doug
   6 Doug
   7 Carol
   8 Doug
   9 Carol
5. Steps outlined in question #3 are in proper order.

6. Time line


Jan 1
Feb 1
March 1
April 1
May 1
15
15
15
15
step 1
step 2
step 3
step 4
step 5
step 6
step 7
step 8
step 9

7. Time estimates allow for delays--start-up date can be pushed back if needed .
8. Training will be provided to all staff members. Issues discussed will include: Best operating practices, water conservation, maintenance, and communication of problems.
9. Would like to eliminate ink remover from facility and reduce other chemical use by 10% in year 1 while maintaining quality cleaning.
10. Need to clean 25-35 screens per day.
11. Vendor list provided by SPAI. Adequate floor space is currently available. Funds required not expected to exceed $5000-will come out of operating budget.
12. Results will be measured based on the reduction of chemicals used and the quality of the cleaning from the new system.
13. The person responsible for each task will report findings to me upon completion.
14. Checkpoints and milestones: by March 1 the high-pressure screen washer will be installed; by April 1 the washer will be in full-operation.
15. Vital steps:

    1) Getting employee cooperation. Training sessions should provide a means of voicing all objections and concerns about the new cleaning technique.

    2) Ensuring quality cleaning. The use of the high-pressure screen washer will be phased in over a one month period. All problems should be worked out during this period.
16. Product could fail. We will keep inventory for the current cleaning method in stock until we are sure the new method is a success.
17. Plan will affect all workers responsible for screen reclamation and equipment maintenance and office manager whose responsibilities include ordering stock. Doug will need to continually monitor the success of the washer and the reduction in chemical use.
18. For the first year after implementation, staff meetings will include a discussion of the washer. Employees will be encouraged to make suggestions towards improving the process and Doug will report on the reduction in chemical use and the per unit cost of cleaning.
19. See #15 and #18.

Figure 4: Action Plan Form

Overall Target: Install high-pressure washer					
Action	Responsible person	Performance standard	Monitoring technique	Completion deadline	Resources needed
1.Call suppliers	Carol	List of 510 providers	Discuss results	Jan 15	List of vendors
2.Contract with vendor	Marcy	Signed contract	None	Feb 1	Action #1 complete
3. Meet with employees	Marcy & Doug	Highly interactive meeting	Question employees before and after	Feb 1	Firm date for meeting
4. Perform installation	Vendor	Complete installation	On-time and on-budget	March 1	Floor space
5. Employee training	Vendor & Doug	Employees able to use and maintain washer	Doug evaluates work	March 7	Training material from vendor
6. Test and debug	Doug	High quality washing with least amount of chemicals	Check all washed screens for cleanliness	April 1	Action #4 complete
7. Change orders	Carol	Inventory as needed	Document inventory	April 1	None
8. Monitor resources used	Doug	Demonstrate changes in resource use	Check chemical & water use	Ongoing	Action #4 complete
9. Pick up ink remover	Carol	All ink remover disposed of or returned	Follow-up with memo to Marcy	April 18	Action #4 complete

Overall Target					
Action	Responsible person	Performance Standard	Monitoring Technique	Completion Deadline	Resources Needed
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Here are a few suggestions to make pollution prevention continue to work for you:

- ***Return to the Nothing to Waste activities and concepts as you make business decisions.***

- ***Schedule regular pollution prevention reviews of your business.***

Remember: Pollution Prevention saves resources, saves money, and prevents accidents!

Nothing to Waste Manual

The U.S. Environmental Protection Agency (EPA) funded the development of this “Nothing to Waste" manual for its Environmental Justice Program. This manual is derived from a training model developed by a not-for-profit group, Working Capital. Their approach was designed to help micro-businesses learn how to write business plans and request loans from banks.

In the *Nothing to Waste* manual, each of the Systems Approach tools is described in a separate chapter and is designed to offer three levels of involvement with the information. First, a warm-up exercise offers the participants a simple activity to start their thinking in the context of the tool. Next, an exercise is provided to develop their familiarity with the tool. Last, each participant is asked to use the tool for a situation or issue that is relevant to his or her own business. This three-step approach offers the participants an experience of each tool before using it for their own business.

Several states have adopted *Nothing to Waste* (e.g., New Mexico) to bring very small businesses together in off-hours so they can map one another's business processes and apply the tools to identify P2 opportunities and derive and select P2 alternatives. The group facilitator also helps provide the group members with P2 information and resources that may be needed to implement the selected P2 alternatives.

Back HOME

Back to P2 Tools Page

Please Note:
This is the first page of this Sample P2 Plan.

This generic Pollution Prevention Program Procedure may be used as a basis for preparing company-specific procedure(s). This example, provided electronically by the Oak Ridge National Laboratory (ORNL), was based on a procedure being used by another facility on the Oak Ridge Reservation (ORR).

Company Name

Health and Safety
Procedure

Subject: **Company Name** Plant Pollution Prevention Program

Approvals:

Prepared By	Date
Procedure Validator	Date
Functional Procedures Configuration Control Board Chairperson	Date
Functional Policy Coordinator	Date
Plant Procedures Coordinator	Date

This procedure has been reviewed by an Authorized Derivative Classifier and has been determined to be UNCLASSIFIED. This review does not constitute clearance for public release.

Name & Date

Effective Date

CONTENTS

Subject: Company Name Plant Pollution Prevention Program

I. PURPOSE

To establish requirements and responsibilities for the **Company Name** Pollution Prevention Program. The Program on four major elements which are as follows: (1) the evaluation of processes for pollution prevention opportunities a projects, (2) pollution prevention awareness activities, (3) tracking of activities, and (4) the exchange of information technology. These elements are addressed with respect to roles and responsibilities of all organizations within this p

II. REQUIREMENT REFERENCES

A. Flowdown Documents

1. U.S. Environmental Protection Agency (EPA): PL 98-616, 98 Stat. 3221, *Hazardous and Solid Wast Amendments* (November 8, 1984)

2. EPA PL 101-508: *The Pollution Prevention Act of 1990* (November 5, 1990)

3. EPA Executive Order 12873: *Federal Acquisition, Recycling, and Waste Prevention* (October 22, 1993)

4. U.S. Department of Energy (DOE) Order 5400.1: *General Environmental Protection Program* (November 9, 1988)

5. DOE Order 5400.5: *Radiation Protection of the Public and the Environment*

6. DOE, *Waste Minimization and Pollution Prevention Policy* (September 1992)

7. Tennessee Department of Environment and Conservation (TDEC): TCA 68-212-301 et. seq., *Tenness Hazardous Waste Reduction Act of 1990* (1990)

8. **Document Number**: **Company Name** *Pollution Prevention Program Plan* (**Date**)

B. Other Documents Needed

Project Activity Report Form (Appendix)

C. Information References

1. DOE and TDEC: *State Oversight Agreement between the State of Tennessee and the Department of Energy* (May 13, 1991)

2. DOE Defense Programs: *Guidance for the Preparation of the Waste Minimization and Pollution Prevention Awareness Plan* (December 1993)

3. DOE, Document No. DOE/S-0118: *Pollution Prevention Program Plan 1996*

4. DOE: *DOE Model Pollution Prevention Opportunity Assessment Guidance* (February 1996)

5. DOE: *DOE Model Process Waste Assessment Plan* (January 15, 1991)

6. DOE Environmental Management, DOE Order 5400.1: *Site WMin/PP Awareness Plans DOE-Wide Implementation Guidance - Update* (March 1994)

7. DOE: *Environmental Restoration and Waste Management 5-Year Plan*, (1993)

8. DOE, Memorandum from Hazel R. O'Leary, Secretary of Energy, to Distribution (all elements of the "Implementation of Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollu Prevention Requirements" (November 15, 1994)

9. DOE Order 5400.3: *Hazardous and Radioactive Mixed Waste Program* (February 22, 1989)

10. DOE Order 5700.6C: *Quality Assurance* (August 21, 1991)

11. DOE Order 5820.2A: *Radioactive Waste Management* (September 26, 1988)

12. DOE Order 6430.1A: *General Design Criteria* (April 6, 1989)

13. DOE Secretary of Energy Notice SEN-37-92 from James D. Watkins, Admiral, U.S. Navy (Retired), Secretary of Energy: *Waste Minimization Crosscut Plan Implementation* (May 13, 1992)

14. DOE: *Waste Minimization/Pollution Prevention Crosscut Plan* (1994)

15. EPA, Document No. EPA/625/7-88/003: *Waste Minimization Opportunity Assessment Manual* (July 1988)

16. EPA Executive Order 12088: *Federal Compliance With Pollution Control Standards* (October 13, 1978)

17. EPA Executive Order 12856: *Federal Compliance With Right-to-Know Laws and Pollution Prevention Requirements* (August 3, 1993)

18. EPA, *Federal Acquisition and Community Right to Know*, Executive Order 12969, (August 8, 1995)

19. EPA, Federal Register Vol. 58, No. 102: *Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program* (May 28, 1993)

20. EPA PL 94-83: *National Environmental Policy Act* (August 9, 1975)

21. EPA PL 99-499: *The Emergency Planning and Community Right-to-Know Act of 1986* (October 17, 1986)

22. EPA PL 101-549, 104 Stat. 2399-2712: *The Clean Air Act Amendments of 1990* (November 15, 1990

23. EPA PL 102-580: *Clean Water Act of 1992* (October 31, 1992)

24. EPA PL 102-886: *Federal Facility Compliance Act of 1992* (September 22, 1992)

III. SCOPE/LIMITATIONS

Applies to all organizations at the **Company Name** and to all sources of pollution, including air emissions; untreated effluents; and all wastes, including hazardous, radioactive, radioactive mixed, toxic, sanitary, industrial, asbestos, me infectious waste generated from operations of the **Company Name**.

IV. DEFINITIONS

A. *Acronyms*

1. DOE: United States Department of Energy
2. DOE - **XYZ**: Department of Energy **- Office Name** Operations
3. DP: Defense Programs
4. EM: Environmental Restoration and Waste Management
5. EO: Executive Order
6. EPA: United States Environmental Protection Agency
7. EPCRA: Emergency Planning and Community Right-to-Know Act
8. P2: Pollution Prevention
9. PPOA: Pollution Prevention Opportunity Assessment
10. PWA: Process Waste Assessment
11. RCRA: Resource Conservation and Recovery Act
12. TDEC: Tennessee Department of Environment and Conservation
13. TSCA: Toxic Substances Control Act

B. *Representative*: A representative from each **Company Name** Organization that serves as the central technical and administrative contact within that organization for the implementation of the Pollution Preve Program.

C. *Pollution Prevention (P2)*: Activities that minimize or eliminate the volume, toxicity, or both of waste streams, emissions, or discharges generated; recycling processes that use, reuse, or reclaim a material from stream in any media. The primary method for pollution prevention should be through source reduction. F opportunities should be explored secondarily to source reduction. Pollution Prevention does not include tr these are defined as implementation of best available technology or management practices.

D. *P2 Activity Report Form*: Forms used to populate the P2 Activity Data Base from which regulatory report prepared to provide the latest status to our customers, help with budgeting requests, identify barriers, and p general knowledge of activities occurring on site. The P2 Program Office uses the information exclusivel document activities, progress, etc., of the company program.

E. *Pollution Prevention (P2) Council*: The P2 Council is composed of Pollution Prevention Representatives from each **Company Name** Organization, central organizations located at **Company Name**, and the Environmental Restoration Organization at **Company Name**; the **Company Name** P2 Coordinator and Program Staff; DOE; and technical subject matter experts as needed. The **Company Name** P2 Coordinat chairs this council.

F. *Pollution Prevention Opportunity Assessment (PPOA)*: The evaluation of process and operations for potential opportunities to apply pollution prevention techniques to reducing waste generation and disposal were previously known as Process Waste Assessments (PWA).

G. *Pollution Prevention Program Office*: Composed of the **Company Name** Pollution Prevention Coordinator and other dedicated staff members within the **Company Name Organization** to administer t P2 Program.

H. *Project Activity Data Base*: A data base developed to help with the tracking of pollution prevention activi The information given to the Pollution Prevention Program Office on the P2 Activity Report Form is ente maintained within the P2 data base. This mechanism allows for the easy retrieval of information to suppo needs such as reporting functions, informational requests, and budget and programmatic planning activitie

I. *Recycling*: The use or reuse of waste as an effective substitute for a commercial product or as an ingredie feedstock in an industrial process. It can occur on- or off-site and includes the reclamation of useful const fractions within a waste material, the removal of contaminants from waste to allow it to be used, or the use as a fuel supplement or fuel substitute.

J. *Source Reduction*: The reduction or elimination of water, emissions, or discharges at the source, usually v process. Any practice which (1) reduces the amount of any hazardous substance, pollutant, or contaminan any waste stream, emission, or discharge or otherwise released into the environment (including fugitive en prior to recycling, treatment, or disposal; and (2) reduces the hazards to public health and the environment with the release of such substances, pollutants, or contaminants. The term includes equipment or technolo modifications; process or procedure modifications; reformulation or redesign of products; substitution of r materials; and improvements in housekeeping, maintenance, training, or inventory control.

K. *Waste Generators*: All **Company Name** employees generate waste and are waste generators.

L. *Waste Minimization*: Any source reduction or recycling activity that results in either (1) reduction of total volume of waste; (2) reduction of toxicity of waste: or (3) both, as long as that reduction is consistent with general goal of minimizing present and future threats to human health and the environment.

M. *Waste Reduction*: Any change in a process, operation, or activity that results in the economically efficient reduction in waste material per unit or production without reducing the value output of the process, operat activity, taking into account the health and environmental consequences of such change.

N. *Waste Treatment*: Any method, technique, or process that changes the physical, chemical, or biological ch of any waste in a way that neutralizes the waste or renders such waste nonhazardous, less hazardous, safer amenable for recovery, amenable for storage, or reduced in volume.

V. GENERAL INFORMATION

The Pollution Prevention Act of 1990 established a national policy hierarchy for pollution prevention activities reduction as the preferred method over waste treatment, control, and disposal. Waste that cannot be prevented is to be treated in an environmentally safe manner to reduce volume, toxicity, or mobility prior to storage and For the purposes of this procedure, pollution prevention activities will include source reduction and recycling including hazardous, radioactive, mixed, and sanitary. Waste treatment and disposal are addressed as best ma practices.

Pollution prevention is a multimedia and multidisciplinary approach that advocates source reduction in which substitutions and engineering solutions are sought to reduce the mass and toxicity of waste and pollutants. It s concept of as low as reasonably achievable in that it promotes the use of innovative approaches in the front en process to achieve maximum pollution abatement.

In addition to the Pollution Prevention Act of 1990, pollution prevention philosophy has been incorporated in environmental statutes including the Clean Air Act, Clean Water Act, Emergency Planning and Community R Know Act (EPCRA) Title III, Resource Conservation and Recovery Act (RCRA) and Toxic Substances Contr (TSCA). The P2 provisions included in these statutes are not discussed specifically in this procedure.

The overall objectives of the **Company Name** Program are to:

A. Foster a company-wide philosophy to conserve resources, reduce the costs of production operations, and c minimum of waste and pollution in achieving company strategic objectives through developing and imple techniques, technologies, and programs that minimize waste and pollution generation.

B. Promote the use of nonhazardous materials in **Company Name** operations to minimize the potential risks human health and the environment.

C. Reduce or eliminate the generation of waste materials through input substitution; product reformulation; p modification; improved housekeeping; on-site, closed-loop recycling; and off-site recycling to achieve mi adverse effects on the air, water, and land when technically and economically feasible and cost effective.

D. Comply with federal and state regulations and DOE requirements for pollution prevention.

VI. REQUIREMENTS

A. Airborne, liquid, and solid wastes and effluents will be reduced to the greatest extent practical and results accordance with the provisions of DOE orders; the applicable regulations of local, state, and federal agenc company directives.

B. Air emission and water effluent pollutants will be integrated into all source reduction/recycling efforts.

C. Planning, budgeting, and implementation of pollution prevention activities shall be an integrated function.

D. Pollution prevention budgeting and funding requests shall be established annually to provide for a compre pollution prevention program.

E. An aggressive pollution prevention program will be established with primary emphasis on reduction of all pollutants at the source. Following source reduction options, recycling alternatives will be investigated ar instituted.

F. A waste stream prioritization matrix will be established to determine which streams should be targeted for

G. Waste streams and other pollutants will be prioritized. Following prioritization, characterization of waste and airborne and aqueous effluent will be conducted to:

   1. establish mechanisms to determine pollutant/waste generation rates, and

   2. provide a baseline by which reductions can be ascertained and quantified.

H. Pollutant and waste records shall be established and maintained to:

1. track waste and pollutant generation, storage, disposal, and discharge operations; and,

2. report pollution prevention efforts and accomplishments in accordance with DOE orders and state, loc federal regulations and permits.

I. Proactive and aggressive pollution prevention awareness programs for all employees will be established ar maintained to provide pollution prevention information to employees and to support a cultural change tow pollution prevention philosophy.

J. Employee training programs in pollution prevention will be developed to support the company's overall in

K. Methodologies for monitoring and quantifying pollution prevention successes will be developed.

L. Incentive and awards programs for individual and team efforts associated with positive pollution preventio will be established and maintained.

M. Characterization information from waste and pollutants should be used to conduct the following assessme and pollutant-generating process and activities to determine the most effective pollution-abatement metho

1. Develop process area flow diagrams, materials balance, and process descriptions as applicable.

2. Develop options to minimize waste and pollutants.

3. Evaluate and prioritize reduction options.

4. Implement practicable low-cost or no-cost options.

5. Assess project expenditure options for cost savings/avoidance.

6. Budget for economically or environmentally practicable expenditure options.

N. Recycling programs will be utilized and, where necessary, developed to promote environmental benefits a comply with the requirements of Executive Order (EO) 12873.

O. A proactive approach, including the development of internal mechanisms to increase the purchase of recyc materials in accordance with EO 12873, will be established and maintained.

P. Procurement practices will be developed which favor the purchase of more environmentally preferred proc less toxic, smaller quantity, recyclable, etc.).

Q. Future regulatory trends and initiatives in pollution prevention will be identified and communicated withir company.

R. Pollution prevention achievements and lessons learned will be communicated.

S. Pollution prevention information will be exchanged within the company and DOE facilities and with indu

T. Pollution prevention research needs will be communicated to federal research facilities, academia, and ind

U. Compliance with all orders, agreements, compliance schedules, or compliance agreements issued by feder regulatory agencies shall be maintained and documented.

VII. RESPONSIBILITIES

A. **Company Name** Manager

1. Supports the P2 Program by approving a company P2 Policy and Plan for the administration of an act Pollution Prevention Program.

2. Recognizes employee(s) achievements related to P2 activities (e.g., issue letters of appreciation).

B. Organizational Managers

1. Be accountable for reducing waste where practical within their respective organization. This should b accomplished by first considering source reduction opportunities followed by recycling.

2. Appoint Pollution Prevention Representatives, who are knowledgeable in organization processes and generation, to represent their organizations on the Pollution Prevention Council.

3. Develop and maintain organization-specific P2 Plans that outline goals and activities.

4. Ensure that funding is requested to meet P2 Program objectives, plans, and data requests.

5. Monitor and keep records of organizational pollution prevention activities (Appendix).

6. Conduct a semiannual assessment of the P2 Program elements within the organization.

7. Participate in the use/reuse of material surplus through various material exchange mechanisms.

8. Submit P2 Projects/Activities for nominations toward applicable award recognition programs (e.g., A Excellence, Presidents Award for Continuous Improvement, DOE-**XYZ** Waste Minimization Award,

9. Appoint PPOA team members as needed to support preparation of assessments.

C. P2 Program Office Personnel

1. Involve all employees in the pollution prevention effort by promoting integration and coordination of generators and waste management personnel on pollution prevention matters.

2. Communicate with the P2 Council to exchange information, provide updates on pollution prevention developments, discuss problems, receive suggestions, and review the program. Hold meetings of the

3. Maintain open channels of communication laterally and vertically among the **Company Name** organizations to enhance awareness and convey pollution prevention objectives, goals, ideas, methods learned, and successes.

4. Prepare, review, and revise P2 Policy and Plans for approval and signature of company management.

5. Establish tracking and communication systems that are designed to provide waste stream characteriza baseline waste stream generation data and to enable quantitative evaluation of pollution prevention ef

6. Develop and maintain a system of reporting pollution prevention activities and results of minimizatio both internally and in accordance with regulatory and DOE requirements.

7. Track, report, and keep records of the company P2 activities and accomplishments.

8. Support the identification and implementation of pollution prevention methods and technologies to re generated waste volume and toxicity.

9. Test and evaluate new pollution prevention opportunities and associated technologies as applicable.

10. Target any policies, procedures, or practices that may be barriers to pollution prevention.

11. Review other procedures and practices for incorporation of P2 philosophy [e.g., incorporating P2 opp into the early planning stages of proposed projects (National Environmental Policy Act)].

12. Evaluate on an annual basis progress made in implementation of pollution prevention opportunities id previous PPOAs, and determine if additional PPOA activities are required.

13. Develop and revise, as necessary, specific goals and schedules for pollution prevention activities.

14. Conduct management briefings to keep management abreast on P2 activities, barriers, and successes.

15. Develop performance measures for which to assess the P2 Program elements. Administer a self-asses organization and the entire program on a semiannual basis.

16. Determine a mechanism to prioritize waste streams, emissions, and discharges for additional studies/recommendations for targeting reduction.

17. Identify funding and personnel requirements and establish schedules for the implementation of selecte pollution prevention options and program activities.

18. Track associated resource utilization to allow evaluation of use and needs.

19. Create incentives for pollution prevention by establishing a program of awards for pollution preventio suggestions and accomplishments and establishing achievable, measurable pollution prevention goals each organization manager's annual measures of performance.

20. Plan and organize incentives and awards programs for individual and team efforts associated with P2

21. Develop and implement employee pollution prevention awareness and occupational training programs

22. Sponsor an annual awareness event to focus on environmental issues and general awareness of polluti prevention opportunities (usually conducted in conjunction with Earth Day, April 22).

23. Support the procurement and use of products containing recovered materials.

24. Collect and exchange pollution prevention information through technology transfer, outreach, and edu networks.

25. Develop and maintain mechanisms for fully disseminating current technical information to company u

26. Share pollution prevention information with other DOE sites in **Location** and across the DOE comple Participate in information exchange (e.g., attending when appropriate, EPA Seminars, DOE Contracto

Reduction Workshops, EM and DP Conferences on P2, P2 Coordinators meetings, **Company Name** I Task Team, etc.).

27. Communicate P2 achievements and difficulties (lessons learned) within the company.

D. Pollution Prevention Council Members

1. Represent and support their organization managers and serve as the pollution prevention technology t point within their organization. This includes providing information about the wastes generated withi organization for reporting purposes; ensuring that new projects or changes to existing facilities have c pollution prevention in design and construction; and submitting ideas or problems for pollution preve efforts originating within their organization.

2. Attend P2 Council Meetings. The members provide a comprehensive approach to meeting various po prevention and waste minimization requirements, and the meeting serves as a forum for increased communication and consistent implementation of pollution prevention activities. The meeting also se information exchange mechanism to promote general awareness of pollution prevention information, providing a system to document pollution prevention progress, and to identify resources necessary to pollution prevention opportunities.

3. Implement the **Company Name** P2 Program Plan and Organization P2 Plan, if applicable. Review th objectives of the **Company Name** program in accordance with the facility's mission and needs.

4. Develop pollution prevention goals and implement programs and activities necessary to reduce both t and toxicity of waste and environmental pollutants within the organization.

5. Ensure that progress in pollution prevention implementation is documented and communicated for ac within the organization.

6. Advise **Company Name** Management on methods to initiate and carry out pollution prevention initia as well as promotion of employee awareness and incentive programs.

7. Assist in long- and near-term pollution prevention planning activities, including evaluating technical i recommending resource requirements.

8. Ensure that project activity report forms are completed and submitted to the P2 Program Office for all proposed or ongoing activities as soon as the project/planning is initiated.

9. Periodically communicate program objectives to organization personnel.

10. Obtain waste generator support and input for the plant program.

11. Facilitate integration and coordinated interaction between waste generators on new and current polluti prevention matters.

12. Evaluate and revise pollution prevention goals and objectives in accordance with regulatory, DOE, an **Company Name** requirements.

13. Prioritize waste streams or production areas for assessment.

14. Support the selection of teams to conduct or update pollution prevention opportunity assessments (PP required.

15. Support the evaluation of the technical and economical feasibility of options to reduce waste generatio

16. Support the recommendations and ranking of options for specific implementation by management.

17. Support monitoring the performance of pollution prevention options that have been implemented and the performance according to established criteria.

18. Support the monitoring and reporting of progress of the program through evaluations such as audits ar reviews.

19. Solicit personnel nominations for achievement and incentives awards for P2 Activities.

20. Coordinate program participation within organization.

21. Support, sponsor, and suggest ongoing and proposed employee awareness and training.

22. Facilitate technology transfer and pollution prevention awareness.

23. Submit budget and project information to support reporting functions of the P2 Program as necessary.

E. Waste Generators

1. Support tracking and reporting activities related to their material usage, waste generation, and pollutio prevention progress made.

2. Communicate P2 initiatives/issues to the P2 Representative for their organization and complete a proj activity report form (Appendix) for activities with the help of the P2 Representative.

3. Support PPOA activities related to their wastes and investigate and implement pollution prevention te

4. Support the development and implementation of new pollution prevention techniques as necessary.

5. Request technical assistance as needed from the P2 Program.

6. Participate in plant-wide source reduction and recycling programs.

7. Participate in P2 related training and awareness activities.

VIII. REQUIRED RECORDS

A. The Pollution Prevention Activity Report Forms which identify P2 projects proposed or ongoing at the **Co Name** are to be transferred from the P2 Representatives of each respective organization to the P2 Program The P2 Program Office maintains a copy of the forms as well as transfers the information to the P2 Activi Base.

B. Other reporting requirements that are fulfilled to satisfy regulatory requirements are maintained in the P2 Office. The following is a list of the reports that are required to date:

1. **Company Name** Annual Waste Reduction Report (SEN-37),

2. Tennessee Annual Generator Report (Waste Minimization Information Summary), and

3. Hazardous Waste Reduction Progress Report.

IX. ADMINISTRATION

A. The **Company Name** Pollution Prevention Coordinator is responsible for the implementation, interpretati maintenance of this procedure.

B. A hard copy of this procedure shall remain in the **Company Name** Procedures Group office in Building (I **Bldg. Number**), in the **HS&E Organization** Procedures Representative's office in Building (**Insert Bldg. Number**), and in the **Company Name Organization** Procedures Representative's office in Building (**Insert Bldg. Number**). The *master copy* of this procedure is done in **PC WordPerfect 5.1**, and the electronic (disk) storage is to be kept in the **Electronic Publishing** office in Building (**Insert Bldg Number**).

X. APPENDIXES

Project Activity Report Form

Appendix

PROJECT ACTIVITY REPORT FORM

Activity Number_______

Pollution Prevention Activity Report
Note: All Information Must Be Unclassified!

Organization:	Date:	P2 Adv.
Project Title:		
Project Contact/Phone/Address:	Process Description	Process Location:

Project Current Status:
o Development o Construction o Implementation Complete
o Engineering/Design o Pilot Study o On Hold
o Procurement o Start-up o Canceled

WASTE TYPE
o Solid o Liquid o Gas o Sludge o Emulsion

RELEASE TYPE (If Applicable)
o Air Emission o Water o Soil

WASTE CATEGORY: (CHECK ALL APPLICABLE)
o (01) Oils and Other Oily Wastes
o (02) Solvents and Other Solvent Wastes
o (03) Commercial Chemical Products
o (04) RCRA-Ignitable Wastes
o (05) RCRA-Corrosive Wastes
o (06) RCRA-Reactive Wastes
o (07) Mercury Wastes
o (08) Lead Wastes
o (09) Cadmium and Chromium Wastes
o (10) Other RCRA F-Listed Wastes
o (11) Sanitary Waste, Solid
o (12) Sanitary Waste, Sewer
o (13) Medical Wastes
o (14) Industrial Waste, Liquid
o (15) Special Solid Waste
o (16) RAD Contaminated
o (17) PCB Contaminated (< 50 ppm)
o (18) PCB Contaminated (> 50 ppm)
o (19) Other: (List all RCRA EPA Codes)
____

POLLUTION PREVENTION/WASTE MINIMIZATION TECHNIQUES (CHECK ALL APPLICABLE)

SOURCE REDUCTION

o Inventory Control o Spill and Leak Prevention
o Good Operating Practices o Product or Process Changes
o Equipment/Technology Changes o Input Material Changes

o RECOVERY OR RECYCLE
o TREATMENT
o POLLUTION CONTROL
o AFFIRMATIVE PROCUREMENT
o OTHER____________________

ESTIMATED ANNUAL QUANTITY AND PERCENT REDUCTION:

Quantity Reduced:______________________ Quantity Represents a _____% Reduction in Existing Stream
o Pounds o Cubic Feet o Kg o Gallons Category Changes: o RCRA to Non-RCRA o RAD to Non-RAD
ESTIMATED ANNUAL TOXICITY REDUCTION:
Original Concentration _____(ppm) Reduced Concentration ____(ppm) Contaminant:__________

BUDGET INFORMATION:
Total Estimated Cost:__________ Total Expended To Date:___________ o Capital o Expense

Work Order Number:___________ Funding Status: o Completely Funded o Unfunded
o Funding Requested o Funding Canceled
o Submitted for ROI/HIVAL - Date Submitted_________
Estimated Cost Savings:__________ (Use attached worksheet to complete cost savings)

Appendix (Cont.)

PROJECT ACTIVITY REPORT FORM

PROJECT DESCRIPTION AND JUSTIFICATION: (Attach additional information if needed.)

PROJECT IMPLEMENTATION PLAN:

Date Initiated	- *Date Complete*		*Date Initiated*	- *Date Complete*	
	-	Developmental		-	Funding Requested
	-	Pilot Testing		-	Design/Engineering
	-	Procurement		-	Start-Up
	-	Construction/Implementation		-	Fully Operational

PROJECT MILESTONES/ACCOMPLISHMENTS: (Date Each Entry)

PROJECT IMPEDIMENTS: (Check all applicable)

o Training or Technical Assistance
o Economic Payback
o Implementation Experience
o Other______________________

o Technical Feasibility
o Resource Limitations
o Accidental Generation

Explain Impediments and Possible Solutions:

List all Request for Disposal Numbers associated with this waste stream in the past that would be affected by this project. Include UCN-2109 Numbers, WSIN Numbers, and SID Numbers. (Attach additional information if necessary.)

List Air Permit Number or Outfall Number associated with this release that will be affected by this project.

P2 Representative Signature/Date

Project Contact Signature/Date

Appendix (Cont.)

PROJECT ACTIVITY REPORT FORM

Cost Savings Worksheets

	Before Costs	After Cost	One-Time Cost	Cost Savings
Total One-Time cost (nonrecurring)				
Operating & maintenance costs (recurring):				
1. Raw material purchasing costs				
2. Process operation costs				
3. PPE and related health/safety supply costs				
4. Waste management costs				
5. Recycling costs				
Totals				
	B	A	C + E	F

Return On Investment (%) = $\frac{(B - A) - \text{Depreciation}}{(C + E)} \times 100$

Depreciation = [Total One time Costs (e.g., Capital + Expensed) + Useful Life] and can be ignored for projects with a useful life of more than 10 years.

Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual

State of Ohio Environmental Protection Agency
Office of Pollution Prevention
(614) 644-3469, FAX (614) 728-1245

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Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual

Chapter 1
Introduction

"To keep ahead of the many environmental and economic challenges that face us in the 1990s, Ohio must focus on pollution prevention. Global competition and the public's demand for environmental protection require that business be as efficient and produce as little waste as possible."

Donald R. Schregardus, Director, Ohio EPA

Why is pollution prevention planning essential for the State of Ohio? Ohio companies and governments generate large amounts of waste, as illustrated in brief summary below, "Waste Generation in Ohio." These wastes discharged to our air, water or land represent a significant loss of raw materials and a potential threat to human health and the environment. To be responsible guardians of environmental quality, waste generators must review their production processes and operations as well as consider both the economic and the environmental benefits of implementing a pollution prevention program. The public, consumers and employees expect simultaneous attention to both economics and the environment. Pollution prevention is an excellent way to satisfy this demand.

Waste Generation in Ohio
2.9 million tons of hazardous waste generated in 1991
125,500 tons of toxic chemicals released or transferred in 1991
13.9 million tons of residential, industrial and commercial solid waste per year

Adopting a pollution prevention program as a way of doing business can provide a number of significant benefits to a company. By decreasing the amount of waste generated or released, a company can reduce waste disposal costs, improve worker safety, and reduce long-term liability. In addition, pollution prevention methods may increase the efficiency of the production line and decrease costs associated with the purchase of raw materials, inventory control, etc. Any resulting changes in efficiency or expenditures may help the company to retain or improve its competitiveness in the marketplace.

Companies have traditionally evaluated their industrial processes in terms of optimizing their production, but times have changed. Due to increasing environmental concerns associated with industrial waste, companies must now incorporate waste management and prevention strategies into their production lines with the goal of reducing waste generation. By increasing efficiency of operation, companies can see that more of their raw materials go into products rather than ending up as waste.

Donald R. Schregardus, Director of the Ohio EPA, emphasizes that, "To keep ahead of the many environmental and economic challenges that face us in the 1990's, Ohio must focus on pollution prevention. Global competition and the public's demand for environmental protection require that business be as efficient and produce as little waste as possible." Ohio is also working to reach the national goal for environmental protection - to reduce or eliminate waste at its source - as established by the Pollution Prevention Act of 1990 (see Chapter 4).

Introduction to the Guidance Manual

This guidance manual is a general overview of how Ohio businesses and government facilities can develop and implement a pollution prevention program. The manual uses the pollution prevention program steps (with limited modifications) outlined in U.S. EPA's 1992 publication, *Facility Pollution Prevention Guide* (EPA/600/R-92/088). (Table C-3 in Appendix C compares the elements of U.S. EPA's and the State of Ohio's guidance for developing a program). These steps include planning and organization, assessment, feasibility analysis, implementation, and measuring progress. The manual also uses substantial portions of the text from the Illinois Hazardous Waste Research and Information Center's 1993 publication, *Pollution Prevention: A Guide to Program Implementation*.

On September 1, 1993, Governor George V. Voinovich requested the top 100 Toxic Release Inventory (TRI) reporters in Ohio to work with Ohio EPA on developing comprehensive pollution prevention plans to reduce the various types of waste they generate. As Ohio EPA Director Donald R. Schregardus emphasized, "This is not just a paperwork exercise. The real goal is not the plan, it's the reduction."

This document was prepared under a federal fiscal year 1993 RCRA grant from U.S. EPA to Ohio EPA, Division of Hazardous Waste Management, and the Office of Pollution Prevention, for Great Lakes Basin activities. The original intent of this guidance manual was to provide waste minimization planning guidelines (1) for class I injection well facilities and (2) for hazardous waste treatment, storage, and disposal facilities. Class I injection well facilities have a statutory requirement to prepare and adopt a waste minimization and treatment plan, including several general requirements for plan content. Hazardous waste facilities are required by Ohio permits to submit a report describing their waste minimization program. Specific requirements for these types of facilities are slightly different; however, Ohio EPA does not want to create different pollution prevention and waste minimization planning guidance manuals for each regulated category of business nor for each environmental medium. This general guidance manual provides a common approach for pollution prevention planning in Ohio for all waste generators and for all media. This manual can be used by any organization, including businesses and state and local government organizations. For brevity the words "company" and "business" are used throughout the manual, but any organization's title can be substituted for these terms.

Because this manual is a generalized overview of how to develop and implement a pollution prevention program, you will want to modify the program as needed to fit your facility.

Specific requirements for class I injection well facilities and hazardous waste treatment, storage, and disposal facilities are included as appendices.

For more detailed information about pollution prevention programs, refer to U.S. EPA's *Facility Pollution Prevention Guide* and to the reference section in the appendices of this guidance manual. U.S. EPA's *Facility Pollution Prevention Guide* contains worksheets that may be helpful in implementing and documenting a pollution prevention program. Another general reference document is U.S. EPA's *1993*

Reference Guide to Pollution Prevention Resources (EPA/742/B-93/001). This annual guide contains information about publicly sponsored pollution prevention resources and training opportunities. The document consolidates a wide range of pollution prevention information. Contact the Ohio EPA's Office of Pollution Prevention for copies of these documents and a list of additional references.

Purpose of the Guidance Manual
This guidance manual is intended to increase the amount and improve the quality of activity in pollution prevention planning in Ohio. It will help companies to compare their pollution prevention programs to the State of Ohio's goals. The State of Ohio, including Ohio EPA, does not intend to enforce the letter of this manual to determine what should be included in a pollution prevention plan or program. Ohio EPA does not intend to issue related checklists for inspection and enforcement. However, we do expect that all pollution prevention programs and plans will have significant substantive content, include the general components covered in this manual where appropriate, and clearly meet the spirit of this guidance and any applicable law. We do expect that programs and plans include efforts and substance comparable to the general headings of Table C-3 in Appendix C of this document, e.g., "Establish the pollution prevention program." We do not expect to require subsections, e.g., "Executive level decision; Policy statement;" following the exact content of Table C-3.

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ACRONYMS

CAAA
: Clean Air Act Amendments of 1990

CAMP
: Cleveland Advanced Manufacturing Program

CFC
: Chlorofluorocarbon

HAP
: Hazardous air pollutant (regulated by the CAAA)

HSWA
: Hazardous and Solid Waste Amendments of 1984

HWRIC
: Illinois Hazardous Waste and Research Information Center

IAMS
: Institute of Advance Manufacturing Sciences

MSDS
: Material safety data sheet

NICE3
: National Industrial Competitiveness Through Efficiency: Energy, Environment, and Economics

NPDES
: National Pollutant Discharge Elimination System

OAC
: Ohio Administrative Code

OAQDA
: Ohio Air Quality Development Authority

Ohio DOD
: Ohio Department of Development

Ohio EPA
: Ohio Environmental Protection Agency

Ohio DNR
: Ohio Department of Natural Resources

OPP

Office of Pollution Prevention, Ohio EPA

ORC

Ohio Revised Code

OWDA

Ohio Water Development Authority

PIES

Pollution Prevention Information Exchange System

PMN

Premanufacture Notice

POTW

Publicly owned treatment works

PPDW

Pollution Prevention Development Workgroup

PPIC

Pollution Prevention Information Clearinghouse

RCRA

Resource Conservation and Recovery Act

SARA

Superfund Amendments and Reauthorization Act

SBAP

Small Business Assistance Program, Ohio EPA

SOP

Standard operating procedure

TQM

Total Quality Management

TRI

Toxic Chemical Release Inventory

TSCA

Toxic Substance Control Act

U.S. DOE

United States Department of Energy

U.S. EPA

United States Environmental Protection Agency

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Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual

Chapter 2
Benefits and Obstacles of Pollution Prevention

"If you make the commitment to do pollution prevention and that commitment is at every level of the company, you can create a healthier, much cleaner environment."

George Makrauer, Amko Plastics

Pollution prevention is often referred to as business planning with environmental benefits. The most common benefits and incentives for establishing a pollution prevention program are presented here. Some of the obstacles that may hinder implementation or program development are also discussed.

Incentives

Reduced Operating Costs (Economics) Pollution prevention activities usually save a company money in the long term. Many pollution prevention projects have good returns on investment and short payback periods. Money is usually saved in disposal costs, new material costs and improved operating efficiency. Many firms report that the majority of savings comes from the latter.

Improved Worker Safety Reduction of the use of toxins in the workplace is a major aspect of pollution prevention. (However, toxic users who manufacture a toxic substance would not be expected to plan for the reduction in manufacturing of the specific toxic substance as a product.) By reducing or eliminating toxic substance use, the safety of the work environment can be improved and personal protective equipment requirements decreased. Also, reducing the likelihood of leaks, spills and releases can decrease worker, visitor, and contractor exposure. These steps will result in cost savings through preventing the loss of materials and possibly through decreased insurance rates by reducing medical claims and disability leave. Better labor relations can also result from improved worker safety.

Reduced Compliance Costs Undertaking pollution prevention projects can reduce your regulatory exposure and, in some cases, may eliminate the need for permits, manifesting, monitoring and reporting. Keeping up with regulatory requirements and submitting the required reports is an expensive and time consuming process which, if eliminated, saves money.

Increased Productivity Pollution prevention can improve plant productivity through more efficient use of raw materials due to improved processes and operations. Many industrial plants that produce large quantities of wastes may be using old technologies to make their products, or their processes may be poorly controlled and inefficiently operated. Sometimes small improvements can result in increased product yield and better quality.

Increased Environmental Protection Many waste disposal and treatment methods have been shown to be less protective of the environment than previously estimated. These methods may just move environmental contaminants from one medium to another. They may cause future problems that are not yet apparent. Pollution prevention reduces the generation of wastes at the source, or results in less toxic waste, and thus assures improved environmental protection.

Reduced Exposure to Future Liability Costs Reduction of potential long term liability from waste disposal has become an important concern in recent years. Past disposal practices, even though they may have been legal, have often caused environmental damage that has proved to be expense for industrial facilities as well as damaging to their public image. Pollution prevention can help to reduce long term liability by reducing the amount and the hazard of waste generated.

Continuous Improvement Successful implementation of a pollution prevention program can be an integral part of a company's continuous improvement or Total Quality Management program. Reducing wastes and improving efficiency are what both pollution prevention and continuous improvement are all about.

Improved Company Image Society is becoming increasingly aware of the environmental hazards associated with all types of waste. U.S. EPA publishes details of companies' waste and pollution prevention efforts through the Toxic Release Inventory. U.S. EPA also publicly recognizes those companies that make voluntary commitments to pollution prevention. To enhance their public image, companies are implementing and publicizing pollution prevention activities.

Obstacles

Capital Requirements Implementation of many pollution prevention measures often requires capital investment. Such projects may need to be justified on an economic basis.

Specifications Specifications can be both an incentive and an impediment. For instance, government contracts may specify certain materials be used in the manufacture of a product or that virgin materials be used rather than recycled materials. This can lead to the use of materials that are damaging to the environment or the unnecessary use of virgin materials where recycled materials would suffice.

Regulatory Issues It may be necessary to obtain a new or modified permit, or other governmental approval, before implementing a process change or material substitution. This can be time consuming and costly. Companies should contact the appropriate regulatory agency early in the process of making changes to the facility to ensure that all permitting requirements are considered.

Product Quality Issues Companies have great concern for the quality of the products they manufacture. Some pollution prevention projects may change product quality, even when properly implemented, and thus may be regarded with skepticism.

Customers' Acceptance The customer ultimately defines product quality requirements. Anything that affects the quality, or even the perception of its quality, may affect acceptance by the customer.

Immediate Production Concerns Implementation of pollution prevention projects may often require time, money, and personnel, all of which are usually in short supply.

Company Image Concerns Occasionally companies are hesitant to admit that the "old way" may not have been the best way. Once easy-to-implement pollution prevention practices such as improved operations, for example, are underway, companies may realize that they could have been doing it all along but do not want the fact made public because it may make them look bad. However, many companies do not have this attitude.

Available Time/Technical Expertise Some organizations may lack sufficient time or technical expertise to develop and implement pollution prevention practices.

Inertia Whenever a production system is in place and working with some degree of success, there is a tendency to leave well enough alone. The old adage, "If it ain't broke, don't fix it," applies.

Although there may be many obstacles to implementing pollution prevention, the benefits can be so great as to warrant working through the obstacles. By properly educating and including all employees, as well as customers and suppliers, about the advantages and stages of a pollution prevention program, successful projects and programs can be achieved.

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Chapter 3
Definition of Terms

"Many terms have been used to describe pollution prevention and related activities."

Many terms have been used to describe pollution prevention and related activities. This guidance manual uses the following terms. References for sources of definitions are given in parentheses.

"Pollution prevention" means the use of source reduction techniques in order to reduce risk to public health, safety, welfare and the environment and, as a second preference, the use of environmentally sound recycling to achieve these same goals. Pollution prevention avoids cross-media transfers of wastes and/or pollutants and is multi-media in scope. It addresses all types of waste and environmental releases to the air, water and land. (Note: This is Ohio EPA's working definition of pollution prevention. See Chapter 4 of this manual for U.S. EPA's definition.)

"Source reduction" means any effort to reduce, at the source, the quantity of waste generated, toxic chemical use, or any release into the environment. Source reduction measures include, but are not limited to, process modifications, feedstock purity, good operating and management practices, increases in the efficiency of machinery, and recycling within a waste generating or other production process. (Ohio EPA, Office of Pollution Prevention, Fact Sheet #1, March, 1993)

"Recycle" means to use, reuse or reclaim a material (Ohio Administrative Code (OAC) 3745-50-10). Recycling does not include incineration, burning waste as fuel, or other treatment.

"Reuse" means reutilization of a material in an environmentally sound manner that will not result in a hazard to human health or the environment (OAC 3745-50-10). A material is reused if it is either:

1. employed as an ingredient, including use as an intermediate in an industrial process to make a product, or
2. used in a particular function or application as an effective substitute for a commercial product (OAC 3745-51-01).

"Reclaim" A material is "reclaimed" if it is processed to recover a usable product or if it is regenerated. (OAC 3745-51-01)

"Waste minimization" means any effort to reduce or recycle the quantity of waste generated, and when feasible, to reduce or eliminate toxicity. "Waste minimization" does not include treatment, unless the treatment is part of the recycling process. (Ohio Revised Code (ORC) 6111.045(F)) (Note: Waste minimization for hazardous waste is defined at OAC 3745-50-10)

"Treatment" means any method, technique or process designed to change the physical, chemical or biological characteristics or composition of industrial waste or other waste; to neutralize the waste; to recover energy or material resources from the waste; to render the waste nonhazardous or less hazardous, safer to transport, store, or dispose of, or amenable for recovery, storage, further treatment, or disposal; or to reduce the volume of the waste. (ORC 6111.045(F))

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Chapter 4
Overview of Federal Law, Regulation and Policy

"A strong emphasis on pollution prevention is the most important thing we can do for the future of environmental protection in this country. We have to move our environmental effort 'upstream' to look for opportunities for the use of pollution prevention."

Carol Browner, U.S. EPA Administrator

U.S. EPA is committed to a preventive strategy to reduce or eliminate the generation of environmentally harmful pollutants which may be released to the air, land, and water. The following sections detail some of U.S. EPA's efforts in pollution prevention, hazardous waste minimization, and voluntary pollution prevention programs.

Pollution Prevention

The Pollution Prevention Act of 1990 established a national goal for environmental protection: to reduce or eliminate waste at its source. The Pollution Prevention Act established the following national waste hierarchy policy:

- 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.

U.S. EPA defines "pollution prevention" to mean "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 as 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) before recycling, treatment, or disposal; and reduces hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants. Some practices commonly described as "in-process recycling" may qualify as pollution prevention. Environmentally sound recycling can reduce the need for treatment or disposal, and conserve energy and resources. Pollution prevention addresses solid and hazardous waste and all air and water pollutants, whether regulated or not.

The Pollution Prevention Act also states that each owner or operator of a facility required to file an annual toxic chemical release form under section 313 of the Superfund Amendments and Reauthorization Act (SARA) shall include with each filing a toxic chemical source reduction and recycling report for the preceding calendar year. This requirement became effective in 1992. The reporting requirements include the following:

1. the quantity of the chemical entering any waste stream or otherwise released to the environment;
2. the amount of the chemical which is recycled in a calendar year, including the percentage change from the previous year;
3. source reduction practices used with respect to that chemical during the year (this includes a variety of technologies and techniques such as improvement in management, training, inventory control, materials handling, or other general operational phases of industrial facilities);
4. projections of expected releases for the next two reporting years;
5. a ratio of production in the reporting year to production in the previous year; and,
6. techniques which were used to identify source reduction opportunities (such as employee recommendation, external and internal audits, participative team management, and material balance audits).

Although there are other requirements, these six provide an overview of the scope of information being requested by the Act. Point 6 above lists a number of items that are important components of a pollution prevention plan, and although not required, it is obvious that planning by Ohio businesses and government facilities is desired and will be necessary to fully comply with the regulations.

Hazardous Waste Minimization

With the passage of the Hazardous and Solid Waste Amendments (HSWA) of 1984, amending the 1976 Resource Conservation and Recovery Act (RCRA), Congress established a new policy concerning hazardous waste management. Specifically, Congress declared that the reduction or elimination of hazardous waste generation at the source should take priority over the management of hazardous wastes after they are generated. HSWA contains several specific requirements that promote implementation of waste minimization. Generators of hazardous waste who transport waste off-site are required to certify on each hazardous waste manifest that they have a program in place to reduce the volume and toxicity of such waste to the degree determined by the generator to be economically practicable. Owners and operators of permitted hazardous waste treatment, storage and disposal facilities are also required to provide the same certification annually. Hazardous waste generators and owners/operators of treatment, storage and disposal facilities who manage their own waste on-site, must also identify in a biennial report to U.S. EPA (annual to Ohio EPA): (1) the efforts undertaken during the year to reduce the volume and toxicity of waste generated; and (2) the changes in volume and toxicity actually achieved in comparison to previous years.

With the intent of meeting HSWA's goal, U.S. EPA has published a notice, "Interim Final Guidance:

Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program" (Federal Register, volume 58, May 28, 1993). The full text of this notice is included in Appendix C of this guidance manual. The notice is intended to provide guidance to hazardous waste generators and treatment, storage and disposal facilities about what constitutes a waste minimization program in place for certification under HSWA. The elements of a waste minimization program are also important components of a pollution prevention plan. The elements include top management support, characterization of waste generation and waste management costs, periodic waste minimization assessments, developing a cost allocation system, encouraging technology transfer, and program implementation and evaluation. Table C-2 in Appendix C compares U.S. EPA's program to the program outlined in this guidance manual.

On May 18, 1993, U.S. EPA also announced a new Hazardous Waste Reduction and Combustion Strategy. Waste reduction is a key component of the strategy. A state/federal task force has been convened to fully evaluate the role of hazardous waste combustion in the management of hazardous waste.

Ohio EPA is authorized to administer the federal hazardous waste program in Ohio. Appendix C of this document contains information about Ohio Hazardous Waste Facility Installation and Operation Permits and their condition that requires a Waste Minimization Report. The Waste Minimization Report is a written document that the permittee must use to demonstrate compliance with the certification requirement to have a waste minimization program in place.

Voluntary Pollution Prevention Programs

U.S. EPA has developed several programs to encourage the use of pollution prevention techniques, among other methods, to reduce toxic releases. U.S. EPA's 33/50 Program is a voluntary program to reduce national pollution releases and off-site transfers of 17 toxic chemicals by 33 percent by the end of 1992 and by 50 percent by the end of 1995. The Green Lights Program sponsored by U.S. EPA encourages companies to decrease their energy use by using more energy efficient lighting, which in turn reduces the amount of emissions and waste generated through the generation of power. The State of Ohio is a Green Lights Partner and promotes the Green Lights Program to companies in Ohio. Appendix B discusses both of these programs in more detail.

U.S. EPA has proposed the creation of a program that would encourage and publicly recognize environmental leadership. As described in the January 15, 1993 Federal Register, this program would also promote pollution prevention in manufacturing.

As part of the New Chemicals Program under the Toxic Substances Control Act, companies are required to submit Premanufacture Notices (PMNs) before beginning production of new chemicals. The "Optional Pollution Prevention Information" page of the PMN form provides submitters with the opportunity to consider and provide descriptions of pollution prevention and risk reduction options considered by the company in regard to specific new chemical substances. Providing this optional pollution prevention information to U.S. EPA may benefit PMN submitters by reducing regulatory controls and/or testing requirements, if the pollution prevention information sufficiently mitigates U.S. EPA's concerns for the toxicity, human exposure, or environmental releases of the PMN substance.

Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual

Chapter 5
Overview of State of Ohio Law, Regulation and Policy

"Pollution prevention is a priority for this Administration. A strong pollution prevention program minimizes waste and maximizes profits. It's good for business and for the environment - a real win-win."

Governor George V. Voinovich

The State of Ohio's environmental programs are increasingly emphasizing pollution prevention. Ohio is modifying and expanding efforts that will help to redirect attention toward prevention for toxics and other emissions and wastes. These activities are found in the Ohio Environmental Protection Agency, the Ohio Department of Development, and the Ohio Department of Natural Resources. Appendix B, "Sources of pollution prevention information," provides additional information about these activities.

Two Ohio laws are aimed at reducing waste generation in the state. House Bill 147 directs owners and operators of Class I injection well facilities to prepare waste minimization and treatment plans for wastes generated at these facilities. The plans will identify the specific technically and economically feasible measures that will be taken to prevent or reduce releases into the environment. Appendix D of this guidance manual discusses the waste minimization planning requirements for Class I injection well facilities in detail.

The implementation of House Bill 592 has helped to stimulate activity in solid waste reduction and recycling throughout Ohio's solid waste management districts. The major goals of H.B. 592 are to reduce solid waste generation and increase recycling. By 1994, all districts will implement a solid waste management plan which includes strategies for achieving 25 percent waste reduction and/or recycling as a goal. The reduction goal is a planning objective, not an inflexible standard. These plans must be approved by Ohio EPA. Some districts have developed innovative programs including establishing commitments by business to reduce and recycle.

Hazardous waste minimization requirements are detailed in the preceding chapter on overview of federal laws, regulations and policies. Appendix C of this document contains information about Ohio Hazardous Waste Facility Installation and Operation Permits and their condition that requires a Waste Minimization Report. The Waste Minimization Report is a written document that the permittee must use to demonstrate compliance with the certification requirement to have a waste minimization program in place as required by RCRA.

Ohio EPA has general permitting authority for storm water general permits. The objective of the storm water program is to reduce or eliminate illegal, whether intentional or unintentional, dumping of materials into storm water discharges. The general permit for industrial activity requires preparation and implementation of a storm water pollution prevention plan. Permits also require implementation of best management practices to control the quality of storm water runoff.

The Ohio Environmental Protection Agency (Ohio EPA) strongly supports the move toward more pollution prevention and is involved in a number of specific pollution prevention activities. The Office of Pollution Prevention (OPP) coordinates pollution prevention activities for all of Ohio EPA. The OPP has four main objectives:

1. Facilitate the incorporation of pollution prevention into standard Agency operations and into standard State government operations.
2. Review and develop legislative initiatives for pollution prevention.
3. Increase awareness of pollution prevention opportunities through education, outreach and technical assistance for business, government and the public.
4. Analyze, develop and publicize information and data related to pollution prevention for use by business, government and the public.

The OPP provides on-site, by mail, or over the phone technical assistance; provides literature search information; prepares program and industry specific fact sheets; and makes public presentations regarding pollution prevention.

The OPP is currently coordinating the development of a strategy to integrate pollution prevention into activities at Ohio EPA. This strategy will identify regulatory and non-regulatory options for integrating pollution prevention concepts into existing media programs and propose new pollution prevention activities for consideration by Ohio EPA.

As part of the Agency Pollution Prevention Strategy, Ohio EPA is now incorporating pollution prevention requirements in many environmental enforcement cases. The Agency is pursuing this condition to encourage additional environmental improvements, not just penalties, as a result of enforcement. Some offers of settlement may include reduced monetary penalties in exchange for commitments to develop pollution prevention plans, or for commitments to install source reduction processes.

In 1991, Governor George V. Voinovich announced the formation of the Pollution Prevention Development Workgroup (PPDW), directed by Ohio EPA. The purpose of the Workgroup is to develop and coordinate pollution prevention initiatives throughout state government, business and consumer activities. The goals of the workgroup include the development of a comprehensive Pollution Prevention Strategy for Ohio and increasing communication on pollution prevention efforts between state agencies, business and the public.

Currently, the PPDW is initiating pollution prevention planning for State Agencies by implementing a pilot program which includes the Ohio Department of Administrative Services, the Ohio Department of Natural Resources, the Ohio Environmental Protection Agency, and one facility within the Ohio Department of Rehabilitation and Correction. Results are expected to reveal areas in State government where pollution can be prevented through a variety of means. This effort is expected to be extended to other state agencies based upon the results of this initial effort.

On September 1, 1993, Governor Voinovich requested the top 100 emitters of toxic pollutants in Ohio to work with the Ohio EPA to develop comprehensive pollution prevention plans to reduce the various types of wastes they generate. The State of Ohio's press release, "Pollution Prevention Planning - The Environmental Strategy for the Future," states that wastes in the plans will include chemicals in the Toxic Release Inventory, hazardous and solid wastes, air emissions, and wastewater discharges. The plans will identify the types of waste generated, evaluate ways to limit the source of the wastes, set forth a written course of action to carry out each facility's commitment to pollution prevention, and establish progress reporting to measure the success of each program.

Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual

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Appendix C
Ohio Hazardous Waste Facility Installation and Operation Permit Waste Minimization Report Condition

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This appendix describes the Waste Minimization Report Condition in Ohio Hazardous Waste Facility Installation and Operation Permits and describes references that can be used to complete a Waste Minimization Report. The appendix also compares the elements of a pollution prevention/waste minimization program in this guidance manual, U.S. EPA's interim final guidance to hazardous waste generators, and U.S. EPA's *Facility Pollution Prevention Guide*.

Owners and operators of permitted hazardous waste treatment, storage and disposal facilities are required to certify annually that they have a waste minimization program in place, and are required to include this certification in their operating record. The Ohio Administrative Code (OAC 3745-54-73 (B)(9)) states that the operating record must include:

> "A certification by the permittee, no less often than annually, that the permittee has a program in place to reduce the volume and toxicity of hazardous waste that he generates to the degree determined by the permittee to be economically practicable; and the proposed method of treatment, storage, or disposal is that practicable method currently available to the permittee which minimizes the present and future threat to human health and the environment."

Ohio Hazardous Waste Facility Installation and Operation Permits contain a condition that requires a Waste Minimization Report. The waste minimization report condition is given in Table C-1. The Waste Minimization Report is a written document that the permittee must use to demonstrate compliance with the certification requirement to have a waste minimization program in place.

Ohio EPA is authorized to administer the RCRA program in Ohio, including issuing hazardous waste treatment, storage and disposal facility permits. Ohio EPA's authorized RCRA program operates in lieu of U.S. EPA's program. Ohio EPA's authority includes conditional authority for waste minimization condition in permits. For informational purposes only, facilities should note that U.S. EPA's Region V office has developed RCRA waste minimization permit language, evaluation criteria, and checklists (December, 1992). Region V has also developed two guidance documents related to their permit language. Region V's *Recommended Minimum Standards, Hazardous Waste Reduction Plan/Waste Reduction Implementation Report Evaluation Criteria*, is to be used by Permittees to develop plans and reports, and by permit writers to evaluate the plans and reports. Region V's *Region 5 Hazardous Waste Reduction Plan/Waste Reduction Implementation Report Guidance* is designed to aid the facility in the development of these documents.

Table C-1. Waste Minimization Report Condition

Waste Minimization Report OAC Rule 3745-54-73 (a) The Permittee shall submit a Waste Minimization Report describing the waste minimization program required by O.A.C. 3745-54-75 (H), (I), and (J); O.A.C. 3745-54-73 (B) (9); and, O.A.C. 3745-52-20 (B) at least once every two years. The provisions of O.A.C. 3745-54-75 (H), (I), and (J); and O.A.C. 3745-54-73 (B) (9) must be satisfied annually. (b) In completing this report, the Permittee shall refer to the following information: instructions prepared by the Ohio EPA for completing the Waste Minimization Annual Report required by O.A.C. 3745-54-75 (H), (I), and (J); the Federal Register notice of May 28, 1993, vol. 58, p. 31114, "Interim Final Guidance: Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program"; U.S. EPA's "Facility Pollution Prevention Guide" (EPA/600/R-92/088) May, 1992; Ohio EPA's "Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual"; and any subsequent updates. The Waste Minimization Report prepared by the permittee should incorporate the phases outlined in the "Facility Pollution Prevention Guide" including planning and organization, assessment, feasibility analysis, implementation, measuring progress, and maintaining the program. Similar content and additional discussion are found in Ohio EPA's "Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual." (c) The Permittee shall submit the Waste Minimization Report to the Director within one-hundred and eighty days (180) of journalization of this permit, and shall submit updates to this report biennially thereafter.

Waste Minimization References

The waste minimization permit condition lists four references that permittees shall refer to when completing their waste minimization reports. These references are briefly described here.

a) Instructions prepared by the Ohio EPA for completing the Waste Minimization Annual Report required by OAC 3745-54-75 (H), (I), and (J).

The instructions include definitions for waste minimization, recycling, and source reduction, examples of waste minimization activities, and a general list of waste minimization activities (see activity codes list).

b) Federal Register notice of May 28, 1993, vol. 58, p. 31114, "Interim Final Guidance: Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program."

The notice is intended to provide guidance to hazardous waste generators and treatment, storage and disposal facilities about what constitutes a waste minimization program in place for certification under HSWA. An effective waste minimization program should include each of the general elements listed below, although some of these elements may be implemented in different ways depending on the preferences of individual companies. The notice provides specific explanations and examples for each of the elements. The full text of this notice is included as a part of Appendix C.

1) Top management support
2) Characterization of waste generation and waste management costs
3) Periodic waste minimization assessments
4) A cost allocation system
5) Encourage technology transfer
6) Program implementation and evaluation

c) U.S. EPA's *Facility Pollution Prevention Guide* (EPA/600/R-92/088) May, 1992

U.S. EPA's *Facility Pollution Prevention Guide* concentrates on procedures that motivate people to search, screen, and put into practice measures involving administrative, material, or technology changes that result in decreased waste generation. The manual is also a source of concepts and ideas for developing and implementing a pollution prevention program. The manual lists several steps in a program, including planning and organization, assessment, feasibility analysis, implementation, measuring progress, and maintaining the program. The *Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual* uses the pollution prevention program steps (with limited modifications) outlined in U.S. EPA's *Facility Pollution Prevention Guide*.

d) *Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual*

The *Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual* (this document) should also be used as a reference when writing a Waste Minimization Report. Two tables are included in this manual that compare elements of different manuals and guidelines to U.S. EPA's *Facility Pollution Prevention Guide* (refer to Table C-2, Comparison of elements of a pollution prevention program in U.S. EPA's *Facility Pollution Prevention Guide* to elements of a waste minimization program in U.S. EPA's interim final guidance to hazardous waste generators; and to Table C-3, Comparison of elements of a pollution prevention program in U.S. EPA's *Facility Pollution Prevention Guide* to elements of a pollution prevention/waste minimization program in the *Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual*). These comparison tables illustrate that although the names of elements and order of elements may be different, the manuals and guidelines essentially describe the same kind of pollution prevention and waste minimization programs.

General Considerations

The Waste Minimization Report must be specific and should include the phases outlined in U.S. EPA's *Facility Pollution Prevention Guide*. However, operations and processes at different facilities may be quite diverse. Because waste minimization activities are dependent on the operations and processes, waste minimization reports will vary and may be tailored to individual facilities.

Considerations for commercial treatment, storage and disposal facilities and research and development facilities

Commercial treatment, storage and disposal facilities and research and development facilities have different constraints on both the type and amount of material inputs to their facilities that limit their options for pollution prevention. Commercial treatment, storage and disposal facilities are in business to take a variety of wastes from generators. Research and development facilities work with a variety of materials and the types of materials that will be used (and subsequent waste generated) in a specific project are not always identified before a project starts. Some pollution prevention projects may require changes in the facility's hazardous waste permits. The permitting process can be lengthy and may delay implementation of the pollution prevention projects.

While there are numerous pollution prevention opportunities at such facilities, their pollution prevention plans and programs should reflect the above constraints and the nature of materials input. Because of these constraints, pollution prevention plans and programs for these facilities may be less extensive than plans and programs for other business or government facilities. Pollution prevention assessments can still be conducted, giving special consideration to assessing support departments that are common to many facilities (see Chapter 12, Table 2). For basic concepts on pollution prevention options, research and development facilities can refer to Ohio EPA's Fact Sheet 16, *Research and Educational Laboratory Waste*, and to U.S. EPA's 1990 document *Guides to Pollution Prevention: Research and Educational Institutions*, EPA/625/7-90/010.

Hazardous waste treatment, storage and disposal facilities have many common activities, some required by hazardous waste regulations, that provide the opportunity for implementing and integrating pollution prevention into the operation of the facility. Several activities are listed here with suggestions for pollution prevention options. Any changes implemented as a result of pollution prevention options must be in compliance with the facility's permit and with applicable environmental regulations.

All facilities must evaluate wastes to determine their characteristics. Procedures for sampling and laboratory analysis can be designed to incorporate pollution prevention.

All facilities must train employees about the operation of the facility and hazardous waste management. Pollution prevention and waste minimization should be an integral part of the training. Employees should be encourage to provide suggestions for pollution prevention projects.

Contingency plans can be written to incorporate pollution prevention options. Plans on responding to emergencies and spills should consider responses that will address the situation and at the same time minimize the use of resources and minimize waste generation. Proactive measures against leaks and spill should be incorporated in plans for these facilities.

All facilities have general inspection requirements and emergency preparedness and prevention requirements. Facilities could use these inspections and requirements as opportunities to continually look for pollution prevention aspects of daily operations.

All facilities receive waste and manage waste in containers, tanks, or pipelines. Standardized practices for preventing pollution can be incorporated in loading/unloading procedures, storage procedures, and daily operations of waste management units.

Treatment, storage and disposal activities should be assessed as unit processes by following the steps outlined in Chapter 9 of this manual. Treatment, storage and disposal activities are the "production" processes of a hazardous waste facility and can be evaluated in a similar manner. For example, a different flocculent could be used in a wastewater treatment operation that may result in less solids being generated for later management or disposal.

The following example illustrates some of the challenges facing a commercial solvent reclaimer. The spent solvent waste generators may determine, to a large extent, the amount of waste generated by the solvent reclaimer when processing a given waste stream. The annual volume of hazardous waste generated by the reclaimer is dependent on the percentage of reclaimable material in the hazardous waste and the total hazardous waste received for the year. The reclaimer's annual receipts are dependent on the generators' reduction of generated spent solvent waste and the reclaimer's competitive market position for that business year.

The reclaimer can work to improve operating efficiencies and improve reclamation processes at the reclamation facility as part of a pollution prevention program. For example, the reclaimer could survey the entire process, look for areas and equipment that might have fugitive emissions, and institute equipment and operating practices to reduce or eliminate emissions. The reclaimer could use statistical process control techniques to determine the optimum operating conditions for distillation equipment. The reclaimer might also want to work with the generators to educate them on ways to consolidate waste streams and reduce waste generation in an effort to maximize recovery of spent solvent. Although working with customers to reduce waste at the source might be very desirable from the reclaimer's and customers' points of view and is strongly encouraged by the State of Ohio, this activity is not required for hazardous waste treatment, storage and disposal facilities.

The following example illustrates some of the challenges facing a specialty chemicals research and development facility. The "products" of the research and development facility are knowledge (formulations for new chemical products) and waste. Experimental products developed during the research process cannot be sold; they must be managed as waste. Research and development of new chemicals is a constantly changing field and highly individualized. Constantly changing experiments make it difficult to define production units. It is also difficult to meaningfully determine a waste per unit product index when the product undergoes frequent changes.

Research and development facilities might define "research" as a process, and concentrate on how to make pollution prevention, particularly source reduction, part of and integrated into the design of research processes. Engineers and chemists can work with statisticians to design experiments to reduce waste. Procedures for procuring raw materials can be established. Information about past experiments can be made easily accessible by computer so that research chemists do not repeat old work. Computer modelling can help to predict experimental outcomes and product performance.

Table C-2
Comparison of Elements of a Pollution Prevention Program in U.S. EPA's *Facility Pollution Prevention Guide* to Elements of a Waste Minimization Program in U.S. EPA's Interim Final Guidance to Hazardous Waste Generators

Facility Pollution Prevention Guide Pollution Prevention Program	Hazardous Waste Generators Waste Minimization Program
Establish the pollution prevention program ● Executive level decision ● Policy statement ● Consensus building	Top management support ● Policy statement ● Commit to implementing recommendations
Organize the program ● Name task force ● State goals	Top management support ● Designate a waste minimization coordinator ● Set specific goals
Do preliminary assessment ● Collect data ● Review sites ● Establish priorities	Characterization of waste generation and waste management costs
Write program plan ● Consider external groups ● Define objectives ● Identify potential obstacles ● Develop schedule	"The generator or treatment, storage, or disposal facility should document its program (in writing)..." (see note 3)
Do detailed assessment ● Name assessment teams ● Review data and sites ● Organize and document information	Periodic waste minimization assessments ● Identify opportunities for waste minimization
Define pollution prevention options ● Propose options ● Screen options	Periodic waste minimization assessments

Do feasibility analysis • Technical • Environmental • Economic	Encourage technology transfer Periodic waste minimization assessments • Analyze waste minimization opportunities based on the true costs of the waste Cost allocation system
Write assessment report	"The generator or treatment, storage or disposal facility should document its program (in writing)..." (see note 3)
Implement the plan • Select projects • Obtain funding • Install the selected projects	Top management support • Commit to implementing recommendations Program implementation and evaluation
Measure progress • Acquire data • Analyze results	Program implementation and evaluation
Maintain the pollution prevention program	Top management support • Publicize success stories • Reward employees • Train employees Program implementation and evaluation

Notes:

1. The pollution prevention program elements follow the outline of U.S. EPA's *Facility Pollution Prevention Guide* (EPA/600/R-92/088).
2. The waste minimization program elements follow the outline of U.S. EPA's Interim Final Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program (Federal Register, May 28, 1993, vol. 58, p. 31114).
3. This statement is part of the May 28, 1993 Federal Register explanation of the waste minimization program.

Table C-3
Comparison of Elements of a Pollution Prevention Program in U.S. EPA's *Facility Pollution Prevention Guide* to Elements of a Pollution Prevention/Waste Minimization Program in the *Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual*

Facility Pollution Prevention Guide Pollution Prevention Program	State of Ohio Pollution Prevention/Waste Minimization Program
Establish the pollution prevention program • Executive level decision • Policy statement • Consensus building	Establish the pollution prevention program • Executive level decision • Policy statement • Consensus building

Organize the program • Name task force • State goals	Organize the pollution prevention program • Name the pollution prevention task force • State goals • Increase employee awareness and involvement • Train employees • Reward pollution prevention successes
Do preliminary assessment • Collect data • Review sites • Establish priorities	Do a preliminary assessment • Understanding processes and wastes • Gathering background information • Define production units • Characterize general process • Understand unit processes • Outputs • Perform materials balance • Establish priorities
Write program plan • Consider external groups • Define objectives • Identify potential obstacles	Write the pollution prevention program plan • Define objectives • Identify potential obstacles • Develop schedule • Augment the plan
Do detailed assessment • Name assessment teams • Review data and sites • Organize and document information	Do a detailed assessment • Begin assessments
Define pollution prevention options • Propose options • Screen options	Define pollution prevention and waste minimization options • Propose options • Screen options
	Cost considerations • Determine full cost of waste • Develop economics • Establish a cost allocation system
Do feasibility analysis • Technical • Environmental • Economic	Do feasibility analysis • Technical evaluation • Economic evaluation • Environmental evaluation
Write assessment report	Write the assessment report
Implement the plan • Select projects • Obtain funding • Install the selected projects	Implement the pollution prevention plan • Select projects • Obtain Funding • Install the selected projects

Measure progress • Acquire data • Analyze results	Measure progress: Program and project evaluation • Program evaluation • Program modification
Maintain the pollution prevention program	Maintain the pollution prevention program

Notes:

1. The pollution prevention program elements follow the outline of U.S. EPA's *Facility Pollution Prevention Guide* (EPA/600/R-92/088).
2. The pollution prevention/waste minimization program elements follow the outline of the *Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual*.

Federal Register / Vol. 58, No. 102 / Friday, May 28, 1993

Part VII Environmental Protection Agency

Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program; Notice

This reference is not included here in this Web version. You may check the U.S. EPA Web site for it.

Appendix B
Sources of Pollution Prevention Information

Ohio Environmental Protection Agency (Ohio EPA)

Office of Pollution Prevention (OPP)

The Ohio EPA Office of Pollution Prevention is responsible for coordinating pollution prevention activities for all divisions at Ohio EPA. The office is comprised of the Technical Assistance Unit and the Program Management and Evaluation Unit. Both units are responsible for developing criteria for measuring pollution prevention progress, supporting activities relating to the preparation and passage of pollution prevention legislation in Ohio, and supporting the development of a pollution prevention strategy for Ohio. OPP has a total of 10 permanent staff positions. Additional part time staff form a Pollution Prevention Intern Program.

The goal of OPP is to develop and implement pollution prevention initiatives that effectively reduce pollutants and conserve natural resources in Ohio by emphasizing source reduction and environmentally sound recycling. OPP seeks to accomplish this goal through five objectives:

- Facilitate the incorporation of pollution prevention into standard Agency operations and into standard State government operations;
- Review and develop legislative initiatives for pollution prevention;
- Increase awareness of pollution prevention through education, outreach, and technical assistance for business, government, and the public; and
- Analyze, develop, and publicize information and data related to pollution prevention for use by government and the public.

The OPP provides on-site or over the phone technical assistance; provides literature search information; prepares program and industry specific fact sheets; and makes public presentations regarding pollution prevention. OPP maintains a library containing more than 1400 pollution prevention documents such as case studies, fact sheets, manuals, guides, videotapes and more. OPP has access to several databases and information from other agencies. In addition, interested parties can request copies of approximately 75 publications via an information request form.

For more information contact:
Office of Pollution Prevention
Ohio EPA

1800 WaterMark Drive
P.O. Box 1049
Columbus, OH 43216-1049
Phone: 614/644-3469

Small Business Assistance Program

The Clean Air Act Amendments (CAAA) of 1990 require each state to develop a Small Business Stationary Source Technical and Environmental Compliance Assistance Program to help small businesses comply with the Act. This program will consist of two elements, a Small Business Assistance Program (SBAP) and a Small Business Ombudsman. Ohio EPA's Division of Air Pollution Control will administer the SBAP which will provide information to small businesses on compliance, pollution prevention, accidental release prevention and detection, alternative technologies, and other areas. The Ombudsman will represent small businesses with air pollution control concerns before appropriate government offices and aid in the dissemination of information, operate a toll-free hotline, and refer small businesses to specialists, as well as other functions. The Ohio Air Quality Development Authority is proposed as the state's Small Business Ombudsman for CAAA related activities

For more information contact:
Small Business Assistance Program
Division of Air Pollution Control
Ohio EPA
1600 WaterMark Drive
Columbus, OH 43215
Phone: 614/644-2270

Ohio Department of Development (DOD)

Edison Technology Centers

Ohio's Edison Technology Centers are independent not-for-profit organizations funded in part by the Ohio Department of Development and in part by industry. By offering pollution prevention technical assistance to waste generators, these Centers can offer a wealth of good information geared toward cost-effective benefits to businesses which help improve manufacturing bottom lines and protect the environment.

Cleveland Advanced Manufacturing Program (CAMP)

CAMP, northeastern Ohio's Edison Technology Center, plays an active role in helping manufacturers adopt new technologies, integrate new management techniques, and streamline operations to increase productivity. A new goal is to encourage businesses to think in terms of pollution prevention and total quality management. CAMP now offers several environmental services, including pollution prevention assistance. CAMP provides waste reduction assessments and counselling. Technology application engineers develop options, estimate cost savings and project the impact of suggested changes.

For more information contact:
Cleveland Advanced Manufacturing Program
4600 Prospect Avenue

Cleveland, OH 44103
Phone: 216/432-5300
Outside Cleveland: 800/927-0436
Fax: 216/362-2900

Institute of Advanced Manufacturing Sciences (IAMS)

IAMS' Center for Applied Environmental Technologies (CAET) offers technical assistance in pollution prevention (Ohio Pollution Prevention Technical Assistance, OPPTA), assists companies in applying "clean" technologies, and serves as a an information clearinghouse for pollution prevention methods and technologies. CAET offers industry on-site pollution prevention assessments to quantify wastes, suggest process changes, and identify potential savings. Following an assessment, CAET is available to work with companies to develop and initiate pollution prevention programs. Literature searches and telephone assistance are available as well as training programs and networking opportunities. CAET is also working to help industry reduce solid waste and to develop markets for recycled products.

For more information contact:
Institute of Advanced Manufacturing Sciences, Inc.
1111 Edison Drive
Cincinnati, OH 45216-2265
In Cincinnati call: 513/948-2000
Outside of Cincinnati: 800/345-4482
Fax: 513/948-2109

Ohio Department of Natural Resources (ODNR)

ODNR's Division of Litter Prevention and Recycling is very active in public awareness activities concerning recycling through the "Keep Ohio Beautiful" program and through several grant programs to enhance recycling activities in the State. ODNR works with the Association of Ohio Recyclers and the National Recycling Coalition to promote recycling on both state and national levels.

For more information contact:
Division of Litter Prevention and Recycling
Ohio Department of Natural Resources
Fountain Square
Columbus, OH 43224-1387
614/265-6333

Ohio Air Quality Development Authority (OAQDA)

OAQDA was created in 1970 by the Ohio General Assembly to work in partnership with Ohio's businesses and citizens to promote clean air and economic prosperity. OAQDA helps businesses - large and small - obtain competitive, low cost financing to purchase and install air pollution control equipment to meet clean air standards. OAQDA's responsibilities include:

- Issuing air quality revenue bonds, notes, and refunding bonds;
- Making loans for air quality projects for industry, public utilities, commerce, distribution, or research;

- Making loans and grants to government agencies to acquire and construct air quality facilities;
- Acquiring, constructing, and operating air quality facilities; and
- Conducting research and development on air quality issues

For more information contact:
OAQDA
50 West Broad Street, Suite 1901
Columbus, OH 43215
Phone: 614/224-3383

Ohio Water Development Authority (OWDA)

OWDA was created by the Ohio General Assembly in 1968 to provide financing to Ohio communities for the planning and construction of drinking water, waste water, and solid waste facilities. OWDA also issues private activity bonds for solid waste facilities, facilities which furnish potable water, and facilities for the disposal of hazardous waste. Additionally, OWDA administers a Research and Development Grant Program which provides grants to communities seeking innovate solutions to environmental problems dealing with solid waste, water, waste water, and energy resource development.

For more information contact:
OWDA
50 W. Broad Street, Suite 1425
Columbus, OH 43215
Phone: 614/466-5822

United States Environmental Protection Agency (U.S. EPA)

33/50 Program

The 33/50 Program was initiated in January of 1991 by U.S. EPA to reduce national pollution releases and off-site transfers of 17 toxic chemicals reported under the Toxics Release Inventory (TRI). Reduction goals are 33 percent by the end of 1992 and 50 percent by the end of 1995. Companies are encouraged to examine their industrial processes and establish cost effective pollution prevention practices for these chemicals. Participation in the 33/50 Program is completely voluntary. The TRI will be used to track these reductions using 1988 data as a baseline.

The 17 chemical groups are:

- benzene
- cadmium & cadmium compounds
- carbon tetrachloride
- chloroform
- chromium & chromium compounds
- cyanide & cyanide compounds
- lead & lead compounds
- mercury & mercury compounds

- methylene chloride
- methyl ethyl ketone
- methyl isobutyl ketone
- nickel & nickel compounds
- tetrachloroethylene
- toluene
- 1,1,1-trichloroethane
- trichloroethylene
- xylenes

For more information contact:
The TSCA Hotline: 202/554-1404. All information received by EPA through the 33/50 program is available to the public through the Emergency Planning and Community Right to Know Act (EPCRA) Reporting Center
P.O. Box 23779
Washington, D.C. 20026-3779
Phone: 202/488/1501.

Green Lights Program

Green Lights is a voluntary, non-regulatory program that encourages the widespread use of energy-efficient lighting and the reduction of pollution generated by energy consumption. Green Lights participants agree to survey their facilities and over five years upgrade 90 percent of their square footage. The upgrade must be profitable and the lighting quality must be maintained or enhanced. As of July 1993, over 1000 organizations have joined the program. In addition to saving energy, participants receive positive public recognition.

On July 8, 1993, the State of Ohio officially became a Green Lights Partner. Ohio is the first state in U.S. EPA's Region V to join the program. The Ohio Department of Administrative Services is coordinating all state related projects. Ohio is also promoting Green Lights to other businesses in Ohio through the Ohio EPA, Office of Pollution Prevention.

For more information contact:
Green Lights Program
U.S. EPA
401 M Street, SW
(6202J)
Washington, DC 20460
or call the Green Lights Hotline:
Phone: 202/775-6650
Fax: 202/775-6680

For State of Ohio buildings contact:
Ohio Green Lights Office
Department of Administrative Services

35th Floor, State Office Tower
30 East Broad Street
Columbus, OH 43266
Phone: 614/644-5901

Ohio companies and local governments should contact Ohio EPA, Office of Pollution Prevention.

Pollution Prevention Information Clearinghouse (PPIC) and Pollution Prevention Information Exchange System (PIES)

The PPIC is dedicated to reducing or eliminating industrial pollutants through technology transfer, education, and public awareness. It is a free, nonregulatory service of the U.S. EPA which is operated by the U.S. EPA's Office of Pollution Prevention and Toxics and the Office of Research and Development. PPIC includes the following information exchange mechanisms to ensure efficient and comprehensive support:

- Repository - a hard copy reference library containing up-to-date information on pollution prevention.
- PIES - an interactive, PC-based system designed to provide instant access to data bases, publications, and on-line access to peers.
- Hotline - a free telephone service for those without access to a personal computer. The hotline can answer technical questions, locate and order documents and provide referrals.
- Outreach efforts - general and industry- specific information packets on prevention opportunities as well as workshop training sessions.

PIES is the computerized information network of EPA's PPIC. PIES provides on-line interactive access through modem and PC to a wide range of pollution prevention information. It is open 24 hours a day and requires no user fees. PIES features literature search functions, a national calendar of conferences and workshops relating to pollution prevention, hundreds of case studies of pollution prevention, a message center for interaction and exchange with participants, and direct access to news and documents. The International Cleaner Production Information Clearinghouse (ICPIC) and OzonAction are also available by accessing PIES.

To access PIES, a personal computer, a modem, communications software, and a telephone line are necessary. PIES is accessible through a regular telephone call, and the SprintNet network.

For more information on PPIC contact:
Pollution Prevention Information Clearinghouse
U.S. EPA, PM 211-A
401 M Street, SW
Washington, D.C. 20460
Phone: 202/260-1023
Fax: 202/260-0178

For more information on PIES contact:
Pollution Prevention Information Exchange System c/o SAIC
7600-A Leesburg Pike
Room 369

Falls Church, VA 22043
Phone: 703/821-4800
Fax: 703/821-4775

National Industrial Competitiveness Through Efficiency: Energy, Environment and Economics (NICE3)

A joint project of the U.S. Department of Energy (U.S. DOE) and U.S. EPA's Office of Pollution Prevention and Toxics (OPPT), the NICE3 grant program strives to improve energy efficiency, advance industrial competitiveness, and reduce environmental emissions of industry. Large-scale research and demonstration projects are targeted at industries with the highest energy consumption and greatest levels of toxics and chemicals released.

Eligible industries are in SIC codes 26 (paper), 28 (chemicals), 29 (petroleum and coal products), and 33 (primary metal industries). Projects are expected to use the one-time grant funds as seed money to overcome start-up risks. It is expected that industry will finance continuation of projects past the initial grant funding period. As part of the grant-funded phase, awardees will design, test, demonstrate, and assess the feasibility of new processes and/or equipment which can significantly reduce generation of high-risk pollution.

For more information contact:
David Bassett
Office of Pollution Prevention and Toxics
U.S. EPA
401 M Street, SW (7409)
Washington, D.C. 20460
Phone: 202/260-2720

Waste Exchanges

A waste exchange is a specialized service which provides a network for linking wastes (industrial and municipal) with those who may be able to use the wastes or recycle them. A waste exchange is a medium for finding uses for wastes which otherwise would be discarded. A waste exchange is like a specialized classified advertising system where a third party (the waste exchange) maintains confidentiality of the parties listing available waste or wanting to use recyclable material. Waste exchanges provide information on reuse and recycling opportunities which is not readily available otherwise and typically reach thousands of specialists in waste management with information.

National Materials Exchange Network
(800) 858-6625 modem access line
(509) 325-0551

Northeast Industrial Waste Exchange
90 Presidential Plaza, Suite 122
Syracuse, New York 13202
(315) 422-6572
Fax: (315) 422-9051

Canadian Waste Materials Exchange

ORTECH
Sheridan Park Research Community
2395 Speakman Drive
Mississauga, Ontario, Canada L5K 1B3
(416) 822-4111 Ext. 265
Fax: 416/823-1446

The Indiana Waste Exchange
c/o RTN
P.O. Box 454
Carmel, IN 46032
(317) 574-6505
Fax: (317) 844-8765

Industrial Material Exchange Service
P.O. Box 19276
2200 Churchill Road, #24
Springfield, Illinois 62794-0276
(217) 782-0450
Fax: (217) 782-9142

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

RENEW, Office of Pollution Prevention
P.O. Box 13087
Austin, Texas 78711-3087
(512) 463-7773
Fax: (512) 463-8317

Southeast Waste Exchange
Urban Institute
Department of Civil Engineering
Univ. of North Carolina at Charlotte
Charlotte, North Carolina 28223
(704) 547-2307

Gene Jones
Southern Waste Information Exchange
P.O. Box 960
Tallahassee, Florida 32302
(800) 441-SWIX
Fax: (904) 574-6704

Waste Net

401 Mazur St.
Cincinnati, Ohio 45219
(513) 421-9768

Waste Reduction Strategies
9060 Outville Road
Pataskala, Ohio 43062
(614) 927-2511
Fax: (614) 927-1147

Merit Environmental Management
781 Beta Drive, Suite G
Cleveland, Ohio 44143
(216) 461-7760
Fax: (216) 461-2873

Tencon/Wastelink
P.O. Box 12
Terrace Park, Ohio 45174-0012
(513) 248-0012

Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual

Chapter 6
Overview of Developing a Pollution Prevention Program

*"A pollution prevention **program** involves developing and implementing a continuous strategy to address all waste generated by a facility and procedures for prioritizing and systematically reducing these wastes."*

There is often general confusion among the terms pollution prevention program, plan and project. Many companies have compiled a list of projects and called the list a plan - such a list is not a plan. A pollution prevention **program** involves developing and implementing a continuous strategy to address all waste generated by a facility and procedures for prioritizing and systematically reducing these wastes. A pollution prevention **plan** is a written guide used to chart the progress of the program. It reiterates management support, lists reasons for the program, identifies the pollution prevention team, describes how waste will be characterized, provides a strategy and schedule for pollution prevention assessments, includes an evaluation of all costs incurred by producing and handling waste, institutes a cost allocation system, indicates how technology transfer will take place, addresses training needs, and discusses how the program and projects will be evaluated and implemented. The plan needs to be periodically updated to reflect the continuous nature of a pollution prevention program. Pollution prevention **projects** are the specific activities undertaken to reduce or eliminate waste.

In the chapters that follow, the steps to establish and maintain a pollution prevention program will be presented. These steps follow the elements (with limited modifications) outlined in U.S. EPA's 1992 publication, *Facility Pollution Prevention Guide* (EPA/600/R-92/088). Figure 1 illustrates the major steps in a pollution prevention program as described in this guidance manual. These steps include:

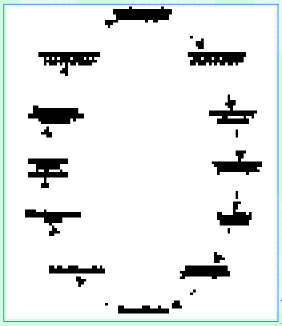


Figure 1: Elements of a Pollution Prevention Program

A. Establishing the pollution prevention program by obtaining support from top management, writing a policy statement, and building consensus within the company or facility.

B. Getting the program started by naming a task force, stating goals, increasing employee awareness and involvement, and training employees in pollution prevention.

C. Doing a preliminary assessment, including reviewing and describing in detail the manufacturing processes within the facility to determine the sources of waste generation and to define a baseline inventory to be used to set goals and evaluate progress; and establishing priorities for further assessment based on the results.

D. Writing the pollution prevention program plan.

E. Conducting a detailed assessment.

F. Identifying potential pollution prevention opportunities for the facility.

G. Determining all costs of current waste generation, management, and disposal, and establishing a system of proportional waste management charges for those departments that generate waste.

H. Selecting the best pollution prevention options for the company through feasibility analyses of technical, economic, and environmental considerations.

I. Writing an assessment report to describe results of the assessment and including the report in the program plan.

J. Implementing the pollution prevention plan, including selecting projects, obtaining funding, and installing projects

K. Measuring progress by evaluating the pollution prevention program on a company-wide or facility-wide basis as well as evaluating specific pollution prevention projects.

L. Maintaining and sustaining the pollution prevention program for continued growth and continued benefits to the company. Reevaluating the program as economic situations change and/or process equipment require upgrading.

The concepts presented in this manual are applicable to the reduction of all waste regardless of environmental media, quantity or toxicity. Some interpretation may be needed to make the suggestions usable by your specific business and facility.

For more detailed information about pollution prevention programs, refer to U.S. EPA's *Facility Pollution Prevention Guide* and to the reference section in the appendices of this guidance manual. U.S. EPA's *Facility Pollution Prevention Guide* contains worksheets that may be helpful in implementing and documenting a pollution prevention program.

Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual

Chapter 7
Establish the Pollution Prevention Program

"Pollution prevention plans can get people to think about the alternatives, but action requires leadership and incentive."

Tom Zosel, 3M

Executive Level Decision

Top management support is critical to get a pollution prevention program started, to incorporate it into already existing activities, and to sustain it. Specific types of support needed from management include: assigning responsibility for progress evaluation, allocating time and budget, and recognizing achievements. Continuity of the pollution prevention program is important. It should be set up in such a way that one step can flow naturally into the following step in a continuous cycle.

Suggestions on how to garner the support of all levels of management include providing them with information on some of the benefits of implementing a pollution prevention program. Include the following topics:

- cost savings through reduced raw material use and reduced waste, handling, transportation and storage costs
- increased productivity
- improved product quality
- regulatory compliance
- worker health and safety
- reduction of potential long-term liability
- examples of what other similar companies have achieved
- improved public/corporate image

To get all management levels interested in developing a pollution prevention program and to increase their knowledge about the subject, bring to their attention case studies from other successful companies. Bring in outside speakers to talk about benefits of developing pollution prevention programs. If the company or facility already has some exceptional pollution prevention activities underway, consider applying for the State of Ohio Governor's Awards for Outstanding Achievement in Pollution Prevention. Just the act of applying for this or other awards can result in more commitment from all levels of management.

Policy Statement

To begin a successful pollution prevention program, draft a brief written policy statement in support of a pollution prevention program. Obtain endorsement of the policy by all management levels and then distribute to all employees. In some cases, developing a corporate-wide policy statement can be a lengthy process. Rather than allow this procedure to delay proceeding with the program, an interim policy or area-specific policy can be developed. This can get the program started; the corporate policy can follow later.

As with other policy statements your company develops, your pollution prevention policy statement should state why a program is being established, what is to be accomplished in qualitative terms, and who will do it. Two example policy statements are given in Figure 2. They differ in level of detail, but both answer these key questions:

Why are we implementing pollution prevention?

> *We want to protect the environment while saving money.*
> *We want to save money while protecting the environment.*

What will be done to implement pollution prevention?

> *We will reduce or eliminate the amounts of all types of waste, and we will improve energy efficiency.*

Who will implement pollution prevention?

> *Everyone will be involved.*

Figure 2. Policy Statement Examples

- **POLICY STATEMENT EXAMPLE 1** --- "(Your Company or Facility 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 or Facility Name)'s environmental guidelines include the following:

  --- Environmental protection is everyone's responsibility. It is valued and displays commitment to (Your Company or Facility 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 plant operations. (Your Company or Facility 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 or Facility Name) seeks to demonstrate its responsible corporate citizenship by adhering to all environmental regulations. We promote cooperation and coordination between business, government, and the public toward the shared goal of preventing pollution at its source."

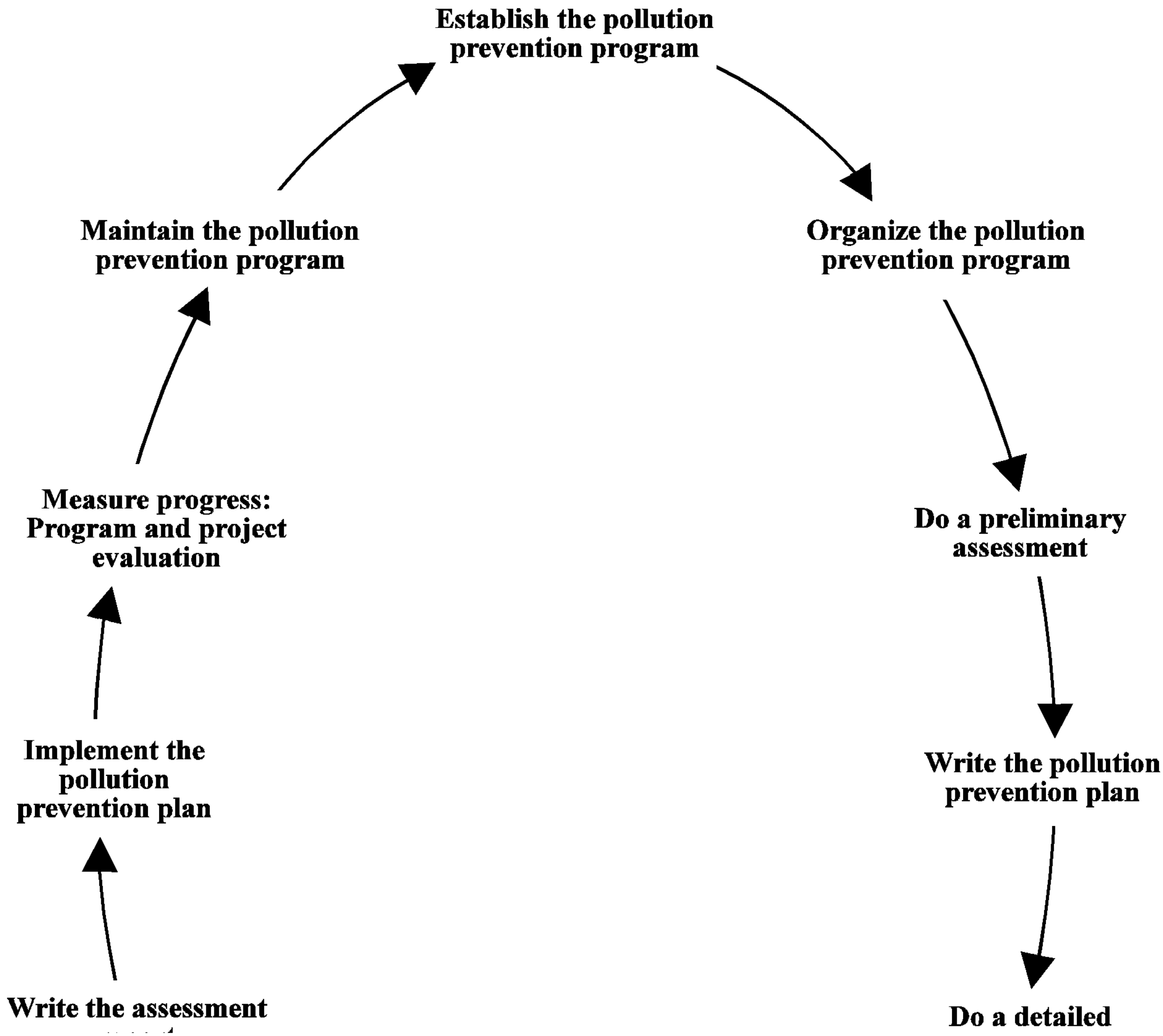
- **POLICY STATEMENT EXAMPLE 2 ---** "At (Your Company or Facility Name), protecting the environment is a high priority. We are pledged to eliminate or reduce our use of toxic substances and to minimize our use of energy and generation of all wastes, whenever possible. Prevention of pollution at the 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."

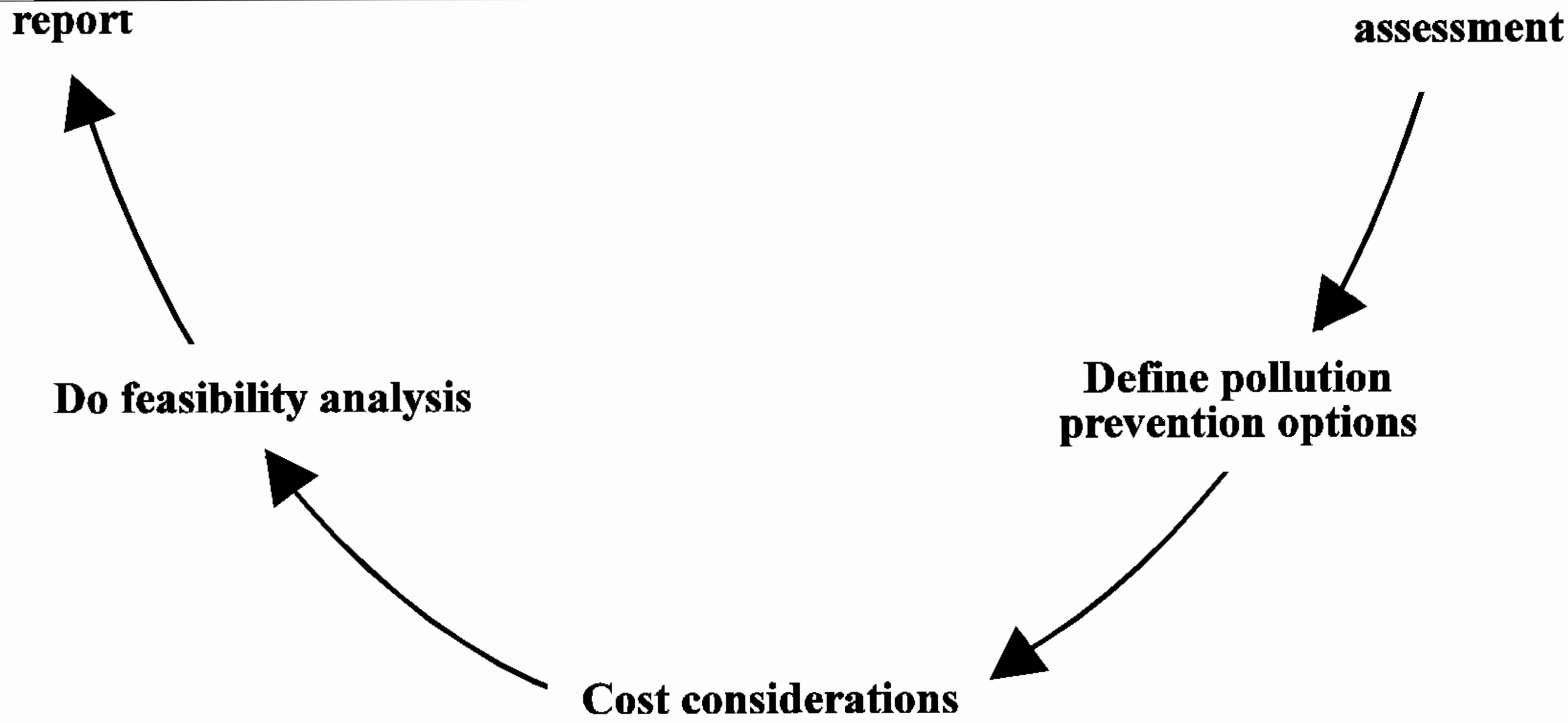
  (Adapted from: Waste Reduction Institute for Training and Applications Research, Inc. (WRITAR), 1991, *Survey and Summaries*, and Minnesota Office of Waste Management, Feb. 1991, *Minnesota Guide to Pollution Prevention Planning*)

Consensus Building

A pollution prevention program needs to be viewed by all personnel in the facility as a way of doing business. It can be incorporated within a total quality management (TQM) program because it focuses on increasing efficiencies and more effectively utilizing raw materials. It also builds nicely on a health or environmental safety program because it can do the following: reduce the amount/toxicity of chemicals in the workplace; reduce short and long-term exposure of employees, visitors, and contractors; reduce or eliminate monitoring requirements; reduce air handling equipment requirements; and, reduce or eliminate the need for personal protective equipment.

The commitment from all employees to implement a pollution prevention program starts before any assessment or evaluations have been performed. It is measured as the time and effort needed to raise employee awareness, establish a cohesive pollution prevention team, and begin to incorporate pollution prevention ideas into the day-to-day operations of the company. Pollution prevention is a team effort. The people who enter the facility every day are the most valuable assets to ensure a pollution prevention program works well.


Establish the pollution prevention program
Organize the pollution prevention program
Do a preliminary assessment
Write the pollution prevention plan
Do a detailed
Write the assessment
Implement the pollution prevention plan
Measure progress: Program and project evaluation
Maintain the pollution prevention program


report
assessment
Do feasibility analysis
Define pollution prevention options
Cost considerations

Ohio Pollution Prevention and Waste Minimization Planning Guidance Manual

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Appendix D
Class I Injection Well Facility
Ohio Revised Code Requirements for Waste Minimization and Treatment Plans

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Effective May 28, 1992, Ohio House Bill 147 amended sections of the Ohio Revised Code (ORC) regarding the regulation of Class I injection wells for the disposal of sewage, industrial wastes, hazardous wastes and other wastes. Pursuant to these amendments, each owner or operator of a Class I injection well facility must prepare and adopt a waste minimization and treatment plan by May 28, 1994. The plan will identify the specific technically and economically feasible measures that will be taken to prevent or reduce releases into the environment. Elements that must be included in a waste minimization and treatment plan are listed on pages D-2 to D-4. Note also that this section of the Ohio Revised Code contains several definitions of terms. These definitions are similar to definitions given in this guidance manual; however, there are some differences in definitions.

Table D-1 is included to show the similarities between a pollution prevention program as outlined in U.S. EPA's *Facility Pollution Prevention Guide* and a waste minimization and treatment plan for a Class I injection well facility. This comparison table illustrates that although the names of elements and order of elements may be different, the guide and the Class I injection well facility requirements essentially describe the same kind of pollution prevention and waste minimization programs.

Owners and operators of Class I injection well facilities may use this guidance manual and U.S. EPA's *Facility Pollution Prevention Guide* as a reference for preparing a waste minimization and treatment plan. These manuals concentrate on pollution prevention and waste minimization. Facilities can use the elements in these manuals for developing plans. However, the manuals do not discuss treatment options.

Treatment technologies are commonly broken down into several categories: physical, thermal, chemical, and biological. Table D-2 lists classes of treatment technologies and gives examples of each class. Facilities should consider all treatment technologies when choosing treatment options, and should also consider innovative technologies.

Ohio Revised Code, Section 6111.045
Injection of waste into wells
Waste minimization and treatment plans

Ohio Revised Code , Section 6111.045

(A) Not later than twenty-four months after the effective date of this section, each owner or operator of a class I injection well facility shall prepare and adopt a waste minimization and treatment plan to identify the specific technically and economically feasible measures that will be taken to prevent or reduce releases into the environment of the industrial waste and other wastes generated at the facility and, in the case of such an injection well facility that is located on the premises of the industrial facility, the industrial waste and other wastes generated at that industrial facility. The waste minimization and treatment plan shall cover a three-year planning period and shall include all of the following:

(1) The name, address, and, if applicable, standard industrial classification code of the facility;

(2) A summary of the industrial wastes and other wastes generated at the facility, including supporting data and calculations;

(3) A description of the facility's historic efforts at waste minimization and treatment and of existing waste minimization and treatment, source reduction, and recycling practices undertaken at the facility in 1987 and subsequent years;

(4) An assessment of the technically and economically feasible options for the further elimination or reduction of such wastes that considers the impacts of cross-media transfers and gives preference to source reduction over the recycling, treatment or disposal of the wastes;

(5) The identification of specific objectives to prevent, reduce, or recycle releases of such wastes when technically and economically feasible options exist;

(6) An explanation of the rationale for the objectives identified under division (A)(5) of this section;

(7) A signed policy statement articulating the commitment of upper management and the corporation to implement the waste minimization and treatment plan and its objectives.

(B) Each waste minimization and treatment plan prepared and adopted under division (A) of this section shall be retained at the facility to which it applies and shall be made available for inspection and review by the director of environmental protection or his authorized representative. The disclosure of any trade secret information contained in any such plan is subject to section 1333.51 of the Revised Code.

(C) Every three years after the adoption of a waste minimization and treatment plan under division (A) of this section, the owner or operator of the facility to which the plan applies, on or before the anniversary of the date of the adoption of the plan, shall do all of the following:

(1) Review the operation of the facility for any changes in the type and amount of industrial waste or other wastes generated at the facility that have occurred since the adoption of the plan or the most recent revision of the plan;

(2) If necessary or appropriate, reevaluate the technically and economically feasible options for reducing or eliminating the generation of industrial waste or other wastes at the facility;

(3) If any changes in the type or amount of wastes generated at the facility are identified under division (C)(1) of this section or if, after a reevaluation conducted under division (C)(2) of this section, the owner or operator of the facility determines that the waste minimization and treatment options in the plan or most recent revision of the plan should be updated, amend the plan to update the information contained in it and include in the amendment an explanation of the need for the amendment.

(D)(1) Not later than two years after the effective date of this section, each owner or operator of a class I injection well facility shall submit to the director of environmental protection an executive summary of the waste minimization and treatment plan adopted by the owner or operator under division (A) of this section. The executive summary shall include a synopsis of each of the elements required to be included in the plan under divisions (A)(2) to (6) of this section and shall include a signed policy statement articulating the commitment of upper management and the corporation to implement the plan and its objectives.

(2) Every three years after the adoption of a waste minimization and treatment plan under division (A) of this section, the owner or operator of a class I injection well facility, on or before the anniversary of the date of the adoption of the plan, shall submit to the director a revised executive summary of the plan that meets the requirements of division (D)(1) of this section and contains revisions to the amendments to the plan made by the most recent review of the plan required under division (C) of this section.

(E) No person shall fail to comply with this section.

(F) As used in this section:

(1) "Disposal" means the discharge, deposit, injection, dumping, spilling, leaking, emitting, or placing of any industrial waste or other wastes into or on any land or ground or surface water or into the air, except if the disposition constitutes storage or treatment.

(2) "Recycling" means to use, reuse, or reclaim a material.

(3) "Release" means any spilling, leaking, pumping, pouring, emitting, emptying, injecting, escaping, leaching, dumping, or discharging into the environment of any industrial waste or other wastes, including the abandonment or discarding of barrels, containers, or other closed receptacles that contained an industrial waste or other waste.

(4) "Source reduction" means any practice that reduces the amount of any industrial waste or other wastes entering any waste stream or otherwise released into the environment, including fugitive emissions, prior to recycling, treatment, or disposal and that reduces the hazards to public health and the environment associated with the release of such wastes. "Source reduction" 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. "Source reduction" does not include any practice that alters the physical, chemical, or

biological characteristics or the volume of an industrial waste or other wastes through a process or activity that is not integral to and necessary for the production of a product or the providing of a service.

(5) "Treatment" means any method, technique, or process designed to change the physical, chemical, or biological characteristics or composition of any industrial waste or other wastes; to neutralize the waste; to recover energy or material resources from the waste; to render the waste nonhazardous or less hazardous, safer to transport, store or dispose of, or amenable for recovery, storage, further treatment, or disposal; or to reduce the volume of the waste.

(6) "Waste minimization" means any effort to reduce or recycle the quantity of waste generated and, when feasible, to reduce or eliminate toxicity. "Waste minimization" does not include treatment unless the treatment is part of the recycling process.

HISTORY: 144 v H 147. Eff 5-28-92

Table D-1
Comparison of Elements of a Pollution Prevention Program in U.S. EPA's *Facility Pollution Prevention Guide* to Elements of a Waste Minimization and Treatment Plan for a Class I Injection Well Facility

Facility Pollution Prevention Guide Pollution Prevention Program	Class I Injection Well Facility Waste Minimization and Treatment Plan
Establish the pollution prevention program • Executive level decision • Policy statement • Consensus building	ORC 6111.045(A)(7) - A signed policy statement articulating the commitment of upper management and the corporation to implement the waste minimization and treatment plan and its objectives
Organize the program • Name task force • State goals	ORC 6111.045(A)(7) - (same as above)

Do preliminary assessment • Collect data • Review sites • Establish priorities	ORC 6111.045(A)(2) - A summary of the industrial wastes and other wastes generated at the facility, including supporting data and calculations ORC 6111.045(A)(3) - A description of the facility's historic efforts at waste minimization and treatment and of the existing waste minimization and treatment, source reduction, and recycling practices undertaken at the facility in 1987 and subsequent years
Write program plan • Consider external groups • Define objectives • Identify potential obstacles • Develop schedule	
Do detailed assessment • Name assessment teams • Review data and sites • Organize and document information	ORC 6111.045(A)(4) - An assessment of the technically and economically feasible options for the further elimination or reduction of such wastes that considers the impacts of cross-media transfers and gives preference to source reduction over the recycling, treatment or disposal of the wastes
Define pollution prevention options • Propose options • Screen options	ORC 6111.045(A)(4) - (same as above)
Do feasibility analysis • Technical • Environmental • Economic	ORC 6111.045(A)(4) - (same as above)
Write assessment report	ORC 6111.045(A) - ... prepare and adopt a waste minimization and treatment plan ... ORC 6111.045(A)(5) - The identification of specific objectives to prevent, reduce, or recycle releases of such wastes when technically and economically feasible options exist ORC 6111.045(A)(6) - An explanation of the rationale for the objectives identified under division (A)(5) of this section
Implement the plan • Select projects • Obtain funding • Install the selected projects	ORC 6111.045(A)(7) - A signed policy statement articulating the commitment of upper management and the corporation to implement the waste minimization and treatment plan and its objectives

Measure progress • Acquire data • Analyze results	
Maintain the pollution prevention program	ORC 6111.045(C) - Periodic review (every three years) of waste minimization and treatment plan

Notes:

1. The pollution prevention program elements follow the outline of U.S. EPA's Facility Pollution Prevention Guide (EPA/600/R-92/088).
2. The waste minimization and treatment plan elements for Class I injection well facilities are listed in the Ohio Revised Code, Section 6111.045.

Table D-2. Classes of treatment technologies and examples

(from Appendix to OAC 3745-65-73, Table 2)

Thermal treatment	**Physical treatment Separation of components**	**Physical treatment Removal of specific components**
Liquid injection incinerator Rotary kiln incinerator Fluidized bed incinerator Multiple hearth incinerator Infrared furnace incinerator Molten salt destructor Pyrolysis Wet air oxidation Calcination Microwave discharge Cement kiln Lime kiln	Centrifugation Clarification Coagulation Decanting Encapsulation Filtration Flocculation Flotation Foaming Sedimentation Thickening Ultrafiltration	Absorption-molecular sieve Activated carbon Blending Catalysis Crystallization Dialysis Distillation Electrodialysis Electrolysis Evaporation High gradient magnetic separation Leaching Liquid ion exchange Liquid-liquid extraction Reverse osmosis Solvent recovery Stripping Sand filter
Chemical treatment	**Biological treatment**	

Absorption mound Absorption field Chemical fixation Chemical oxidation Chemical precipitation Chemical reduction Chlorination Chlorinolysis Cyanide destruction Degradation Detoxification Ion exchange Neutralization Ozonation Photolysis	Activated sludge Aerobic lagoon Aerobic tank Anaerobic lagoon Composting Septic tank Spray irrigation Thickening filter Trickling filter Waste stabilization pond	

{ Acronyms | Table of Contents }

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Ohio EPA Home Page

page last updated: October 30, 2000

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Chapter 12
Define Pollution Prevention Options

"The diversity of potential strategies for reducing wastes at the source parallels the diversity of pollution sources and opportunities for prevention."

Christine Ervin, World Wildlife Fund

Propose Options

A productive way to generate ideas is to conduct an informal meeting in which team members are encouraged to "brainstorm" and discuss options. The team members should also solicit ideas from other personnel at all levels, not only in their department but from the entire facility. Many times these personnel already have ideas for reducing waste but have never had the opportunity to express them. All options should be written down and given serious consideration.

Some of the options may be simple to identify and implement such as:

- Ship/receive materials in bulk to eliminate drum disposal if large quantities are used
- Reuse containers where possible
- Order materials "just in time" to avoid expiration
- Establish a central stockroom/inventory control system
- Investigate solvent/cleaner alternatives or reducing the total number of different solvents used
- Reuse solvents where possible
- Segregate waste streams

Other options that may not be as easily identified but must definitely be considered involve source reduction. Table 3 provides some examples. Generator checklists for identifying waste reduction opportunities developed by the Minnesota Technical Assistance Program (MnTAP) can also be used to help identify pollution prevention options (MnTAP, various dates).

Table 3. Source Reduction Options

Source Reduction

Substituting less toxic or less hazardous alternatives for raw materials
Using raw materials that generate less waste
Using raw materials that require less frequent cleaning of equipment
Modifying products to eliminate the need for hazardous or toxic materials
Making process modifications and/or operating conditions that improve efficiency
Improving preventive maintenance and operating procedures

(adapted from *Pollution Prevention: A Guide to Program Implementation*, Illinois Hazardous Waste Research and Information Center, 1993)

Once these options have been applied to specific wastes/processes, further investigation or changes in product composition may be required. For example, it may be necessary to implement new or existing techniques/technologies or to identify raw material alternatives. At this point it may be helpful to contact other facilities, vendors, trade associations, state and local environmental assistance agencies, and publications for ideas. These groups may be aware of material alternatives or similar pollution prevention technologies that have been successfully implemented. Further pollution prevention opportunities may be identified through "upstream" suppliers and "downstream" consumers. These individuals should also be allowed input into the company's program.

Another way to identify pollution prevention opportunities is through benchmarking. In the benchmarking process, a company selects an area for improvement and identifies other companies who have similar practices that they consider to be the best in class. They then compare their own practices to those companies' processes to determine where differences exist. The company using benchmarking then implements measures to make their practices more like those of "best in class." A nine step benchmarking program developed by AT&T is described in detail in *Benchmarking: Focus on World Practices* (AT&T Quality Steering Committee, 1992). Working together, AT&T and Intel applied the benchmarking process to develop a pollution prevention program. Benchmarking teams from both companies followed the nine-step process to compare their own pollution prevention programs to the best in class programs of six other companies (Klafter, 1992).

Other waste management options may be considered after pollution prevention strategies have been exhausted. These include, in order of U.S. EPA's priority, recycling on-site to other processes, reclamation, recycling off-site or using material exchanges, on-site treatment (physical, chemical, or biological process that renders a waste less toxic, produces a byproduct that is recyclable or reduces the volume of the waste stream for disposal), treatment off-site; and lastly, proper disposal. These alternative waste management options are discussed in more detail in Chapter 19. For additional sources of technical assistance, refer to Appendix B.

Screen Options

A priority approach in selecting options may be developed. Ranking options on a high, moderate, or low continuum helps to ensure that pollution prevention is not a "one-shot" approach. Moderate and low priority options should still be considered since circumstances such as a change in raw materials, regulations or technology could occur.

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Chapter 9
Do a Preliminary Assessment

"Pollution is nothing but the resources we are not harvesting. We allow them to disperse because we are ignorant of their value."

Buckminster Fuller

Understanding Processes and Wastes

To effectively implement a pollution prevention program, it is important to understand the various unit processes and where in these processes waste is being produced. This chapter will explain how to determine the various unit process steps in materials use and will present methods to determine where wastes are being generated. An extensive amount of data gathering may be necessary in this step in order to achieve a complete process characterization.

Two general approaches characterizing processes and waste generation can be used. One method begins with gathering information on total multi-media (air, land, and water) waste releases at the end of each process, and then backtracks to determine waste sources. Another method tracks materials from the point at which they enter the plant until they exit as wastes or products. Both methods provide a baseline for understanding where and why wastes are generated and a basis to measure waste reduced after implementation of pollution prevention projects. The steps involved in these characterizations include gathering background information, defining a production unit, general process characterization, understanding unit processes, and completing a materials balance.

Gathering Background Information

The first step toward understanding processes and waste generation is gathering background information on the facility. This allows for the accurate determination of the type and quantity of raw materials used, the type and quantity of wastes generated, the individual production mechanisms, and the interrelationships between the unit processes. The pollution prevention team should divide up the responsibilities for obtaining this information. A time frame should be established for assembling the data and presenting it to the group. Table 1 provides suggestions on data that should be assembled and where this information might be found.

In addition to these data, useful information can be obtained from line workers, maintenance staff, process engineers, purchasing, inventory, shipping and receiving; and accounting personnel. These employees can be interviewed to determine how the processes are run; what types of raw materials, cleaning agents, lubricants, etc. are used; what types of waste are generated and how they are handled; what other types of records are kept; and what information is not recorded on a regular basis. When gathering this information, begin to track wastes to determine if there are seasonal or shift variations in wastes generated. Once this information is assembled, the general process can be characterized.

Table 1. Possible Sources of Background Information

INFORMATION ON:	INFORMATION GATHERED FROM:
Raw Materials Use	Purchasing records Inventory records MSDSs Vendor information Production logs Packaging material discarded Shipping and receiving logs Annual report
Waste Generated	Waste manifests TRI data Sewer records (POTWs) Permits/applications Flow diagrams Annual report Rejected product Environmental reporting Waste collection and storage Production logs Environmental violations Laboratory analyses Obsolete expired stock Spill and leak reports
Production Mechanisms	Operations manuals (SOPs) Vendor information Control diagrams Quality control guidebook Production logs Flow diagrams Product specifications
Process Interrelationships	Product-to-raw material data Flow diagrams Quality control data Production logs Product specifications Facility layout

Economic Information	Cost accounting reports Operating costs for waste handling and disposal Pollution control costs Costs for products, utilities, raw materials, and labor

(adapted from *Pollution Prevention: A Guide to Program Implementation,* Illinois Hazardous Waste Research and Information Center, 1993)

Define Production Units

To compare the amounts of waste generated during different time periods, and subsequently measure relative waste reductions, a production unit should be defined for each process - either the unit process or the overall process depending on the nature of the facility. A production unit is simply a set quantity of product that is characteristic of the process - tons of plastic, gallons of acid, number of copies, etc. Try to choose a production unit that can be related to later waste generation. Once the production unit is defined, wastes generated can be quantified as waste per production unit. Since total production can vary, comparing the total amounts of waste generated for different time periods will not reflect the reductions achieved due to pollution prevention activities (i.e., waste will increase or decrease with production changes). For example, a printing press may use 1000 copies for a production unit and might then define wastes as "waste per 1000 copies." Alternatively, a company might consider the unit of product per unit of raw material. This measure would be an indicator of yield and process efficiency.

By assembling background information, process flow diagrams for both the general process and individual processes can be developed. These diagrams, along with the materials balance, help provide an understanding of the processes and the wastes generated. The production unit can be used for waste reduction comparisons throughout the pollution prevention program.

Characterize General Process

A typical process has raw material inputs, product outputs, and waste generation. It can be represented by a general process flow diagram. This diagram may not physically resemble the process but will show the movement of raw material through the process as well as the generation of final product and waste. A simple diagram (Figure 3) of a metal parts fabrication facility illustrates this.

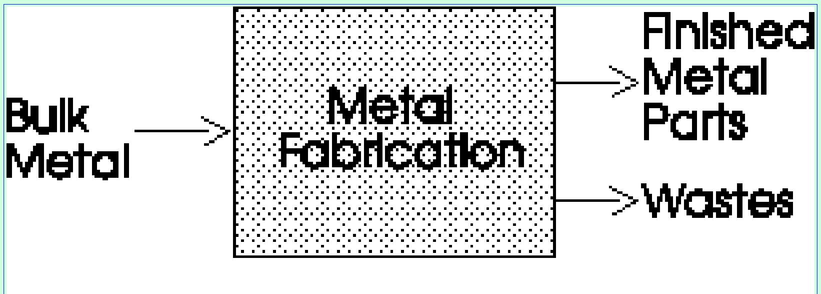

Figure 3: A Simple Flow Diagram

Figure 3: A Simple Flow Diagram

In addition to the raw material, final product, and waste flows, other inputs can be represented on the general flow diagram such as lubrication fluids, cleaning agents, cooling water, etc. This will provide an understanding of the overall process and the associated wastes. The general process can then be separated into individual or unit processes.

Understand Unit Processes

Most production operations can be subdivided into a series of unit processes. For example, the general process of metal parts fabrication can be represented by at least seven individual processes.

1. Receiving and storing bulk metal
2. Cutting, bending, or shaping metal
3. Cleaning metal
4. Painting or coating metal
5. Assembling parts
6. Packaging
7. Shipping of assembled parts

Each unit process has its own inputs and outputs. The product from one step becomes the input material for the following step. The raw materials, products, and wastes for each unit process can be shown on a more detailed flow diagram. This diagram should contain the type/composition and quantity of raw materials, products, and wastes to all media. The diagram should also include other inputs (lubrication fluids, tooling water, cleaning agents, etc.) along with the quantities used. The background information obtained previously will be helpful to determine the types/compositions and quantities of these streams. The subdivision of the general process of metal parts fabrication is illustrated in Figure 4.

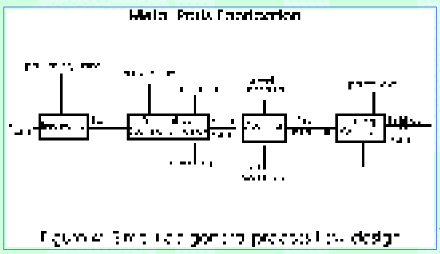
Figure 4: Simplified general process flow design

The flow diagrams for the unit processes (and in some cases the general process) can be completed using either of two approaches: 1) start with the wastes and products generated and then determine the sources of the waste by going backwards through each of the unit processes, or 2) start with the raw materials and track them through each of the unit processes until products and wastes are generated. For cases where waste streams are not separated but rather are combined prior to handling, the second method may be the preferred initial approach. The two methods may also be combined to complete the unit process flow diagrams and thus a detailed overall process diagram.

Outputs

It is critical to determine the types/compositions and quantities of raw materials consumed, product yield, and wastes generated as accurately as possible for each unit process. All wastes released to the environment (gas, liquid, and solid) should be characterized. These wastes can include: emissions from stacks; vent emissions from process areas; fugitive emissions from pipes, tanks, or vessels and leaking equipment; spent wash waters/cleaning solvents; cooling water; over spray from painting operations; cleaning rags; material scrap (e.g., metal, packaging, etc.); and other wastes. By subdividing the process into individual components, these types of wastes become more evident. With this information, a materials balance can be performed for the unit processes and then for the overall facility.

Perform Materials Balance

A materials balance accounts for all inputs and outputs into a process; in other words, what goes in must come out. A materials balance should be performed for each unit process and for the overall production line. Although this typically is a very involved procedure, and while it is usually possible to identify sources of waste without having completed a materials balance, there are long term benefits to having done a materials balance. However, because a materials balance can be very involved, your facility may want to consider this an optional step, especially if you operate a small business. You may want to concentrate on developing process flow charts. Companies may also prefer to develop process flow charts in the preliminary assessment and complete a materials balance later in the pollution prevention program.

A materials balance can help determine if fugitive losses are occurring in the process (e.g., fugitive loss from a solvent tank = difference between solvent in and solvent out). In a physical process, one in which there is no chemical change of materials, the raw materials that are not converted to product generally end up as waste. For example, a materials balance can be performed on the metal parts fabrication process as shown in Figure 4. For a chemical process, the materials balance becomes more complicated as raw material inputs are converted to products through one or more chemical reactions. Some unreacted raw materials may also end up as waste along with reaction by-products.

For these processes, a standard materials balance may already be available as part of the daily production log or cycle. Where possible, however, actual measurements of the amounts of materials used and generated should be used to produce the materials balance. The reason for this is that manufacturing processes can change over a period of time to a point where the actual materials balance would differ from that derived from the standard operating procedures.

Once the materials balance has been performed, the actual amount of each waste generated by a process and the source becomes apparent if not already known. These numbers are the baseline amounts of total waste generated at the start of the pollution prevention assessment and can be used for comparison throughout the implementation of the program.

Table 5. Materials Balance

Key Elements of a Materials Balance
Quantity of raw material brought on-site Quantity produced on-site including amounts produced as production by-product Quantity consumed on-site Quantity shipped off-site as, or in, product Total waste generation (before recycling and treatment) and waste characteristics Amount of raw material in beginning and ending inventory An indicator of production levels involving the chemical Release and transfer rate

(adapted from *Pollution Prevention: A Guide to Program Implementation,* Illinois Hazardous Waste Research and Information Center, 1993)

Establish Priorities

Before conducting an assessment to identify what pollution prevention opportunities are present, wastes and unit processes should be prioritized to determine which should be examined first. The flow diagrams prepared in this chapter provide a good starting point for prioritization because they show all of the input and output streams for each unit process. Both the pollution prevention team and top management should be involved in this decision-making process since each will have their own ideas of what areas should be addressed initially.

When establishing priorities for pollution prevention, all of the input and output streams should be ranked - beginning with those which require immediate attention, followed by those which are less urgent. Each company will have their own procedures for establishing priorities. Companies should estimate the risks posed each stream and consider the risks in the ranking process. These factors should be considered when ranking the streams:

- U.S. EPA's 17 target chemicals from the 33/50 program (see Appendix B)
- Toxic Release Inventory (TRI) waste
- High purchase, disposal and other costs
- High potential cost savings
- Highly toxic
- Hazardous waste
- Particular regulatory concerns
- High use and/or release rate
- Potential for removing bottlenecks in production or waste treatment
- Potential liability due to endangerment of employees, environment or the pubic
- Potential for successful implementation
- High volume waste (may include tonnage)
- Carcinogens
- Hazardous Air Pollutants (HAPs)
- Chlorofluorocarbons (CFCs) and other ozone-depleting or future banned materials
- Local citizens' concerns

Once the streams are ranked, candidate input and output streams (especially wastes) can be identified for the initial pollution prevention assessment, keeping in mind the goals set at the beginning of the program. As the assessment proceeds, these priorities may change.

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Chapter 11
Do a Detailed Assessment

"To investigate opportunities for pollution prevention within your company, you need to assess your current operations."

This chapter provides guidelines for beginning pollution prevention assessments in the facility, starting with the highest priority and/or targeted wastes. The pollution prevention team should name assessment teams, review wastes and processes, and organize and document information before and after the assessments.

When the candidate wastes are established, the assessment for identifying specific pollution prevention opportunities can begin. This procedure involves first looking at the processes associated with the candidate streams and then expanding the assessment to the entire facility so that all potential opportunities are addressed. The pollution prevention team should discuss the potential wastes and the staffing of the overall facility to determine who should conduct the initial process assessment. Typically a team of two to three people is effective.

The assessment team should first become familiar with the targeted processes. The flow diagrams developed in Chapter 9 provide an understanding of the process but may not explain why certain materials are used and why wastes are generated. For this information, the team must go into the facility and study the processes in detail. This study should be conducted while the process is in operation (ideally during all shifts) and, if possible, during a shut-down/clean-out/start-up period to identify what materials are used and wastes are generated by this procedure. When studying the process, the team should note any potential pollution prevention opportunities and should pay particular attention to the following:

- Observe procedures of operation by line workers
- Quantities and concentrations of materials (especially wastes)
- Collection (including exact sources) and handling of waste (note if wastes are mixed)
- Any record keeping - and obtain copies of these if not already done
- Flow diagram - follow through actual process
- Leaking lines or poorly operating equipment
- Any spill residue
- Damaged containers
- Physical and chemical characteristics of the waste or release

It may also be helpful to photograph the process to recall specific details later. Often, details can be better captured visually than with words. However, this should be cleared with the appropriate personnel first.

The assessment team should talk with the line personnel, including operators, supervisors, and foremen, as much as possible. In doing so, they should determine the required operating conditions, product specifications, and equipment specifications for the process. They should discuss the points previously listed as well as the daily routine the workers follow. Specifically, the team should try to identify when waste is generated, not just by the regular process, but by upsets, off-spec products, spills, etc. The team should also talk with the maintenance and housekeeping personnel who service the process to determine when, why, and how the process is serviced. Is preventive maintenance being done or are maintenance people always responding to breakdowns? It is important to talk with these individuals as they generally have the best working knowledge of the processes. The team should also compare written operating procedures for various unit operations to actual in-plant practices.

After examining the targeted processes, the assessment team should set a schedule for looking at the other processes in a similar manner. Assessment for non-targeted sources should be thorough, but it may take more time to completely assess these. Implementing pollution prevention projects on targeted processes can begin before assessments are completed for every process. This will help build momentum and corporate support for a sustained program.

The team should also conduct an overall survey of the facility. This survey consists of investigating supplemental operations such as shipping/receiving, purchasing, inventory, vehicle maintenance, waste handling/storage, laboratories, powerhouses/boilers, cooling towers, and maintenance. Again, the team should discuss daily routine with the personnel in these departments and should note potential opportunities for pollution prevention. Some specific topics to cover in these departments are listed in Table 2.

Once the process assessments and plant survey are completed, the data obtained should be reviewed for thoroughness by all of the pollution prevention team members. This review will also initiate the brainstorming process for ideas to reduce waste at the source.

Table 2. Topics to Cover in Assessing Support Departments

Shipping/receiving	Packaging materials - what is done with waste? How are materials shipped/received - drums, bulk? Can containers be returned/recycled? Are you required to return empty containers to vendor? What happens to pallets?
Purchasing	Who orders materials? How far in advance are materials ordered? Can materials be ordered as needed (just-in-time)? Is the minimum amount ordered?

Inventory	What is the shelf-life of all materials? Is there an inventory control system? Bar coding? Is there a central stockroom (no individual orders)? Do you operate by "just-in-time" philosophy? Do you operate by "first in, first out" principle?
Vehicle maintenance	Are solvents used for parts cleaning? Are solvents recycled and have solvent alternatives been tested? Do you recycle batteries, used oil, or antifreeze? How are used oil filters/carburetor cleaners handled?
Waste handling and storage	Are waste streams segregated? Do you know the sources of all waste? Do you have a "waste inventory" control system? How often is waste shipped off-site? Treated on-site? How is waste handled once shipped off-site?
Laboratories	How are chemicals ordered? In what quantities? What is the shelf life of all chemicals? How are expired chemicals handled? Are solvents recycled/reused (e.g., first rinse)? How are gases stored? How are laboratory wastes handled? Are laboratory wastes segregated?
Powerhouse/boiler	How is fly ash/slag handled? How is tube clean-out material handled? What type of fuel is used? Are alternatives used? What type of boiler water treatment chemicals are used? How is boiler blow-down handled?
Cooling towers	What type of chemical additives are used? How is bottom sediment handled? What is your water source? Is water recycled?
Maintenance	What types of cleaners are used? Are solvents used? Are they recycled/reused? Have solvent/cleaner alternatives been tested? How are waste oil/greases handled? How are other wastes generated and handled?

(adapted from *Pollution Prevention: A Guide to Program Implementation*, Illinois Hazardous Waste Research and Information Center, 1993)

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Chapter 13
Cost Considerations

"In order to receive funding, it is essential that pollution prevention projects successfully compete in the company's capital funding sequence or before the bank's loan committee."

American Institute for Pollution Prevention

Before pollution prevention projects are evaluated for economic feasibility, the full cost of waste generation must be determined. This full cost is necessary to develop the economics of pollution prevention techniques/technologies, including calculating the cost savings and payback periods. Methods for true cost determination and economic analysis are presented in this chapter. A cost accounting system for all wastes generated in the facility will also be described.

Determine Full Cost of Waste

The full cost of waste generation includes more than just treatment or disposal costs; it includes all the costs incurred by producing and handling waste. All of the expenditures associated with the waste, both direct and indirect, should be identified. These include, but are not limited to, the following: purchasing, storage and inventory, and in-process use of materials; air and water emissions, solid waste collection, waste storage, on-site treatment or recycling; waste disposal; waste transportation; lost raw materials; labor costs; and capital depreciation. Often, wasted raw material costs are three fourths of the full cost of generating waste. Waste disposal costs are typically less than half the total costs (Selman and Czarnecki, 1988). Many pollution prevention options will not appear to be justified if only half, or less, of the likely savings are considered. Some examples of waste associated costs to consider are presented in Table 4.

TABLE 4. Costs to Consider Determining Full Costs of a Waste Stream

RAW MATERIAL AND HAZARDOUS SUBSTANCE USE	
Purchasing	Taxes on hazardous and other products Safety training MSDS filing Safety equipment Extra insurance premiums Labor

Storage and Inventory	Special storage facilities Safety equipment Storage area inspection and monitoring Storage container labeling Safety training Emergency response planning Spill containment equipment Lost product from spills, evaporation, etc. Labor SARA Title III (TRI) reporting
In-Process Use	Safety training Safety equipment Containment facilities and equipment Clean-up supplies Labor
Lost Raw Materials	Labor for handling Equipment for clean-up Reporting
WASTE GENERATION	
Air and Water Emissions	Air emission permits and controls TRI measurements/estimates TRI reporting TRI fees Worker health monitoring Sewer discharge fees NPDES permits Water quality monitoring Sampling training Pretreatment equipment Pretreatment system operation
Solid Waste Collection	Safety training Safety equipment Collection supplies Container labels Container labeling Recordkeeping Truck maintenance (for in-house fleet)
Waste Storage	Storage permits Special storage facilities Spill containment equipment Emergency response planning Safety training Storage area inspection and monitoring

On-Site Treatment or Recycling	Capital and operating costs Depreciation Utilities Operator training Safety equipment Emergency response planning Permits Inspection and monitoring Insurance
Disposal	Sewer fees Container manifesting Disposal vendor fees Preparation for transportation Transportation Insurance and liability Disposal site monitoring

(adapted from *Pollution Prevention Planning*, Washington State Department of Ecology, January, 1992)

Develop Economics

Once the full costs of the waste streams are determined, an economic analysis of each specific pollution prevention project can be conducted. This analysis will provide management information on the costs and benefits associated with the techniques/technologies so they can decide whether it is economically feasible to proceed with implementation. Certain benefits, such as reduced long-term liability, reduced worker exposure to toxic chemicals, and improved community relations, will be difficult to quantify.

There are essentially two steps in an economic analysis after the true costs of waste generation have been determined: calculate the initial cost of implementing the pollution prevention strategy, and determine the annual cost savings and payback period (if applicable) for the project. In some cases, the total capital and operating costs (including the waste handling costs) for the existing process and the "new" process must be considered if they are substantially different. For example, some pollution prevention options involve increased use of utilities which must be taken into account.

The initial cost of the implemented technique/technology should include capital requirements for new equipment, start-up costs, training costs for new equipment or procedures, and any costs for regulatory compliance. The full cost for waste generation should also be calculated for the new option using the procedure described previously in this chapter. The strategy in question may have only limited initial costs associated with it, such as capital and start-up expenditures, since it may be as simple as a raw material substitution or making a minor process modification. In these cases, the annual waste cost savings may be the principle factor considered. However, there may be costs associated with implementation of the pollution prevention project such as process down-time or upsets.

A good general reference for cost considerations in pollution prevention is the American Institute for Pollution Prevention's 1993 document, *A Primer for Financial Analysis of Pollution Prevention Projects*. An additional source to consult for in-depth coverage, worksheets, and resources on pollution prevention is U.S. EPA's *Facility Pollution Prevention Guide*.

Once the total initial cost for implementing the pollution prevention strategy is determined, the cost savings should be determined. To calculate this, the following equation may be used:

Cost savings = (Existing full cost of waste) minus (Projected full costs of waste after implementation)

For options which do not involve capital investments or other initial expenditures, waste handling cost savings may be the primary consideration for economic feasibility. For most pollution prevention options, some projected costs will be reduced if the existing full costs for waste generation are identified.

For strategies that involve initial expenditures, such as capital investments and startup costs, each company will have its own criteria of feasibility to consider. It will usually be necessary to calculate the economics of a project by methods specifically determined and approved by the company.

A quick test for initial feasibility is the payback period. Additional methods of determining long-term costs include net present value, internal rate of return, and profitability index. Further information on applying these methods can be found in U.S. EPA's *Total Cost Assessment: Accelerating Industrial Pollution Prevention through Innovative Project Financial Analysis* (1992). The payback period is defined as the amount of time (generally expressed in years) it takes to recover the initial investment through annual cost savings. The following equation can be used as a simple calculation of the payback period. Note that this equation does not account for depreciation, interest, etc. A very thorough and in-depth examination of full cost accounting can be found in Appendix F of U.S. EPA's *Facility Pollution Prevention Guide*.

Simplified Payback Period = (initial investment (capital + start-up + other costs)) divided by (annual full waste handling cost savings)

In options where there is a substantial difference in the total operating costs of the existing process and the "new" process (e.g., use of utilities increases significantly), the total annual operating cost savings (including waste handling cost savings) should be used in place of the annual true waste handling when calculating the payback period.

Establish a Cost Allocation System

A cost allocation system is an important element of a pollution prevention program. A cost allocation system charges each department or process for the total waste management costs for the wastes they generate. The charges should cover the full cost of the waste as explained previously in this chapter. This cost allocation system should lower the total overhead cost because most companies charge waste disposal costs to overhead (i.e., the environmental department). It will also provide incentives for employees associated with the departments/processes that are charged for the waste handling to reduce their waste generation and subsequently their costs.

By calculating the full cost of waste generation, the parameters for determining the economic feasibility of pollution prevention strategies (annual cost savings and payback period) can be developed. These will be used in the following chapter to evaluate the pollution prevention options and to decide which option could be implemented first. Establishing a cost allocation system will provide employees, including management, with a better awareness of the costs associated with waste generation in their department/process.

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Chapter 19
Other Waste Management Options

"Pollution prevention is not the only strategy for reducing risk but is the preferred one. Where prevention or recycling are not feasible, treatment followed by safe disposal as a last resort will play an important role in achieving environmental goals."

Carol Browner, U.S. EPA Administrator

As described in Chapters 4 and 5, it is national and Ohio EPA policy that pollution be prevented or reduced at the source whenever feasible. Despite the tremendous progress some have made in preventing wastes, it is often not economically or technically feasible to eliminate all wastes from industrial processes. For any remaining wastes the preferred management options in order of preference are on-site recycling or reuse, off-site recycling or reuse, treatment, and disposal in landfills. This is commonly referred to as the waste management hierarchy. U.S. EPA and Ohio EPA have taken the position that the hierarchy should be viewed as establishing a set of preferences, rather than an absolute judgment that prevention is always the most feasible option.

For safety or economy-of-scale reasons in some specific situations recycling or treatment may be more feasible than source reduction or in-process recycling. Environmentally sound recycling can have many of the advantages of source reduction because it achieves reduction in the amount of wastes needing treatment or disposal and conserves energy and other resources. However, on-site recycling and treatment are generally preferred over off-site processing because releases often occur during transport and handling and the chances for spills increase.

Some companies lack the skills to operate recycling or treatment equipment properly. The permitting process required for an on-site waste treatment facility is both time consuming and expensive and may require a public hearing. Other companies do not generate a large enough quantity of waste for economic operation of recycling equipment. In those cases, off-site recycling or treatment where wastes from multiple facilities are combined can be an excellent waste management approach.

Other technologies that do not in themselves reduce the mass of contaminants produced also may be beneficial. For example, more efficient use of water in plating by rinsing through use of counter-current flow or spray rinse systems increases the cost effectiveness of in-process metal recovery and reuse. More energy efficient lighting can bring substantial savings.

The emphasis in managing waste should be to continually try to move up the hierarchy toward source reduction. Although a company may have an environmentally sound recycling program for certain wastes, the generation of these wastes may reflect inefficiencies in operation. Recycling is often much more expensive than source reduction, especially when the cost of scrap and other excess materials are completely determined. Obviously, if more of these wastes can be turned into product, the company will decrease its costs and should increase profits.

In summary, source reduction techniques and in-process recycling which prevent and reduce waste generation are preferred over recycling, treatment, and disposal options that deal with wastes after they are produced. Once pollution prevention options have been fully considered, additional methods of handling and controlling wastes should be evaluated according to the waste management hierarchy. Often these approaches need to be used in combination to be most effective. Technical advancements in production processes and waste management technologies make it desirable for each company to routinely review and improve its pollution prevention and waste management practices.

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Chapter 8
Organize the Pollution Prevention Program

"Plasticolors (Ashtabula) reduced waste, lowered operating costs and used its saving to reward employees. It's a good example of how pollution prevention pays off for everyone."

Governor George V. Voinovich

This chapter outlines a method to incorporate a pollution prevention program into daily company activities. The steps involved include: designating a pollution prevention coordinator, developing a pollution prevention team, setting goals, increasing employee awareness and involvement, and rewarding and training employees.

Name the Pollution Prevention Task Force

Designate a Pollution Prevention Coordinator

While a pollution prevention program needs top down support and commitment, it also needs bottom up input and implementation. This means teamwork and participation from all levels within the company are essential. A key element for success is to find a good advocate and leader for the pollution prevention program.

The pollution prevention coordinator will be responsible for establishing the pollution prevention team(s), conducting meetings, and making sure the company is working toward its pollution prevention goals. The coordinator can come from any level in the company. He or she needs to be well organized, an advocate for the program, a cheerleader, and a motivator of people. If the coordinator has top management support and the confidence of supervisors and others on the team, he or she will likely develop a very successful program.

The coordinator will act as the key liaison to top management. This helps to ensure that the best pollution prevention ideas in terms of need, feasibility, and benefit to the company are delivered to top management for consideration. Also, the coordinator will need to obtain interdepartmental cooperation and resources on a continuing basis.

Develop a Pollution Prevention Team

A pollution prevention team needs to be organized prior to beginning the assessment process. These responsibilities should not be assigned to any one department. Some suggested key personnel to consider including are: representatives (both supervisors and line workers) from maintenance, production, environmental, health and safety, purchasing, accounting, shipping and receiving, legal and engineering departments, research and development, and plant and executive managers. Not every company will have these designations, and other personnel may be more appropriate. The final composition of the team should be based on what is most appropriate for your company. It is important to include those individuals knowledgeable about the processes generating wastes and involve them from the beginning.

In addition to those individuals assigned duties on the pollution prevention team, others may wish to help. Do not turn away volunteers - everyone should be encouraged to participate in the pollution prevention program. All volunteers should be commended in some way (the in-house newsletter, etc.) for their interest in helping the company, their co-workers, and the environment. One important point to continually stress throughout the development and implementation of the pollution prevention program is the need to work together. Employee suggestions should continually be encouraged - supervisors need to listen carefully because innovative ideas can come from any employee. Pollution prevention must continue for the life of the facility; establishing a sound, cooperative program from the start will be beneficial in future years.

The initial pollution prevention team meeting should be an informal session to discuss what pollution prevention is, why the company should do it, and where and how to begin. General information about the company's processes and operational procedures should be reviewed. The team will be responsible for developing a formal pollution prevention plan as outlined in the next chapter. This is also a good time for the company to emphasize top management support for the pollution prevention program and for the team's planning process.

State Goals

There are different types of goals a company should set when beginning their pollution prevention program. Some goals will be waste specific, while others will be activity oriented. The team should discuss what types of goals are appropriate for the company. For example, a company may want to set an ultimate goal of zero percent waste generation to acknowledge the fact that pollution prevention is a continuing challenge. This is very similar to company goals like "zero product defects" or "zero lost workdays". Another goal may be to replace some or all of the toxic substances used with non-toxic substances and thus reduce risk to employees, the public, and the environment. Numerical goals for waste reduction may be established once the wastes are characterized. Goals may consider economic and technical feasibility.

In addition to specific goals targeted at source reduction, more general goals should also be set. These could include improving worker health and safety in the facility or improving the company image and attractiveness to investors. Activity goals could include incorporating pollution prevention into performance evaluations of all management staff, installing a revised accounting system that charges the cost back to the production line generating the waste, training all employees in pollution prevention, or holding monthly team meetings.

Goals should be continually updated as they are achieved. This emphasizes the concept of continuous quality improvement and is an important component of a pollution prevention program. Do not remain static. Build on the successes achieved. Specific goals will vary over time and should be based on the size of the facility and the type of production processes undergoing change. It is a good idea to set a number of measurable goals to track progress within a given period.

Increase Employee Awareness and Involvement

One method of increasing pollution prevention knowledge is through a corporate/facility awareness program. Supervisors should discuss the status of the pollution prevention program at weekly meetings. They should encourage the employees to bring pollution prevention ideas to them so they can forward them on for the facility pollution prevention team meetings, or encourage employees to submit ideas directly to the team. Some companies may already have "quality circles" in place to improve product quality and production efficiency. The team should work with these groups to develop ideas for pollution prevention initiatives. The pollution prevention team should include the following aspects in developing their awareness program:

- provide a definition and explanation of the primary components of pollution prevention
- state company policies and guidelines clearly
- identify company goals to reduce waste generation and to improve operations
- stress that pollution prevention is not only essential but also beneficial
- encourage employee participation as extremely important to improve facility and environmental conditions
- make management and pollution prevention team members available to employee suggestions and new ideas
- present facts on safety improvements that occur when a pollution prevention program is implemented
- stress the relationship between the cost of generating waste to company competitiveness
- equate savings from pollution prevention with the company's fiscal health (i.e., increasing job security to encourage employee involvement).

Train Employees

Specialized pollution prevention training programs tailored for management, line, and maintenance staff should be incorporated into company procedures. Consolidated training for different groups can also stimulate discussion between employees who would not interact otherwise. Additional personnel training may be needed if materials handling or accounting changes are made. The facility or company may want to include a pollution prevention orientation program for all new employees, regardless of their job function. Employees will need thorough training on any new technologies or techniques added to unit processes. Depending upon the size of the facility, this may require training on more than one shift.

Another option is to have performance evaluation systems reflect pollution prevention responsibilities. As pollution prevention strategies are identified, the training requirements must be considered by the pollution prevention team prior to implementation.

Reward Pollution Prevention Successes

To stimulate additional interest and participation in pollution prevention, establish an employee incentive award or recognition program for the facility or company. Competition in larger plants may motivate participation. Shifts, departments, or even individuals can be encouraged to compete against their own past year's performance. Recognition in the form of an awards ceremony, a bonus, a special parking place, or added vacation time, provides a tangible reward to individuals and departments who have achieved their pollution prevention goals. Further recognition may be promoted in a regular pollution prevention column in the company newsletter which recognizes pollution prevention efforts and successes. When a company newsletter is not available, a short one page fact sheet on pollution prevention could be started that acknowledges employee participation and accomplishments.

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Chapter 10
Write the Pollution Prevention Program Plan

"Pollution prevention plans should be a practical business plan for attacking today's environmental concerns through the reduction or elimination of waste at its source of generation."

Dennis G. Willis, Capsule Environmental Engineering

After the pollution prevention team has been organized and the preliminary assessment has been completed, the pollution prevention team should write the pollution prevention plan. This plan should include all the ideas developed by the team such as the statement of support from management, the pollution prevention team's structure, organizational guidelines, and statement of purpose; the methods for fostering participation by all employees; the company's general goals; the structure of an incentive/reward program; the procedures, criteria and schedule for implementing pollution prevention projects; and the provisions for employee training.

The formal written pollution prevention plan should include the following elements:

- Corporate policy statement of support for pollution prevention
- The company's general goals
- Description of your pollution prevention planning team(s) makeup, authority, and responsibility
- Description of how all of the groups (production, laboratory, maintenance, shipping, marketing, engineering, and others) will work together to reduce waste generation and energy consumption
- Plan for publicizing and gaining company-wide support for the pollution prevention program
- Plan for communicating the successes and failures of pollution prevention programs within your company
- Description of the processes that produce, use, or release wastes, including clear definition of the amounts and types of substances, materials, and products under consideration
- List of treatment, disposal, and recycling facilities and transporters currently used
- Preliminary review of the cost of pollution control and waste disposal
- Description of current and past pollution prevention activities at your facility
- Evaluation of the effectiveness of past and ongoing pollution prevention activities
- Criteria and schedule for prioritizing candidate facilities, processes, and wastes for pollution prevention projects
- Provisions for employee training

Define Objectives

During the preliminary assessment phase, the program team will have identified opportunities for pollution prevention and will have worked with the executive group to establish priorities. These will be the starting point for defining short- and long-range objectives.

Objectives are the specific tasks that will be necessary to achieve goals. For example, in order to reach a goal of reducing waste, the objectives might be defined as reducing solvent, paper, and packaging wastes by specific amounts over a stated period of time.

Objectives can be defined at the facility- or the department-level, depending on the size and diversity of your company. A small company could decide to develop a single set of objectives to cover all of its operations. A larger company with many facilities or products might develop an overall corporate plan describing goals and objectives, supplemented by facility- or product-specific goals. In any case, the management at each location must understand and support its objectives if the pollution prevention program is to be successful.

Objectives should be stated in quantitative terms and should have target dates. These two attributes make objectives effective tools for directing effort and measuring progress.

Identify Potential Obstacles

During the development of the pollution prevention program and plan, the team may have encountered a number of factors that could complicate the process. These factors need to be recognized, and the means for overcoming them need to be defined. The team should list economic, technical, regulatory, and institutional obstacles and define procedures for addressing them. Apparent obstacles will be less likely to impede the process if everyone understands that there is a mechanism for addressing them in a later stage.

Develop Schedule

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. The execution of these stages (described in the following chapters) should follow this schedule closely. Significant deviations may cause the program to falter because certain steps are not completed. Adherence to the schedule will also help control the startup or implementation costs of the program.

The pollution prevention program plan should be presented and agreed to by management so that they understand how the pollution prevention team will proceed and what resources/support will be required from them. The plan should be modified on an annual basis as pollution prevention experience is gained and goals are reached. A company should strive to continually improve the entire program.

Augment the Plan

After the facility has completed each of the later steps in the pollution prevention program, results and a written summary of each step should be added to the pollution prevention plan. Writing summaries and adding them to the pollution prevention plan will provide a record of all pollution prevention activities in the program. The compilation of reports will be a good reference for anyone who is interested in reviewing your facility's entire pollution prevention program, including implementation, measuring progress, and maintaining the program.

Figure 3: A Simple flow Diagram

Metal Parts Fabrication

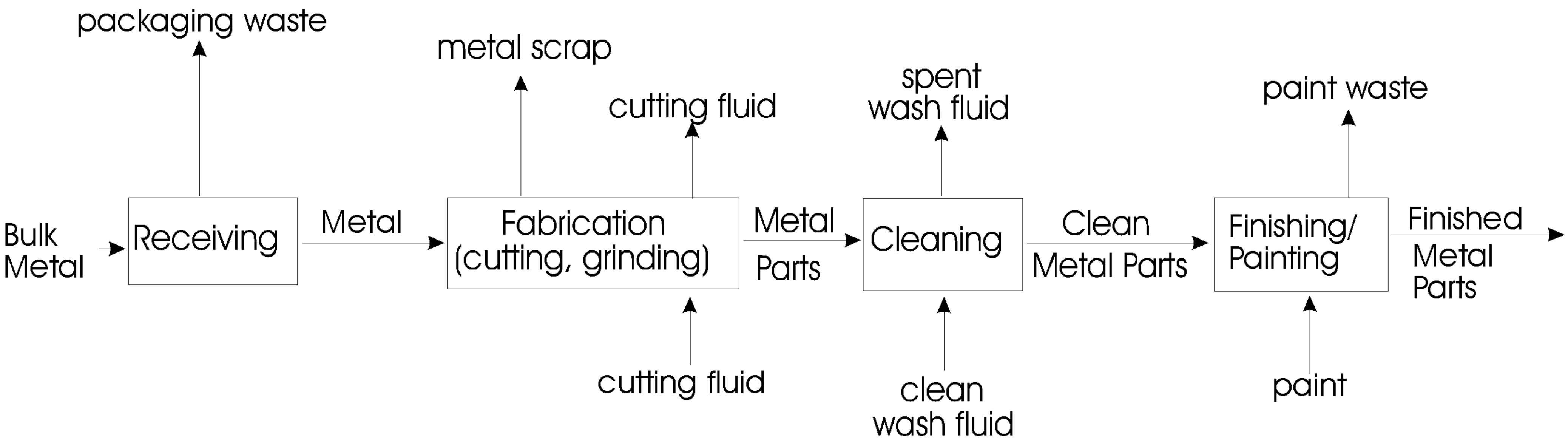

Figure 4: Simplified general process flow design

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Chapter 14
Do Feasibility Analysis

"We have found that up to 65 percent of the waste generated by industrial plants can be prevented at little or no cost to the plant. Most of the recommendations we make to companies have a pay-back period of less than one year."

Charles A. Czarnecki, Waste Advantage

Once suggestions for pollution prevention options are gathered and the costs associated with these options calculated, they should be reviewed by the pollution prevention team and the least beneficial options eliminated from further consideration. These options may be reviewed again at a later time since pollution prevention is a continuous process and what is less beneficial now may work better in the future. The remaining options should then be examined in more detail to determine their overall benefits. Technical, economic and environmental feasibility of each option, based on the company's requirements for these criteria, should be studied. For example, each company has their own standards for economic evaluation, feasibility for implementation, levels of expertise, operational requirements, etc. Those options found to be consistent with the company's goals can then be scheduled for implementation. There may even be cases in which certain benefits of a project override low economic return.

The benefits to be gained by implementing a pollution prevention project should be identified. Along with reduced waste generation (and associated costs), these benefits may include improved worker safety/morale, better community relations, reduced liability, reduced regulatory concerns, and improved relations with regulatory agencies. These benefits may be difficult to quantify but should be emphasized when evaluating options for implementation approval.

Technical Evaluation

There are many factors which should be considered when determining if a project is technically feasible. Table 6 presents some of these factors.

Table 6. Factors to Consider in Determining Feasibility

Process related	Company related

Existing technology available Amount of downtime required Equipment/procedure compatibility Utility requirements/availability Specific training required Acceptable service from vendor Ease of implementation Quality assurance	Pollution prevention goals Product quality maintained Customer acceptance of product Likelihood of success Creation of other environmental concerns Reduction of treatment/disposal costs Payback period Regulatory compliance costs New markets for modified products

(adapted from *Pollution Prevention: A Guide to Program Implementation*, Illinois Hazardous Waste Research and Information Center, 1993)

Personnel that will be directly affected by implementing the project should be consulted and included in the decision-making process. They typically have knowledge of process details that may inhibit the project success and are essential in proper implementation. For projects that involve a new technology or technique, a bench-scale or pilot test may be required to assess the technical feasibility. At this point, if it is determined that an option is not feasible by these criteria, the option should be deferred for consideration at a later time when the circumstances for evaluation may be different. If possible, illustrate effects of an option by modifying flow diagrams of existing processes to show how potential options will improve plant processes.

Economic Evaluation

Once a pollution prevention project has been found to be technically feasible, the economics of the project should be examined. In the previous chapter, the full cost of waste generation and the cost savings for implementing a pollution prevention option were determined. In cases which involve capital and start-up expenditures, the payback period or other economic criteria were calculated. This information is necessary when evaluating the economic feasibility of a project.

Any project that yields a cost savings (annual waste handling or annual operating costs) has potential for profitability. If there are no initial costs involved, then a project can be considered economically feasible if there is a cost savings. Options such as better operating practices may be the most practical to implement first since they do not require an initial capital investment.

For projects with capital and start-up costs, an additional profitability criterion must be examined: payback period and other economic criteria (as calculated in Chapter 13). Typically, if the payback period is less than two years, the project may be considered economically feasible. This criteria varies depending on the company. There may also be other profitability measures that must be considered; this, too, will depend on the company. Before making the final economic feasibility determination, the accounting department controller should be consulted since his/her approval will usually be necessary before the project may proceed. Give the accountant or controller copies of the pollution prevention cost references mentioned in the previous chapter.

Environmental Evaluation

Factors to consider when conducting an environmental evaluation include:

- effect on number and toxicity of wastes
- transfer of pollutants to other media
- environmental impact of alternative input materials
- energy consumption.

The team should review information on the environmental aspects of the relevant product, raw material, or constituent part of the process. The team should consider the environmental effects not only of the production phase and product life cycle but also of extracting and transporting the alternative raw materials and of managing any new wastes.

Companies should start working with the appropriate regulatory agencies as early in the evaluation process as possible. Some pollution prevention projects will require new permits or changes to existing permits. It will also be necessary to learn what regulations might apply to the project. Appendix B and Appendix G of this manual provide contacts for assistance in the environmental evaluation of pollution prevention options.

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Chapter 15
Write the Assessment Report

"An assessment report will help you focus subsequent pollution prevention efforts and will be useful as a record of what aspects of your business you examined for pollution prevention opportunities."

The task force should write a report that summarizes the results of the pollution prevention assessment at the company level. Table 7 lists the report contents. The report will provide a schedule for implementing prevention projects and will be the basis for evaluating and maintaining the pollution prevention program. It may also be needed to secure internal funding for projects that require capital investment, if the members of the pollution prevention assessment task force do not have the authority to commit funds.

You may be tempted to omit this step if your company has an owner-manager and only a few employees. A summary assessment report may not be needed to resolve pollution prevention project conflicts among different areas, and your funding approvals probably are not a formal procedure requiring cost justifications. However, an assessment report will help you focus subsequent pollution prevention efforts and will be useful as a record of what aspects of your business you examined for pollution prevention opportunities.

Table 7. Elements to Include in an Assessment Report

<table>
<tr><td>For each process that is assessed, the report should include:
The results of the assessment
The options proposed
The results of options screening
The results of feasibility analysis
The project proposal for each selected option</td></tr>
<tr><td>For each project proposal, the report should include:
The project's pollution prevention potential
The maturity of the technology and a discussion of successful applications
The overall project economics
The required resources and how they will be obtained
The estimated time for installation and startup
Possible performance measures to allow the project to be evaluated after it is implemented</td></tr>
</table>

Input of the Assessment Teams

In a company that has several assessment teams, the task force will need to evaluate the results and resolve any conflicts that might exist among the teams about the approach and the resources required for the projects they propose.

As input to this integration effort, each assessment team should prepare a summary report, presenting the results of their investigations and listing the options they screened. Each report should describe in some detail the options that the team has determined are feasible and propose a schedule for implementing them. The options recommended for immediate implementation should then be described in detail as proposed projects.

These proposals should evaluate each project under different scenarios. For example, the profitability of projects could be estimated under both optimistic and pessimistic assumptions. Where appropriate, sensitivity analyses indicating the effect of key variables on profitability should be included. Each proposed project should outline a plan for adjusting and fine-tuning the initial projects as knowledge and experience increases. The proposals should include a schedule for addressing those areas and wastes with lower priorities than the ones selected for the initial effort.

Preparing and Reviewing the Assessment Report

The task force will use the assessment teams' reports and project proposals to prepare the summary assessment report and implementation plan. The report should include a qualitative evaluation of the indirect and intangible costs and benefits to your company and employees of a pollution prevention plan. It will provide the basis for obtaining funding of pollution prevention projects. Pollution prevention projects should not be sold on their technical merits alone; a clear description of both tangible and intangible benefits can help a proposed project obtain funding.

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. In addition to ensuring the quality of the assessment report and implementation plan, this review will help ensure the support of the people who will be responsible for the success of the project.

The final assessment report should be included as a part of the original pollution prevention program plan (see "Augmenting the Plan" in Chapter 10). As stated above, the report will provide a schedule for implementing prevention projects and will be the basis for evaluating and maintaining the pollution prevention program.

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Chapter 16
Implement the Pollution Prevention Plan

"You can state corporate positions, write detailed mission statements, outline ambitious goals and prepare detailed plans, but the way you reduce waste is by installing projects that reduce waste."

Ken Nelson, Dow Chemical

Select projects

Once the pollution prevention team selects the projects to be implemented, management approval must be obtained. If management support was obtained as described in Chapter 7, the approval process should not be difficult (providing the project benefits, profitability, and feasibility are acceptable). The pollution prevention coordinator (or whoever will be in charge of the project) should present to management the details of the project along with the budget and project justification (particularly economics). Individual companies will have their own procedures to be followed for project endorsement.

Obtain funding

When approval has been obtained, the necessary funding for the project should be acquired. Again, this procedure will vary with the company. It may be worthwhile to contact the Ohio Department of Development, the Federal Small Business Administration, and other governmental offices. These organizations may provide loans or grants for pollution prevention projects. A joint project of U.S. DOE and U.S. EPA, the National Industrial Competitiveness Through Efficiency: Energy, Environment, and Economics (NICE3) provides one-time grant funds for research and demonstration projects (see Appendix B).

Install the selected projects

When funding is in place, project implementation can begin. The phases of implementation will be the same as for most other projects in the company. Personnel that will be directly affected by the project (line workers, engineers) should be involved from the start. Those personnel indirectly affected (e.g., controllers, purchasing agents) should also be involved as project implementation proceeds. Any additional training requirements should be identified and arrangements made for instruction. All employees should be periodically informed of the project status and should be educated as to the benefits of the project to them and to the company. Encourage employees to comment on the plan and to suggest additional reduction options. This may ease the natural resistance to change.

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Appendix G
Ohio EPA Information Sources

Please see Divisions and Offices of the Ohio EPA for updated information.

Central Office (CO)
1800 Watermark Dr.
P.O. Box 1049
Columbus, Ohio 43216-1049
(614) 644-3020

Southwest District Office (SWDO)
401 East Fifth Street
Dayton, Ohio 45402-2911
(513) 285-6357
(800) 686-8930

Central District Office (CDO)
P.O. Box 1049
3232 Alum Creek Drive
Columbus, Ohio 43216-1049
(614) 728-3778
(800) 686-2330

Northeast District Office (NEDO)
2110 East Aurora Road
Twinsburg, Ohio 44087
(216) 963-1200
(216) 425-9171
(800) 686-6330

Northwest District Office (NWDO)
347 North Dunbridge Road
P.O. Box 466
Bowling Green, Ohio 43402
(419) 352-8461
(800) 686-6930

Southeast District Office (SEDO)
2195 Front Street
Logan, Ohio 43138
(614) 385-8501
(800) 686-7330

Executive Offices

Division of Air Pollution Control	(614) 644-2270
Division of Drinking and Ground Water	(614) 644-2905 and 644-2752
Division of Emergency and Remedial Response	(614) 644-2924
Environmental Education Fund	(614) 644-2873
Division of Environmental and Financial Assistance	(614) 644-2798
Division of Environmental Services	(614) 294-5841
Division of Hazardous Waste Management	(614) 644-2917
Legal Office	(614) 644-2115
Office of Pollution Prevention	(614) 644-3469
Public Interest Center	(614) 644-2160
Division of Solid and Infectious Waste	(614) 644-2621
Division of Surface Water	(614) 644-2001 and 644-2856

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Chapter 18
Maintain the Pollution Prevention Program

"The most successful companies are those that maintain an ongoing series of challenges - setting tough, long-term goals, and revising them up if they seem too easy."

Joel Makower, "the e factor"

Now that a pollution prevention program is underway, it must be sustained in future years. This involves reaffirming commitment to the program at all levels including upper management. Employee enthusiasm and interest must be maintained to ensure continuation of the program. Ideally, the entire cycle should be repeated following the successful implementation of each pollution prevention project. Some specific ideas for sustaining the program include bringing new personnel into the pollution prevention team, training, and publicizing success stories.

Rotate Pollution Prevention Team

To maintain the flow of fresh ideas, the pollution prevention team members should be rotated to introduce new perspectives. With an ongoing pollution prevention program, there may be new employees who join the company over the years that want to participate. A new team leader may step in with high energy, enthusiasm and creativity. If some members do step down, they can serve as consultants to the new team. There may also be dedicated team members who wish to remain on the team; this should be encouraged as they have gained valuable experience. The composition of the team should still include employees from all levels and departments. The importance of a written pollution prevention plan is that it will outline the operating procedures for the program and provide continuity even when team members are replaced.

Refresher Training

Pollution prevention awareness and training should be conducted on a periodic basis so that all new or reassigned employees understand the company's commitment to pollution prevention. Pollution prevention training should be incorporated into a number of the companies existing training programs (health and safety, environmental, processes, etc.). This training should be an ongoing process.

Publicize Success Stories

Publicity is one of the most effective means to sustain the pollution prevention program. Internal publicity raises the awareness of employees of activities going on at the facility and encourages further participation. The results of the various projects should be relayed through bulletin boards, newsletters, interoffice memos, etc. The names of the pollution prevention team members, as well as those employees offering suggestions, should be included in these publications. If individual successes are recognized, other employees may wish to join in to receive the same recognition. Presentation ceremonies for employee/team incentive awards will also help publicize successes. Cost savings, waste reductions, and product quality improvements due to pollution prevention activities/projects should be highlighted.

The pollution prevention program can be a key public relations tool. Any reduction in waste is a benefit to employees, the community and the environment and should be publicized. News releases should be prepared for local and state media documenting the project and the benefits gained by the company and the surrounding community. Reporters could also be invited to the facility for a demonstration of a new technology.

Further public recognition can be facilitated through national, state, county, and local award programs. The Ohio EPA solicits nominations for the Governor's Awards for Outstanding Achievement in Pollution Prevention each year. These awards are presented to individuals; environmental, community, educational and non-profit organizations; business, industry, agricultural, trade, or professional organizations; and local governments that demonstrate significant achievements in pollution prevention.

Trade association meetings and publications are another good avenue for promoting a company's pollution prevention program. Case studies can be submitted which demonstrate the company's progressive stance in environmental protection while describing the use of innovative technologies and techniques to reduce waste. These case studies should emphasize the benefits gained by the company - not only waste reduction but also cost savings, quality improvements, safety improvements, regulatory compliance, and better community relations. Applying for state or national pollution prevention awards can also be a means to publicize the company's efforts.

Chapter 17
Measure Progress: Program and Project Evaluation

"Pollution prevention performance must be measured if it is to be improved, and it must be improved if it is to be praised."

Joel Hirschhorn

Once a pollution prevention program is established it should be continuously evaluated and updated. This periodic review by the pollution prevention team should be conducted for all stages of the program, from management support and team selection to project implementation. Once the elements have been examined, the program can be modified and goals redefined to improve overall effectiveness.

Program Evaluation

The progress of the pollution prevention program can be determined by looking at the individual activities and projects. One way of measuring progress is quantitative. For example, look at actual waste reduction, both in terms of actual change in quantity and change in hazard level. The actual change in quantity is the difference between the waste per production unit reported in the current year and the waste per production unit reported in the previous year. The change in hazard level is based on toxicity, reactivity, ignitability, and corrosivity of the waste and industrial hygiene/employee exposure-type measurements. This comparison measurement is most useful when evaluating an alternative material substitution such as switching from an organic solvent to a water based solvent. These measures of waste reduction may not be appropriate for all facilities and wastes. Other quantitative measurements are adjusted quantity change and throughput ratio. Additional guidelines and detailed descriptions on measuring waste reduction can be found in Chapter 4 of U.S. EPA's *Facility Pollution Prevention Guide*.

Progress can also be measured qualitatively through employee involvement, attitude and number of ideas suggested. Some examples of qualitative evaluation criteria are presented in Table 8.

Table 8. Program Evaluation Criteria

Project Element	Evaluation Criteria
Management support	Statements of support Approval of projects Providing ideas/input Praise and publicity of successes

Team aspects/program initiation	Employee enthusiasm and participation Using skills from training Supporting projects Providing ideas
Understanding process	Processes characterized Flow diagrams developed All wastes and sources identified Waste accounting system implemented
Project implementation	Projects completed within budget Projects completed on schedule Waste reduction achieved Cost savings attained Raw material savings achieved Product quality improved Worker safety improved Cost allocation system implemented
Continuing the program	Follow-up and review procedures established Employees kept informed and involved Pollution prevention team composition rotated

(adapted from *Pollution Prevention: A Guide to Program Implementation,* Illinois Hazardous Waste Research and Information Center, 1993)

When evaluating the elements of the program, it is important to identify those strategies and techniques which have been very successful, marginally successful, or have failed. If possible, the reasons why these projects were or were not successful should be determined. This information will be beneficial for modifying the program and redefining goals.

Program Modification

To ensure continuing progress and success of the pollution prevention program, the individual components and the overall plan should be modified using the knowledge gained from experience. Successful strategies and techniques can be used again or adapted to other areas where progress has been slow or impeded. The initial pollution prevention goals should be redefined and/or expanded, reaching for the ultimate goal of zero waste generation.

This is also an appropriate time to check to see if results and a written summary of the implementation of each step of the program have been added to the pollution prevention plan. As discussed in Chapter 10, writing summaries and adding them to the pollutionprevention plan will provide a record of all pollution prevention activities in the program. The compilation of reports will be a good reference for anyone who is interested in reviewing your facility's pollution prevention program.

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Appendix A
References

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Hazardous Waste Research and Information Center. 1993. Pollution Prevention: A Guide to Program Implementation. Hazardous Waste Research and Information Center, Champaign, Illinois.

Klafter, B. 1992. Pollution Prevention Benchmarking: AT&T and Intel Work Together with the Best. Total Quality Environmental Management, Vol. 2, No. 1, p. 27-34.

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Chapter 173-307 WAC. Publication #91-2. Washington State Department of Ecology, Waste Reduction Recycling and Litter Control Program, Olympia, Washington.

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Appendix E
Examples of Pollution Prevention Activities

Table E-1. Pollution Prevention Through Good Operating Practices

(adapted from *Facility Pollution Prevention Guide*, U.S. EPA, 1992)

Good Operating Practice	Program Ingredients
Waste segregation	Prevent mixing of hazardous wastes with nonhazardous wastes Store materials in compatible groups Segregate different solvents Isolate liquid wastes from solid wastes
Preventive Maintenance Programs	Maintain equipment history cards on equipment location, characteristics, and maintenance Maintain a master preventive maintenance (PM) schedule Keep vendor maintenance manuals handy Maintain a manual or computerized repair history file
Training/Awareness-Building Programs	Provide training for: • Operation of the equipment to minimize energy use and material waste • Proper materials handling to reduce waste and spills • Emphasize importance of pollution prevention by explaining the economic and environmental ramifications of hazardous waste generation and disposal • Detecting and minimizing material loss to air, land, or water • Emergency procedures to minimize lost materials during accidents

Effective Supervision	Closer supervision may improve production efficiency and reduce inadvertent waste generation Centralize waste management. Appoint a safety/waste management officer for each department. Educate staff on the benefits of pollution prevention. Establish pollution prevention goals. Perform pollution prevention assessments.
Employee Participation	"Quality circles" (free forums between employees and supervisors) can identify ways to reduce waste Solicit and reward employee suggestions for waste reduction ideas
Production Scheduling/Planning	Maximize batch size to reduce clean out waste Dedicate equipment to a single product Alter batch sequencing to minimize cleaning frequency (light-to-dark batch sequence, for example)
Cost Accounting/Allocation	Charge direct and indirect costs of all air, land, and water discharges to specific processes or products Allocate waste treatment and disposal costs to the operations that generate the waste Allocate utility costs to specific processes or products

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Appendix F
Pollution Prevention Information Available from Ohio EPA

Please see Order Forms for updated version.

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Appendix H
Trade Secrets and Confidentiality Requests

This appendix provides information about trade secrets and confidentiality requests for pollution prevention and waste minimization plans. Specific provisions for permitted hazardous waste facilities, Class I injection well facilities, air pollution control, and water pollution control are listed for reference. Other related information about trade secrets and confidentiality requests include: Toxic Chemical Release Reporting, Ohio Administrative Code Rule 3745-100-13, Trade Secret Claims; and Miscellaneous Rules, Ohio Administrative Code Rule 3745-49-031, Inspection of Public Records.

Facilities should contact the appropriate Ohio EPA program before submitting trade secret or confidential information to confirm the most current procedures for requesting confidentiality.

General Provisions for Trade Secrets

The general provision for trade secrets for the State of Ohio can be found in the Ohio Revised Code Section 1333.51, Theft or conversion of trade secret.

Ohio Revised Code Section 1333.51 Theft or conversion of trade secret

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(A) As used in this section:
     (1) "Article" means any object, material, device, or
     substance, or copy thereof, including any writing, record,
     recording, drawing, sample, specimen, prototype, model,
     photograph, blueprint, or map.
     (2) "Representing" means describing, depicting, containing,
     constituting, reflecting, or recording.
     (3) "Trade secret" means the whole or any portion or phase of
     any scientific or technical information, design, process,
     procedure, formula, or improvement, or any business plans,
     financial information, or listing of names, addresses, or
     telephone numbers, which has not been published or
     disseminated, or otherwise become a matter of general public
     knowledge.  Such scientific or technical information, design,
     process, procedure, formula, or improvement, or any business
     plans, financial information, or listing of names, addresses,
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or telephone numbers, is presumed to be secret when the owner thereof takes measures designed to prevent it, in the ordinary course of business, from being available to persons other than those selected by the owner to have access thereto for limited purposes.

(4) "Copy" means any facsimile, replica, photograph, or reproduction of an article, or any note, drawing, or sketch made of or from an article.

(B) No person shall, with intent to deprive or withhold from the owner thereof the control of a trade secret, or with intent to convert a trade secret to his own use or the use of another, obtain possession of or access to an article representing a trade secret.

(C) No person, having obtained possessions of an article representing a trade secret or access thereto with the owner's consent, shall convert such article to his own use or that of another person, or thereafter without the owner's consent make or cause to be made a copy of such article, or exhibit such article to another.

(D) No person shall, by force, violence, threat, bribe, reward, or offer of anything of value on or to another person or member of his family, obtain or attempt to obtain from such other person an article representing a trade secret.

(E) No person shall, without authorization, enter upon the premises of another with intent to obtain possession of or access to an article representing a trade secret.

Permitted Hazardous Waste Facilities

The Ohio Revised Code Section 3734.12(G) instructs the Director of Ohio EPA to establish procedures to ensure protection of trade secrets. Trade secrets are defined in the Section and this definition is the same as the definition in Ohio Administrative Code Rule 3745-50-30 (see below). Ohio Hazardous Waste Facility Installation and Operation Permits contain a standard condition for confidential information. The Ohio hazardous waste rules also include a rule, Ohio Administrative Code Rule 3745-50-30, for trade secrets and request for confidentiality. The condition and the rule are listed below.

Ohio Hazardous Waste Facility Installation and Operation Permit Condition
Confidential Information

Ohio Administrative Code Rule 3745-50-30

In accordance with Ohio Revised Code Chapter 3734 and the rules adopted thereunder, the Permittee may request confidentiality of any information required to be submitted by the terms and conditions of this permit.

Ohio Administrative Code Rule 3745-50-30 Trade secrets - request for confidentiality.

(A) Any record, report or other information obtained under the hazardous waste rules or Chapter 3734. of the Revised Code shall not be available to the public upon a showing satisfactory to the Ohio EPA that all or part of such record, report or other information (other than discharge or emission data) would divulge methods or processes entitled to protection as trade secrets of such person, in which instance, the Ohio EPA shall consider such record, report or other information or part thereof confidential and administer such record, report or other information pursuant to this rule.

(B) A request for confidentiality shall be submitted to the Ohio EPA simultaneously with submissions of the specific record, report or other information, and such request shall be accompanied by sufficient supporting documentation. Failure to make such timely request shall constitute a waiver of the right to prevent public disclosure.

(C) A decision as to the confidentiality request shall be made by the Ohio EPA within forty-five days of receipt of a request filed in accordance with rule 3745-49-031 of the Administrative Code. Until such decision is made, the record, report, or other information or part thereof, shall be confidential. The person requesting confidentiality shall be notified by mail of the decision.

(D) Any record, report or other information determined to be confidential may be disclosed, without such person's consent:

(1) To officers, employees, or authorized representatives of the state or a federal agency;

(2) In any judicial proceeding; and

(3) In any hearing conducted by Ohio EPA or the board.

(E) As used in this rule, "trade secrets" may include but are not limited to, any formula, plan, pattern, process, tool, mechanism, compound, procedure, production data or compilation of information which is not patented, which is known only to certain individuals within a commercial concern who are using it to fabricate, produce, or compound an article, trade or service having commercial value, and which gives its user an opportunity to obtain a business advantage over competitors who do not know or use it.

Class I Injection Well Facilities

The Ohio Revised Code Section 6111.045(B), discusses trade secret information in waste minimization and treatment plans and references Ohio Revised Code, Section 1333.51, Theft or conversion of trade secrets. The Ohio underground injection control program rules also include a rule, Ohio Administrative Code Rule 3745-34-03, for confidentiality of information. The section and the rule are listed below.

Ohio Revised Code Section 6111.045(B)

Each waste minimization and treatment plan prepared and adopted under division (A) of this section shall be retained at the facility to which it applies and shall be made available for inspection and review by the director of environmental protection or his authorized representative. The disclosure of any trade secret information contained in any such plan is subject to section 1333.51 of the Revised Code.

Ohio Administrative Code Rule 3745-34-03 Confidentiality of information

(A) Any record, report or other information obtained by the Ohio environmental protection agency shall be made available to the public, except that upon a showing satisfactory to the director by any person that such record, report or other information, or particular part thereof (other than data concerning the amounts of contents of discharges or the quality of the receiving waters), if made public, would divulge methods or processes entitled to protection as trade secrets of such person, the Ohio environmental protection agency shall consider such record, report or other information, or particular part thereof confidential. Any confidential record, report, or information may be disclosed to other officers, employees, or authorized representatives of the state, another state, or of the United States, concerned with carrying out this act or when relevant in any proceeding under these regulations. Prior to divulging any confidential trade secret information, the director shall give ten days' written notice to the person claiming trade secrecy.

(B) A request for confidentiality shall be submitted to the Ohio environmental protection agency simultaneously with submission of the specific record, report or other information, and such request shall be accompanied by sufficient supporting documentation. Failure to make such timely request shall constitute a waiver of the right to prevent public disclosure.

(C) A decision as to the confidentiality request shall be made by the Ohio environmental protection agency within forty-five days of receipt of the request and accompanying documentation. Until such decision is made, the record, report, or other information or part thereof, shall be confidential. The person requesting confidentiality shall be notified by mail of the decision.

Air Pollution Control

Ohio Revised Code Section 3704.08 Records to be available for public inspection; exception.

(A) Any records, reports, or information obtained under Chapter 3704. of the Revised Code shall be available for public inspection, except that upon a showing satisfactory to the director of environmental protection by any person that such records, reports or other information, or particular part thereof, other than emission data, to which the director has access under such chapter, if made public, would divulge methods or processes entitled to protection as trade secrets of such person, the director shall consider such record, report or other information, or particular part thereof confidential, except that such record, report, or information may be disclosed when necessary to sustain an action brought pursuant to section 3704.06 of the Revised Code ordering an adjudication hearing conducted by the director on the denial, modification, or revocation of a variance or permit.

Water Pollution Control

Ohio Revised Code Section 6111.05 Investigation of alleged acts of pollution; right of entry.

... Any records, reports, or information obtained under Chapter 6111. of the Revised Code shall be available for public inspection, except that:

(A) Upon a showing satisfactory to the director of environmental protection by any person that such records, reports or information, or any particular part thereof, other than data concerning the amounts or contents of discharges or the quality of the receiving waters, to which the director has access under this chapter, if made public would divulge information entitled to protection as trade secrets of such person, the director shall consider such record, report or information or particular part thereof confidential. Prior to divulging any alleged trade secret information pursuant to this division, the director shall give ten day's written notice to the person claiming trade secrecy.

Appendix A
Waste Minimization Assessment Worksheets

The worksheets that follow are designed to facilitate the WM assessment procedure. Table A-1 lists the worksheets, according to the particular phase of the program, and a brief description of the purpose of the worksheets. Appendix B presents a series of simplified worksheets for small businesses or for preliminary assessments.

Table A-1. List of Waste Minimization Assessment Worksheets

Phase	Number and Title	Purpose/Remarks
	1. Assessment Overview	Summarizes the overall assessment procedure.
Planning and Organization (Section 2)		
	2. Program Organization	Records key members in the WMA program task force and the WM assessment teams. Also records the relevant organization.
	3. Assessment Team Make-up	Lists names of assessment team members as well as duties. Includes a list of potential departments to consider when selecting the teams.
Assessment Phase (Section 3)		
	4. Site Description	Lists background information about the facility, including location, products, and operations.
	5. Personnel	Records information about the personnel who work in the area to be assessed.
	6. Process Information	This is a checklist of useful process information to look for before starting the assessment.
	7. Input Materials Summary	Records input material information for a specific production or process area. This includes name, supplier, hazardous component or properties, cost, delivery and shelf-life information, and possible substitutes.
	8. Products Summary	Identifies hazardous components, production rate, revenues, and other information about products.
	9. Individual Waste Stream Characterization	Records source, hazard, generation rate, disposal cost, and method of treatment or disposal for each waste stream.
	10. Waste Stream Summary	Summarizes all of the information collected for each waste stream. This sheet is also used to prioritize waste streams to assess.

(continued)

Table A-1. List of Waste Minimization Assessment Worksheets (continued)

Phase	Number and Title	Purpose/Remarks
Assessment Phase (continued) (Section 3)		
	11. Option Generation	Records options proposed during brainstorming or nominal group technique sessions. Includes the rationale for proposing each option.
	12. Option Description	Describes and summarizes information about a proposed option. Also notes approval of promising options.
	13. Options Evaluation by Weighted Sum Method	Used for screening options using the weighted sum method.
Feasibility Analysis Phase (Section 4)		
	14. Technical Feasibility	Detailed checklist for performing a technical evaluation of a WM option. This worksheet is divided into sections for equipment-related options, personnel/procedural-related options, and materials-related options.
	15. Cost Information	Detailed list of capital and operating cost information for use in the economic evaluation of an option.
	16. Profitability Worksheet #1 Payback Period	Based on the capital and operating cost information developed from Worksheet 15, this worksheet is used to calculate the payback period.
	17. Profitability Worksheet #2 Cash Flow for NPV and IRR	This worksheet is used to develop cash flows for calculating NPV or IRR.
Implementation (Section 5)		
	18. Project Summary	Summarizes important tasks to be performed during the implementation of an option. This includes deliverable, responsible person, budget, and schedule.
	19. Option Performance	Records material balance information for evaluating the performance of an implemented option.

Firm ______	**Waste Minimization Assessment Worksheets**	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET 1

ASSESSMENT OVERVIEW

EPA

Begin the Waste Minimization Assessment Program

↓

Worksheets used

PLANNING AND ORGANIZATION

	Worksheets used
• Get management commitment	
• Set overall assessment program goals	
• Organize assessment program task force	2

↓ Assessment organization and commitment to proceed

ASSESSMENT PHASE

	Worksheets used
• Compile process and facility data	4,6,7,8,9,10
• Prioritize and select assessment targets	10
• Select people for assessment teams	3
• Review data and inspect site	
• Generate options	11,12
• Screen and select options for further study	13

Select new assessment targets and reevaluate previous options

↓ Assessment report of selected options

FEASIBILITY ANALYSIS PHASE

	Worksheets used
• Technical evaluation	14
• Economic evaluation	15,16,17
• Select options for implementation	

↓ Final report, including recommended options

IMPLEMENTATION

	Worksheets used
• Justify projects and obtain funding	
• Installation (equipment)	18
• Implementation (procedure)	18
• Evaluate performance	19

Repeat the process

↓

Successfully operating waste minimization projects

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____		Checked By ____
Date ____	Proj. No. ____	Sheet 1 of 1 Page __ of __

WORKSHEET
2

PROGRAM ORGANIZATION

EPA

FUNCTION	NAME	LOCATION	TELEPHONE #
Program Manager			
Site Coordinator			
Assessment Team Leader			

Organization Chart

(sketch)

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET
3

ASSESSMENT TEAM MAKE-UP

EPA

Function/Department	Name	Location/ Telephone #	Manhours Required	Duties		
				Lead	Support	Review
Assessment Team						
Leader						
Site Coordinator						
Operations						
Engineering						
Maintenance						
Scheduling						
Materials Control						
Procurement						
Shipping/Receiving						
Facilities						
Quality Control						
Environmental						
Accounting						
Personnel						
R & D						
Legal						
Management						
Contractor/Consultant						
Safety						

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET 4

SITE DESCRIPTION

EPA

Firm:

Plant:

Department:

Area:

Street Address:

City:

State/ZIP Code:

Telephone: (   )

Major Products:

SIC Codes:

EPA Generator Number :

Major Unit or:

Product or:

Operations:

Facilities/Equipment Age:

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page __ of __

WORKSHEET 5

PERSONNEL

EPA

Attribute	Overall	Department/Area			
Total Staff					
Direct Supv. Staff					
Management					
Average Age, yrs.					
Annual Turnover Rate %					
Seniority, yrs.					
Yrs. of Formal Education					
Training, hrs./yr.					
Additional Remarks					

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET 6

PROCESS INFORMATION

EPA

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 & 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						

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____		Checked By ____
Date ____	Proj. No. ____	Sheet 1 of 1 Page ___ of ___

WORKSHEET 7

INPUT MATERIALS SUMMARY

EPA

Attribute	Description[1]		
	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[2]			
Shipping Container Size & Type[3]			
Storage Mode[4]			
Transfer Mode[5]			
Empty Container Disposal/Management[6]			
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)			

1 stream numbers, if applicable, should correspond to those used on process flow diagrams.
2 e.g., pipeline, tank car, 100 bbl. tank truck, truck, etc.
3 e.g., 55 gal. drum, 100 lb. paper bag, tank, etc.
4 e.g., outdoor, warehouse, underground, aboveground, etc.
5 e.g., pump, forklift, pneumatic transport, conveyor, etc.
6 e.g., crush and landfill, clean and recycle, return to supplier, etc.

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____		Checked By ____
Date ____	Proj. No. ____	Sheet 1 of 1 Page ___ of ___

WORKSHEET 8

PRODUCTS SUMMARY

EPA

Attribute	Description[1]		
	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)			

1 stream numbers, if applicable, should correspond to those used on process flow diagrams.

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet 2 of 4 Page __ of __

WORKSHEET 9a

INDIVIDUAL WASTE STREAM CHARACTERIZATION

EPA

1. **Waste Stream Name/ID:** ______ **Stream Number** ______

   Process Unit/Operation ______

2. **Waste Characteristics** (attach additional sheets with composition data, as necessary.)

   ☐ gas ☐ liquid ☐ solid ☐ mixed phase

   Density, lb/cuft ______ High Heating Value, Btu/lb ______

   Viscosity/Consistency ______

   pH ______ ,Flash Point ______ ; % Water ______

3. **Waste Leaves Process as:**

   ☐ air emission ☐ waste water ☐ solid waste ☐ hazardous waste

4. **Occurrence**

   ☐ continuous ______

   ☐ discrete ______

   discharge triggered by ☐ chemical analysis ______

   ☐ other (describe) ______

   Type: ☐ periodic ______ length of period: ______

   ☐ sporadic (irregular occurrence)

   ☐ non-recurrent

5. **Generation Rate**

   Annual ______ lbs per year

   Maximum ______ lbs per ______

   Average ______ lbs per ______

   Frequency ______ batches per ______

   Batch Size ______ average ______ range

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 2 of 4 Page ___ of ___

WORKSHEET 9b

INDIVIDUAL WASTE STREAM CHARACTERIZATION

(continued)

EPA

6. Waste Origins/Sources

Fill out this worksheet to identify the origin of the waste. If the waste is a mixture of waste streams, fill out a sheet for each of the individual waste streams.

Is the waste mixed with other wastes? ☐ Yes ☐ No

Describe how the waste is generated.

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

Example: Formation and removal of an undesirable compound, removal of an unconverted input material, depletion of a key component (e.g., drag-out), equipment cleaning waste, obsolete input material, spoiled batch and production run, spill or leak cleanup, evaporative loss, breathing or venting losses, etc.

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 3 of 4 Page ___ of ___

WORKSHEET
9c

INDIVIDUAL WASTE STREAM CHARACTERIZATION

(continued)

EPA

Waste Stream ______

7. Management Method

Leaves site in

- ☐ bulk ______
- ☐ roll off bins ______
- ☐ 55 gal drums ______
- ☐ other (describe) ______

Disposal Frequency ______

______

Applicable Regulations[1] ______

______

Regulatory Classification[2] ______

______

Managed

- ☐ onsite ☐ offsite
- ☐ commercial TSDF ______
- ☐ own TSDF ______
- ☐ other (describe) ______

______

Recycling

- ☐ direct use/re-use ______
- ☐ energy recovery ______
- ☐ redistilled ______
- ☐ other (describe) ______

reclaimed material returned to site?

☐ Yes ☐ No ☐ used by others

residue yield ______

residue disposal/repository ______

______

Note[1] list federal, state & local regulations, (e.g., RCRA, TSCA, etc.)

Note[2] list pertinent regulatory classification (e.g., RCRA - Listed K011 waste, etc.)

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____	Proc. Unit/Oper. ____	Checked By ____
Date ____	Proj. No. ____	Sheet 4 of 4 Page ___ of ___

WORKSHEET 9d

INDIVIDUAL WASTE STREAM CHARACTERIZATION

(continued)

EPA

Waste Stream ____

7. **Management Method (continued)**

Treatment

- ☐ biological ____
- ☐ oxidation/reduction ____
- ☐ incineration ____
- ☐ pH adjustment ____
- ☐ precipitation ____
- ☐ solidification ____
- ☐ other (describe) ____

residue disposal/repository ____

Final Disposition

- ☐ landfill ____
- ☐ pond ____
- ☐ lagoon ____
- ☐ deep well ____
- ☐ ocean ____
- ☐ other (describe) ____

Costs as of ____ (quarter and year)

Cost Element:	Unit Price $ per ___	Reference/Source:
Onsite Storage & Handling		
Pretreatment		
Container		
Transportation Fee		
Disposal Fee		
Local Taxes		
State Tax		
Federal Tax		
Total Disposal Cost		

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page __ of __

WORKSHEET 10

WASTE STREAM SUMMARY

EPA

Attribute		Description[1]					
		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[2]							
Priority Rating Criteria[3]	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		$\Sigma(R \times W)$		$\Sigma(R \times W)$		$\Sigma(R \times W)$	
Priority Rank							

Notes: 1. Stream numbers, if applicable, should correspond to those used on process flow diagrams.

2. For example, sanitary landfill, hazardous waste landfill, onsite recycle, incineration, combustion with heat recovery, distillation, dewatering, etc.

3. Rate each stream in each category on a scale from 0 (none) to 10 (high).

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____	Proc. Unit/Oper. ____	Checked By ____
Date ____	Proj. No. ____	Sheet 1 of 1 Page ___ of ___

WORKSHEET 11

OPTION GENERATION

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

Meeting Coordinator ____

Meeting Participants ____

List Suggested Options	Rationale/Remarks on Option

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET 12

OPTION DESCRIPTION

EPA

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** ___ **Material reused for original purpose**

___ **Offsite** ___ **Material used for a lower-quality purpose**

___ **Material sold**

___ **Material burned for heat recovery**

Originally proposed by: ______ **Date:** ______

Reviewed by: ______ **Date:** ______

Approved for study? ______ **yes** ______ **no, by:** ______

Reason for Acceptance or Rejection ______

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page 1 of 1

WORKSHEET 13

OPTIONS EVALUATION BY WEIGHTED SUM METHOD

EPA

Criteria	Weight (W)	Options Rating (R)									
		#1 Option ______		#2 Option ______		#3 Option ______		#4 Option ______		#5 Option ______	
		R	R x W	R	R x W	R	R x W	R	R x W	R	R x W
Reduction in waste's hazard											
Reduction of treatment/disposal costs											
Reduction of safety hazards											
Reduction of input material costs											
Extent of current use in industry											
Effect on product quality (no effect = 10)											
Low capital cost											
Low O & M cost											
Short implementation period											
Ease of implementation											
Final Evaluation: Sum of Weighted Ratings Σ (W x R)											
Final Evaluation: Option Ranking											
Feasibility Analysis Scheduled for (Date)											

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 6 Page ___ of ___

WORKSHEET 14a

TECHNICAL FEASIBILITY

EPA

WM Option Description ______

1. Nature of WM Option

☐ **Equipment-Related**
☐ **Personnel/Procedure-Related**
☐ **Materials-Related**

2. If the option appears technically feasible, state your rationale for this. ______

______

______

Is further analysis required? ☐ Yes ☐ No. If yes, continue with this worksheet. If not, skip to worksheet 15.

3. Equipment - Related Option

	YES	NO	
Equipment available commercially?	☐	☐	______
Demonstrated commercially?	☐	☐	______
In similar application?	☐	☐	______
Successfully?	☐	☐	______

Describe closest industrial analog ______

______

______

Describe status of development ______

______

______

Prospective Vendor	Working Installation(s)	Contact Person(s)	Date Contacted 1.

1. **Also attach filled out phone conversation notes, installation visit report, etc.**

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 2 of 6 Page ___ of ___

WORKSHEET 14b

TECHNICAL FEASIBILITY

(continued)

EPA

WM Option Description ______

3. Equipment-Related Option (continued)

Performance information required (describe parameters): ______

Scaleup information required (describe): ______

Testing Required: ☐ yes ☐ no

Scale: ☐ bench ☐ pilot ☐ ______

Test unit available? ☐ yes ☐ no ______

Test Parameters (list) ______

Number of test runs: ______

Amount of material(s) required: ______

Testing to be conducted: ☐ in-plant ☐ ______

Facility/Product Constraints:

Space Requirements ______

Possible locations within facility ______

WORKSHEET **14c**

TECHNICAL FEASIBILITY

(continued)

EPA

WM Option Description ______

2. Equipment-Related Option (continued)

Utility Requirements:

Electric Power Volts (AC or DC) ______ kW ______

Process Water Flow ______ Pressure ______

Quality (tap, demin, etc.) ______

Cooling Water Flow ______ Pressure ______

Temp. In ______ Temp. Out ______

Coolant/Heat Transfer Fluid ______

Temp. In ______ Temp. Out ______

Duty ______

Steam Pressure ______ Temp. ______

Duty ______ Flow ______

Fuel Type ______ Flow ______

Duty ______

Plant Air ______ Flow ______

Inert Gas ______ Flow ______

Estimated delivery time (after award of contract) ______

Estimated installation time ______

Installation dates ______

Estimated production downtime ______

Will production be otherwise affected? Explain the effect and impact on production. ______

Will product quality be affected? Explain the effect on quality. ______

Firm ________	Waste Minimization Assessment	Prepared By ________
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WORKSHEET 14d

TECHNICAL FEASIBILITY

(continued)

EPA

WM Option Description ________

3. Equipment-Related Option (continued)

Will modifications to work flow or production procedures be required? Explain. ________

Operator and maintenance training requirements

Number of people to be trained ________

☐ Onsite

☐ Offsite

Duration of training

Describe catalyst, chemicals, replacement parts, or other supplies required.

Item	Rate or Frequency of Replacement	Supplier, Address

Does the option meet government and company safety and health requirements?

☐ Yes ☐ No Explain ________

How is service handled (maintenance and technical assistance)? Explain ________

What warranties are offered? ________

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____	Proc. Unit/Oper. ____	Checked By ____
Date ____	Proj. No. ____	Sheet 5 of 6 Page __ of __

WORKSHEET 14e

TECHNICAL FEASIBILITY

(continued)

EPA

WM Option Description ____

3. Equipment-Related Option (continued)

Describe any additional storage or material handling requirements. ____

Describe any additional laboratory or analytical requirements. ____

4. Personnel/Procedure-Related Changes

Affected Departments/Areas ____

Training Requirements ____

Operating Instruction Changes. Describe responsible departments. ____

5. Materials-Related Changes (Note: If substantial changes in equipment are required, then handle the option as an equipment-related one.)

	Yes	No
Has the new material been demonstrated commercially?	☐	☐
In a similar application?	☐	☐
Successfully?	☐	☐

Describe closest application. ____

Firm ____________	Waste Minimization Assessment	Prepared By ____________
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Date ____________	Proj. No. ____________	Sheet 6 of 6 Page ___ of ___

WORKSHEET 14f

TECHNICAL FEASIBILITY

(continued)

EPA

WM Option Description ____

4. Materials-Related Changes (continued)

Affected Departments/Areas ____

____

____

____

Will production be affected? Explain the effect and impact on production.

____

____

____

Will product quality be affected? Explain the effect and the impact on product quality.

____

____

____

____

Will additional storage, handling or other ancillary equipment be required? Explain.

____

____

____

Describe any training or procedure changes that are required.

____

____

____

Decribe any material testing program that will be required.

____

____

____

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 6 Page ___ of ___

WORKSHEET 15a

COST INFORMATION

EPA

WM Option Description ______

CAPITAL COSTS - Include all costs as appropriate. | TOTALS

☐ Purchased Process Equipment

- Price (fob factory) ______
- Taxes, freight, insurance ______
- Delivered equipment cost ______
- Price for Initial Spare Parts Inventory ______ | ______

☐ Estimated Materials Cost

- Piping ______
- Electrical ______
- Instruments ______
- Structural ______
- Insulation/Piping ______ | ______

☐ Estimated Costs for Utility Connections and New Utility Systems

- Electricity ______
- Steam ______
- Cooling Water ______
- Process Water ______
- Refrigeration ______
- Fuel (Gas or Oil) ______
- Plant Air ______
- Inert Gas ______ | ______

☐ Estimated Costs for Additional Equipment

- Storage & Material Handling ______
- Laboratory/Analytical ______
- Other ______ | ______

☐ Site Preparation | ______

(Demolition, site clearing, etc.) | ______

☐ Estimated Installation Costs

- Vendor ______
- Contractor ______
- In-house Staff ______ | ______

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____	Proc. Unit/Oper. ____	Checked By ____
Date ____	Proj. No. ____	Sheet 2 of 6 Page ___ of ___

WORKSHEET 15b

COST INFORMATION

(continued)

EPA

CAPITAL COSTS (Cont.) **TOTALS**

☐ **Engineering and Procurement Costs (in-house & outside)**

- **Planning** ____
- **Engineering** ____
- **Procurement** ____
- **Consultants** ____ ____

☐ **Start-up Costs**

- **Vendor** ____
- **Contractor** ____
- **In-house** ____ ____

☐ **Training Costs** ____ ____

☐ **Permitting Costs**

- **Fees** ____
- **In-house Staff Costs** ____ ____

☐ **Initial Charge of Catalysts and Chemicals**

- **Item #1** ____
- **Item #2** ____ ____

☐ **Working Capital** [Raw Materials, Product, Inventory, Materials and Supplies (not elsewhere specified)].

- **Item #1** ____
- **Item #2** ____
- **Item #3** ____
- **Item #4** ____ ____

☐ **Estimated Salvage Value (if any)** ____

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 3 of 6 Page ___ of ___

WORKSHEET **15c**

COST INFORMATION

(continued)

EPA

CAPITAL COST SUMMARY

Cost Item	Cost
Purchased Process Equipment	
Materials	
Utility Connections	
Additional Equipment	
Site Preparation	
Installation	
Engineering and Procurement	
Start-up Cost	
Training Costs	
Permitting Costs	
Initial Charge of Catalysts and Chemicals	
Fixed Capital Investment	
Working Capital	
Total Capital Investment	
Salvage Value	

Firm ______	Waste Minimization Assessment	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 4 of 6 Page ___ of ___

WORKSHEET 15d

COST INFORMATION

(continued)

☐ Estimated Decrease (or Increase) in Utilities

Utility	Unit Cost $ per unit	Decrease (or Increase) in Quantity Unit per time	Total Decrease (or Increase) $ per time
Electricity			
Steam			
Cooling Process			
Process Water			
Refrigeration			
Fuel (Gas or Oil)			
Plant Air			
Inert Air			

INCREMENTAL OPERATING COSTS - Include all relevant operating savings. Estimate these costs on an incremental basis (i.e., as decreases or increases over existing costs).

☐ BASIS FOR COSTS Annual ______ Quarterly ______ Monthly ______ Daily ______ Other ______

☐ Estimated Disposal Cost Saving

Decrease in TSDF Fees ______

Decrease in State Fees and Taxes ______

Decrease in Transportation Costs ______

Decrease in Onsite Treatment and Handling ______

Decrease in Permitting, Reporting and Recordkeeping ______

Total Decrease in Disposal Costs ______

☐ Estimated Decrease in Raw Materials Consumption

Materials	Unit Cost $ per unit	Reduction in Quantity Units per time	Decrease in Cost $ per time

Firm ____	Waste Minimization Assessment	Prepared By ____
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Date ____	Proj. No. ____	Sheet 5 of 6 Page __ of __

WORKSHEET
15e

COST INFORMATION
(continued)

EPA

☐ **Estimated Decrease (or Increase) in Ancillary Catalysts and Chemicals**

Catalyst/Chemical	Unit Cost $ per unit	Decrease (or Increase) in Quantity Unit per time	Total Decrease (or Increase) $ per time

☐ **Estimated Decrease (or Increase) in Operating Costs and Maintenance Labor Costs (Include cost of supervision, benefits and burden).**

☐ **Estimated Decrease (or Increase) in Operating and Maintenance Supplies and Costs.**

☐ **Estimated Decrease (or Increase) in Insurance and Liability Costs (explain).**

☐ **Estimated Decrease (or Increase) in Other Operating Costs (explain).**

INCREMENTAL REVENUES

☐ **Estimated Incremental Revenues from an Increase (or Decrease) in Production or Marketable By-products (explain).**

Firm ______	**Waste Minimization Assessment**	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 6 of 6 Page __ of __

WORKSHEET 15 f

COST INFORMATION

(continued)

EPA

INCREMENTAL OPERATING COST AND REVENUE SUMMARY (ANNUAL BASIS)

Decreases in Operating Cost or Increases in Revenue are Positive.
Increases in Operating Cost or Decrease in Revenue are Negative.

Operating Cost/Revenue Item	$ per year
Decrease in Disposal Cost	
Decrease in Raw Materials Cost	
Decrease (or Increase) in Utilities Cost	
Decrease (or Increase) in Catalysts and Chemicals	
Decrease (or Increase) in O & M Labor Costs	
Decrease (or Increase) in O & M Supplies Costs	
Decrease (or Increase) in Insurance/Liabilities Costs	
Decrease (or Increase) in Other Operating Costs	
Incremental Revenues from Increased (Decreased) Production	
Incremental Revenues from Marketable By-products	
Net Operating Cost Savings	

Firm ______	**Waste Minimization Assessment**	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET
16

PROFITABILITY WORKSHEET # 1
PAYBACK PERIOD

EPA

Total Capital Investment ($) (from Worksheet 15c) ______

Annual Net Operating Cost Savings ($ per year) (from Worksheet 15f) ______

$$\textbf{Payback Period (in years)} = \frac{\textbf{Total Capital Investment}}{\textbf{Annual Net Operating Cost Savings}} = \underline{\qquad\qquad}$$

Firm ____________	Waste Minimization Assessment	Prepared By ____________
Site ____________	Proc. Unit/Oper. ____________	Checked By ____________
Date ____________	Proj. No. ____________	Sheet 1 of 1 Page ___ of ___

WORKSHEET **17**

PROFITABILITY WORKSHEET #2
CASH FLOW FOR NPV, IRR

EPA

Cash incomes (such as net operating cost savings and salvage value) are shown as positive. Cash outlays (such as capital investments and increased operating costs) are shown as negative.

Line		Constr. Year 0	Operating[1] Year 1	2	3	4	5	6	7	8
A	Fixed Capital Investment									
B	+ Working Capital									
C	Total Capital Investment									
D	Salvage Value[2]									
E	Net Operating Costs Savings									
F	- Interest on Loans									
G	- Depreciation									
H	Taxable Income									
I	- Income Tax[3]									
J	Aftertax Profit[3]									
K	+ Depreciation									
L	- Repayment of Loan Principal									
M	- Capital Investment (line C)									
N	+ Salvage Value (line D)									
O	Cash Flow									
P	Present Value of Cash Flow[4]									
Q	Net Present Value (NPV)[5]									
	Present Worth[6] (5% discount)	1.0000	0.9524	0.9070	0.8638	0.8227	0.7835	0.7462	0.7107	0.6768
	(10% discount)	1.0000	0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665
	(15% discount)	1.0000	0.8696	0.7561	0.6575	0.5718	0.4972	0.4323	0.3759	0.3269
	(20% discount)	1.0000	0.8333	0.6944	0.5787	0.4823	0.4019	0.3349	0.2791	0.2326
	(25% discount)	1.0000	0.8000	0.6400	0.5120	0.4096	0.3277	0.2621	0.2097	0.1678

1 Adjust table as necessary if the anticipated project life is less than or more than 8 years.
2 Salvage value includes scrap value of equipment plus sale of working capital minus demolition costs.
3. The worksheet is used for calculating an aftertax cash flow. For pretax cash flow, use an income tax rate of 0%.
4 The present value of the cash flow is equal to the cash flow multiplied by the present worth factor.
5 The net present value is the sum of the present value of the cash flow for that year and all of the preceeding years.
6 The formula for the present worth factor is $\frac{1}{(1+r)^n}$ where n is years and r is the discount rate.
7 The internal rate of return (IRR) is the discount rate (r) that results in a net present value of zero over the life of the project.

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____	Proc. Unit/Oper. ____	Checked By ____
Date ____	Proj. No. ____	Sheet 1 of 1 Page ___ of ___

WORKSHEET 18

PROJECT SUMMARY

EPA

Goals/Objectives ____

Task	Deliverable	Task Leader	Manhours	Budget	Duration			Reference
					Wks	Start	Finish	
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13.								
14.								
15.								
16.								
17.								
18.								
19.								
20.								
21.								
22.								
23.								
		TOTALS						

Approval By ____ Date ____

Authorization By ____ Date ____

Project Started (Date) ____

Firm ____________	Waste Minimization Assessment	Prepared By ____________
Site ____________	Proc. Unit/Oper. ____________	Checked By ____________
Date ____________	Proj. No. ____________	Sheet 1 of 1 Page ___ of ___

WORKSHEET 19

OPTION PERFORMANCE

EPA

WM Option Description ____________________

☐ Baseline (without option) ☐ Projected ☐ Actual

(a) Period Duration ____________ From ____________ To ____________

(b) Production per Period ____________ Units (____________)

(c) Input Materials Consumption per Period

Material	Pounds	Pounds/Unit Product

(d) Waste Generation per Period

Waste Stream	Pounds	Pounds/Unit Product

(e) Substance(s) of Concern - Generation Rate per Period

Waste Stream	Substance	Pounds	Pounds/Unit Product

Appendix B
Simplified Waste Minimization Assessment Worksheets

The worksheets that follow are designed to facilitate a simplified WM assessment procedure. Table B-1lists the worksheets, according to the particular phase of the program, and a brief description of the purpose of the worksheets. The worksheets here are presented as supporting only a preliminary effort at minimizing waste, or in a situation where a more formal rigorous assessment is not warranted.

Table B-1. List of Simplified WM Assessment Worksheets

Phase	Number and Title	Purpose/Remarks
	S1. Assessment Overview	Summarizes the overall assessment procedure.
Assessment Phase (Section 3)		
	S2. Site Description	Lists background information about the facility, including location, products, and operations.
	S3. Process Information	This is a checklist of useful process information to look for before starting the assessment.
	S4. Input Materials Summary	Records input material information for a specific production or process area. This includes name, supplier, hazardous component or properties, cost, delivery and shelf-life information, and possible substitutes.
	S5. Products Summary	Identifies hazardous components, production rate, revenues, and other information about products.
	S6. Waste Stream Summary	Summarizes all of the information collected for each waste stream. This sheet is also used to prioritize waste streams to assess.
	S7. Option Generation	Records options proposed during brainstorming or nominal group technique sessions. Includes the rationale for proposing each option.
	S8. Option Description	Describes and summarizes information about a proposed option. Also notes approval of promising options.
Feasibility Analysis Phase (Section 4)		
	S9. Profitability	This worksheet is used to identify capital and operating costs and to calculate the payback period.

Firm ______	**Waste Minimization Assessment Simplified Worksheets**	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET **S1**

ASSESSMENT OVERVIEW

EPA

Begin the Waste Minimization Assessment Program

↓

<u>**Worksheets used**</u>

PLANNING AND ORGANIZATION

- Get management commitment
- Set overall assessment program goals
- Organize assessment program task force

↓ Assessment organization and commitment to proceed

ASSESSMENT PHASE

• Compile process and facility data	S5
• Prioritize and select assessment targets	S2,S3,S4
• Select people for assessment teams	S6
• Review data and inspect site	S7,S8
• Generate options	S8
• Screen and select options for further study	S8

↓ Assessment report of selected options

FEASIBILITY ANALYSIS PHASE

• Technical evaluation	
• Economic evaluation	S9
• Select options for implementation	

↓ Final report, including recommended options

IMPLEMENTATION

- Justify projects and obtain funding
- Installation (equipment)
- Implementation (procedure)
- Evaluate performance

Repeat the process → Select new assessment targets and reevaluate previous options → ASSESSMENT PHASE

↓

Successfully operating waste minimization projects

Firm ____ Site ____ Date ____	**Waste Minimization Assessment Simplified Worksheets** Proj. No. ____	Prepared By ____ Checked By ____ Sheet 1 of 1 Page ___ of ___

WORKSHEET **S2**

SITE DESCRIPTION

EPA

Firm:

Plant:

Department:

Area:

Street Address:

City:

State/ZIP Code:

Telephone: (   )

Major Products:

SIC Codes:

EPA Generator Number :

Major Unit or:

Product or:

Operations:

Facilities/Equipment Age:

Firm ______	**Waste Minimization Assessment Simplified Worksheets**	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET S3

PROCESS INFORMATION

EPA

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 & 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						

Firm ____________	Waste Minimization Assessment Simplified Worksheets	Prepared By ____________
Site ____________		Checked By ____________
Date ____________	Proj. No. ____________	Sheet 1 of 1 Page __ of __

WORKSHEET **S4**

INPUT MATERIALS SUMMARY

EPA

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)			

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.

Firm ________________	**Waste Minimization Assessment Simplified Worksheets**	Prepared By ________________
Site ________________		Checked By ________________
Date ________________	Proj. No. ________________	Sheet 1 of 1 Page ___ of ___

WORKSHEET S5

PRODUCTS SUMMARY

EPA

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)			

Firm ____	Waste Minimization Assessment Simplified Worksheets	Prepared By ____
Site ____	Proc. Unit/Oper. ____	Checked By ____
Date ____	Proj. No. ____	Sheet 1 of 1 Page __ of __

WORKSHEET S6

WASTE STREAM SUMMARY

EPA

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		$\Sigma(R \times W)$		$\Sigma(R \times W)$		$\Sigma(R \times W)$	
Priority Rank							

Notes: 1. For example, sanitary landfill, hazardous waste landfill, onsite 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 ____	Waste Minimization Assessment Simplified Worksheets	Prepared By ____
Site ____	Proc. Unit/Oper. ____	Checked By ____
Date ____	Proj. No. ____	Sheet 1 of 1 Page ___ of ___

WORKSHEET
S7

OPTION GENERATION

EPA

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

Meeting Coordinator ____

Meeting Participants ____

List Suggested Options	Rationale/Remarks on Option

Firm ______	**Waste Minimization Assessment Simplified Worksheets**	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET S8

OPTION DESCRIPTION

EPA

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**
- ___ **Material burned for heat recovery**

Originally proposed by: ______ **Date:** ______

Reviewed by: ______ **Date:** ______

Approved for study? ______ **yes** ______ **no, by:** ______

Reason for Acceptance or Rejection ______

Firm ______	**Waste Minimization Assessment Simplified Worksheets**	Prepared By ______
Site ______	Proc. Unit/Oper. ______	Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET S9

PROFITABILITY

EPA

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 ______

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

APPENDIX A

GENERAL CONSIDERATIONS FOR PRIORITIZING THE ASSESSMENT OF WASTE STREAMS

- Costs savings (direct and indirect)
- Potential for (or ease of) minimization
- Potential recovery of valuable by-products
- Reduced quantity of waste
- Compliance with current and future regulations
- Hazardous properties of the waste (including toxicity, flammability, corrosivity, and reactivity)
- Other safety hazards to employees
- Potential environmental and safety liability/improvements
- Potential for removing bottlenecks in production or waste treatment

APPENDIX B

SOURCES OF MATERIAL BALANCE INFORMATION

Listed below are potential sources of information for preparing a process description, flow diagram or material balance inventory. The list is not meant to be exclusive.

- Process Expert Knowledge
- Operating Logs
- On-site Tracking Systems
- Purchasing Records
- Vendor Information
- Process Design Information
- Batch Makeup Records
- Emission Inventories
- Equipment Cleaning and Validation Procedures
- Material & Chemical Inventories
- Operating Procedures and Manuals
- Production Records
- Product Specifications
- Samples, Analyses, and Flow Measurements
- Waste Disposal Records
- Waste Manifests
- E S & H reports
- Permitting Applications
- Experiments
- Laboratory Notebooks

APPENDIX C

LEVEL I EXAMPLE PPOA

SNL/NM Organization: 7813-5 Process Name: Asbestos Brakes & Clutch Removal

DATA FORM 1

DESCRIPTION OF PROCESS/OPERATIONS

Process Location: Area I,II,III,IV,V & Remote Area SNL-Albuquerque NM/SNL-Livermore CA./TTR-Las Vagas NV./KTF-Kauai
(include site, TA, building, room, as appropriate)

Describe the general operations or activities of the organization performing the process. Continue on the back of this sheet, if necessary.

The Crane and Hoist section is responsible for performing annual Inspections, Repairs, and Preventative Maintenance on Cranes and Hoists.

Describe the particular process that generates wastes and/or other pollutants, or uses hazardous materials. Describe how the hazardous materials are used, and how the wastes or pollutants are generated. (See Chapter 2 of the PWA Guidance Manual for guidelines on defining a process.) Continue on the back of this sheet, if necessary.

Asbestos Brakes and Clutches are generated waste in this process.

Asbestos Brakes and Clutches becomes a generated waste when the Asbestos Brakes and Clutches are removed and replaced with Non-Asbestos Brakes and Clutches.

Date: 7/22/93 Prepared by (MinNet Rep): Bernard Alexander Phone: 4-1365
PWA #: Process Contact: Bernard Alexander Phone: 4-1365
(to be completed by WMSC)

PROCESS DEFINITION

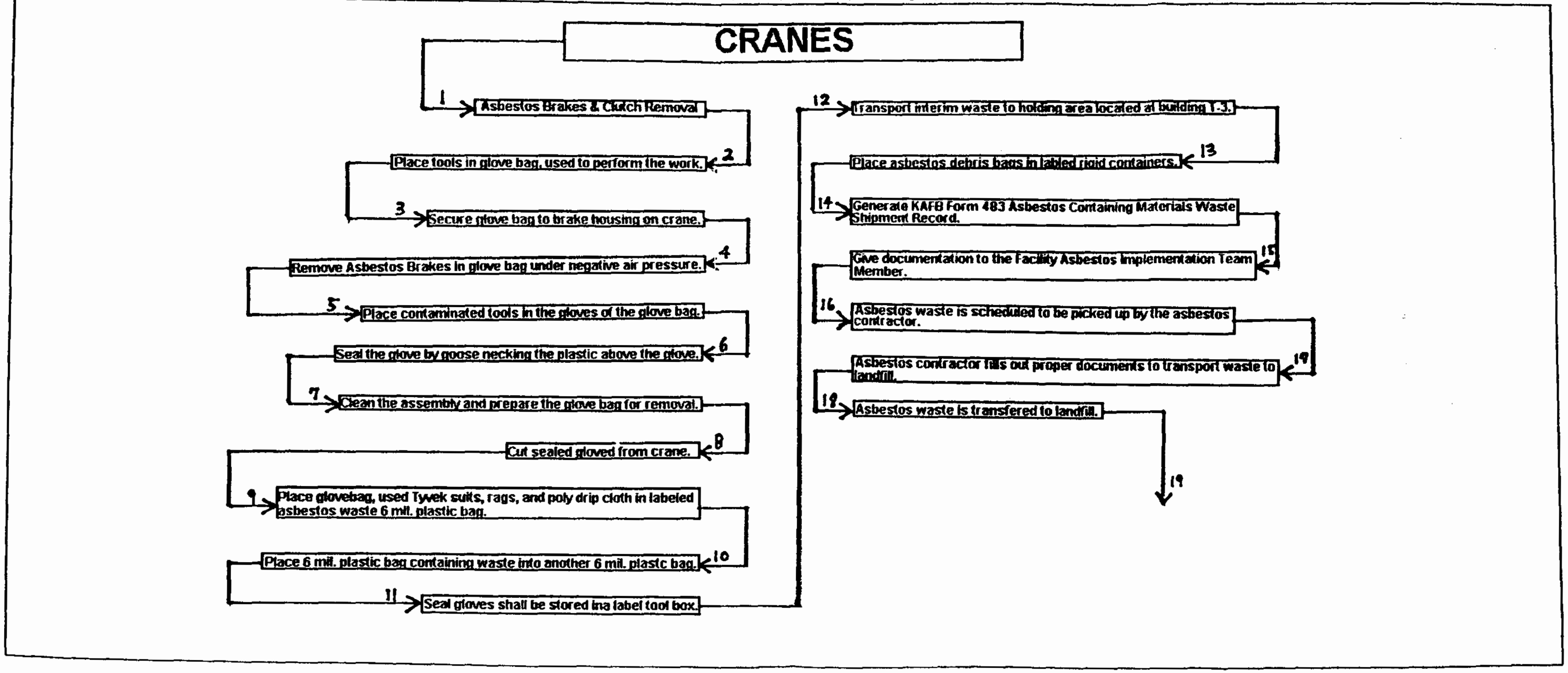
SNL/NM Organization: 7813-5 Process Name: Asbestos Brakes & Clutch Removal

Process Location: Remote Areas Area I,II,III,IV,V/TTR-Las Vegas NV./KTF-Kauai SNL-Albuquerque NM/SNL-Livermore CA.
(include site, TA, building, room, as appropriate)

DATA FORM 2

PROCESS FLOW DIAGRAM

Sketch a flow diagram of the process. Show subprocesses with materials entering the process, as well as products, materials, wastes, and other pollutants generated by the process. Show the sources of the input and destinations of the output materials.



Use additional sheets if necessary.

Date: 7/22/93
PWA #:
(to be completed by WMSC)

Prepared by (MinNet Rep): Bernard Alexander Phone: 4-1365
Process Contact: Bernard Alexander Phone: 4-1365

SNL/NM Organization: 7813-5 Process Name: Asbestos Brakes and Clutches Removal

DATA FORM 3

CALENDAR YEAR 1992 WASTE MINIMIZATION ACTIVITIES

Process Location: Area I,II,III,IV,V, & Remote Areas SNL-Albuquerque NM/SNL-Livermore CA./TTR-Las Vegas NV./KTF-Kauai
(include site, TA, building, room, as appropriate)

Have waste minimization (WM) activities been undertaken in CY92? ☒ Yes ☐ No

If No, briefly discuss factors that have prevented waste minimization activities:

If Yes, short name of WM activity (e.g., Increase Input Purity, Improve Rinse Process) (use other sheets if more than one activity taken): Removing and disposing of a hazardous material.

Type of WM activity (check best one that applies):

Source Reduction
- ☒ Good Operating Practice
- ☐ Inventory Control
- ☐ Spill and Leaks Prevention
- ☐ Raw Material Modification
- ☐ Production Modification
- ☐ Process Modification (Clean and Degreasing)
- ☐ Process Modification (Surface Prep and Finish)
- ☐ Process Modification (Other)
- ☐ Other (specify below)

Recycling
- ☐ Began Onsite Recycling
- ☐ Began Offsite Recycling
- ☐ Reuse in Original Process
- ☐ Reuse in Another Process

Energy Recovery
- ☐ Began Onsite Energy Recovery
- ☐ Began Offsite Energy Recovery

Treatment
- ☐ Began Onsite Treatment
- ☐ Began Offsite Treatment

Briefly describe WM activity: Removal of Asbestos Brakes and Clutches to be replace with a non-asbestos material.

Date: 7/22/93 Prepared by (MinNet Rep): Bernard Alexander Phone: 4-1365
PWA #: Process Contact: Bernard Alexander Phone: 4-1365
(to be completed by WMSC)

SNL/NM Organization: 7813-5 Process Name: Asbestos Brakes and Clutches Removal

DATA FORM 3

FISCAL YEAR 1992 WASTE MINIMIZATION ACTIVITIES

Waste stream type affected: ☒ Hazardous (Chemical) Solid Waste ☐ Waste Water Discharge
☐ Radioactive/Mixed Solid Waste ☐ Air Emission

Waste stream name affected (see corresponding Data Form 2): Asbestos Brakes and Clutches

Did WM activity increase the toxicity of waste generated? ☐ Yes ☒ No

Did WM activity increase the quantity or toxicity of wastes emitted to other media (air, waste, land)?
☐ Yes ☒ No

Did WM activity reduce toxicity but not quantity? ☒ Yes ☐ No

Indicate the quantity impact of the WM activity (use most appropriate measure):

Mass before WM activity (kg/yr): ________ Mass after WM activity (kg/yr): ________
Volume before WM activity (ℓ/yr): ________ Volume after WM activity (ℓ/yr): ________
Specific activity before WM activity (Ci/kg/yr): ________ Specific activity after WM activity (Ci/kg/yr): ________

Basis of quantities (e.g., direct measurement, material balance calculation, published emission factors, engineering calculations, engineering/scientific judgment): ________

Has the WM activity been successful? ☒ Yes ☐ No
Is the activity still being used? ☒ Yes ☐ No

If unsuccessful or otherwise not being used, describe why: ________

Date: 7/22/93 Prepared by (MinNet Rep): Bernard Alexander Phone: 4-1365
PWA #: ________ Process Contact: Bernard Alexander Phone: 4-1365
(to be completed by WMSC)

PROCESS CHARACTERIZATION

SNL/NM Organization: 7813-5 Process Name: Asbestos Brakes and Clutches

DATA FORM 4

HAZARDOUS/RADIOACTIVE MATERIAL INPUTS

Name of Hazardous/Radioactive Material	Input Stream Number	Predicted Frequency of Usage[1]	Average Annual Usage Rate (kg/yr)
Asbestos	1		
Glove Bag	2		
Tyvek Suits,Rags,Drip Cloth	9		

[1]Indicate usage as Continuously (C), Daily (D), Weekly (W), Monthly (M), Quarterly (Q), or Annually (A)

Date: 7/22/93 Prepared by (MinNet Rep): Bernard Alexander Phone: 4-1365

PWA #: ____ Process Contact: Bernard Alexander Phone: 4-1365

(to be completed by WMSC)

SNL/NM Organization: 7813-5 Process Name: Asbestos Brakes and Clutches

DATA FORM 5

HAZARDOUS (CHEMICAL) SOLID WASTE

Waste Stream Number (from Worksheet 1): 1,2,9,10

Waste Stream Name (from Data Form 2/Worksheet 1): Asbestos,tyvk suits,rags,drip cloth, plastic bag

Location of waste generation (TA, building, room): SNL-Alb/SNL-CA/TTR-NV/KTF-Kauai

Inside RMMA? ☐ Yes ☒ No

Briefly describe how waste is generated: Asbestos Brakes and Clutches are removed and replaced with non-asbestos material. Glove bages,tyvek suits rags, and drip cloth are used in th removal process to remove the generated waste.

Frequency of waste generation: ☐ Continuously ☐ Daily ☐ Weekly ☒ Monthly ☐ Quarterly ☐ Annually

Which description fits the process step that generates the waste (check best one):

☒ A regularly scheduled process step that is likely to be repeated several times during the upcoming year.

☐ A one-time activity that is not likely to be repeated during the upcoming year.

Predicted average quantity of waste generated annually – normal operations (kg): 200 lbs.

Predicted min/max quantity generated annually – normal operations (kg): Min ______ Max ______

List (describe) all hazardous constituents (e.g., mercury inside switches, benzene-tainted glassware) or brand names (e.g., WD-40) that could be in the waste:

Asbestos

Do the hazardous constituents of the waste stream listed above vary (e.g., sometimes contains lead, sometimes contains lead and cadmium)? ☐ Yes ☒ No If yes, describe how the waste varies:

Describe physical characteristics of wastes (e.g., aqueous solution, solid, sludge, oil, containerized compressed gas - include % of solids or % moisture, if applicable): Solid

Date: 7/22/92 Prepared by (MinNet Rep): Bernard Alexander Phone: 4-1365

PWA #: ______ Process Contact: Bernard Alexander Phone: 4-1365

(to be completed by WMSC)

SNL/NM Organization: 7813-5 Process Name: Asbestos Brakes and Clutches

DATA FORM 5

HAZARDOUS (CHEMICAL) SOLID WASTE

The pH of the waste stream may range from N/A to N/A (answer if appropriate)

Is the waste ignitable? (see Guidance Manual for clarification) ☐ Yes ☒ No ☐ Unknown
Is the waste corrosive? (see Guidance Manual for clarification) ☐ Yes ☒ No ☐ Unknown
Is the waste reactive? (see Guidance Manual for clarification) ☐ Yes ☒ No ☐ Unknown

Does the waste stream contain any of the following toxic metals: ☐ Yes ☒ No (check all that apply)

☐ Arsenic ☐ Barium ☐ Cadmium ☐ Chromium
☐ Lead ☐ Mercury ☐ Selenium ☐ Silver

Does the waste stream contain a toxic volatile, semi-volatile, or pesticide listed in Table 3-2?
☐ Yes ☒ No If yes, list:

Does the waste stream contain any of the spent solvents listed in Table 3-3? ☐ Yes ☒ No
If yes, list:

Does the waste stream contain, or is it generated from the production of, any of the following benzene derivatives? ☐ Yes ☒ No (check all that apply)

☐ trichlorophenol ☐ tetrachlorobenzene
☐ tetrachlorophenol ☐ pentachlorobenzene
☐ pentachlorophenol ☐ hexachlorobenzene

Is the waste any of the following? ☐ Yes ☒ No (check all that apply)

☐ waste water treatment sludge ☐ wood preserving process waste
☐ petroleum refining waste ☐ leachate from treatment, storage, or disposal of waste

Does the waste contain cyanide or is cyanide used in the process? ☐ Yes ☒ No

Is the waste any of the following? ☐ Yes ☒ No (check all that apply)

☐ waste from the production of inorganic pigments ☐ waste from the production of pesticides
☐ waste from the production of inorganic chemicals ☐ waste from the production of metals
☐ waste from the production of organic chemicals ☐ waste from the production of pharmaceuticals
☐ waste from the production of explosives ☐ coking waste
☐ waste from the production of ink formulations ☐ petroleum refining waste

Date: 7/22/93 Prepared by (MinNet Rep): Bernard Alexander Phone: 4-1365
PWA #: Process Contact: Bernard Alexander Phone: 4-1365
(to be completed by WMSC)

SNL/NM Organization: 7813-5 Process Name: Asbestos Brakesand Clutches

DATA FORM 5

HAZARDOUS (CHEMICAL) SOLID WASTE

Based on the above description of how the waste is generated, select the <u>single best</u> summary of the waste-generating process step.

CLEANING AND DEGREASING

- ☐ Stripping (A01)
- ☐ Acid cleaning ((A02)
- ☐ Caustic (Alkali) cleaning (A03)
- ☐ Flush rinsing (A04)
- ☐ Dip rinsing (A05)
- ☐ Spray rinsing (A06)
- ☐ Vapor degreasing (A07)
- ☐ Physical scraping and removal (A08)
- ☐ Clean out process equipment (A09)
- ☐ Other cleaning and degreasing (A19)

SURFACE PREPARATION AND FINISHING

- ☐ Painting (A21)
- ☐ Electroplating (A22)
- ☐ Electroless plating (A23)
- ☐ Phosphating (A24)
- ☐ Heat treating (A25)
- ☐ Pickling (A26)
- ☐ Etching (A27)
- ☐ Other surface coating/preparation (A29)

PROCESSES OTHER THAN SURFACE PREPARATION

- ☐ Product rinsing (A31)
- ☐ Product filtering (A32)
- ☐ Product distillation (A33)
- ☐ Product solvent extraction (A34)
- ☐ By-product processing (A35)
- ☐ Spent catalyst removal (A36)
- ☐ Spent process liquids removal (A38)
- ☐ Tank sludge removal (A38)
- ☐ Slag removal (A39)
- ☐ Metal forming (A40)
- ☐ Plastics forming (A41)

PRODUCTION OR SERVICE DERIVED ONE-TIME AND INTERMITTENT PROCESSES

- ☐ Leak collection (A51)
- ☐ Cleanup of spill residues (A53)
- ☐ Oil changes (A54)
- ☐ Filter/battery replacement (A55)
- ☐ Discontinue use of process equipment (A56)
- ☒ Discarding off-spec material (A57)
- ☐ Discarding out-of-date products or chemicals (A58)
- ☐ Other production-derived on-time and intermittent processes (A59)
- ☐ Sludge removal (A60)

REMEDIATION DERIVED WASTE

- ☐ Superfund Remedial Action (A61)
- ☐ Superfund Emergency Response (A62)
- ☐ RCRA Corrective Action at solid waste management unit (A63)
- ☐ RCRA closure of hazardous waste management unit (A64)
- ☐ Underground storage tank cleanup (A65)
- ☐ Other remediation (A69)

POLLUTION CONTROL OR WASTE TREATMENT PROCESSES

- ☐ Filtering/screening (A71)
- ☐ Metals recovery (A72)
- ☐ Solvents recovery (A73)
- ☐ Incineration/thermal treatment (A74)
- ☐ Wastewater treatment (A75)
- ☐ Sludge dewatering (A76)
- ☐ Stabilization (A77)
- ☐ Air pollution control devices (A78)
- ☐ Leachate collection (A79)
- ☐ Other pollution control or waste treatment (A89)

OTHER PROCESSES

- ☒ Clothing and personal protective equipment (A91)
- ☒ Routine cleanup wastes (e.g., floor sweepings) (A92)
- ☐ Closure of hazardous waste management unit(s) or equipment other than by remediation (A93)
- ☐ Laboratory wastes (A94)
- ☐ Other (A99)

Date: 7/22/93 Prepared by (MinNet Rep): Bernard Alexander Phone: 4-1365

PWA #: ______ Process Contact: Bernard Alexander Phone: 4-1365

(to be completed by WMSC)

APPENDIX D

PPOA GRADED APPROACH WEIGHTED SUMS FORM, CRITERIA, AND INSTRUCTIONS

Date: ________

Page ______ of ________

Pollution Prevention Opportunity Assessment Graded Approach

Weighted Sums Evaluation

Evaluation Criteria	Weight 'W'	Process:		Process:		Process:		Process:		Process:	
		Scale 'S'	'WxS'	Scale 'S'	'WxS'	Scale 'S'	'WxS'	Scale 'S'	'WxS'	Scale 'S'	'WxS'
Environmental, Safety, & Health Hazards	Site Assigns										
Quantity of Waste Generated	" "										
Site Liabilities	" "										
Economic Factors - Process & Waste Costs (Unit &/or Annual)	"										
Process By-Product Management	" "										
Other											
Subtotal											
WMin/PP Potential Multiplier		x		x		x		x		x	
Total											
PPOA Level											

Date: ______

Page ______ of ______

Pollution Prevention Opportunity Assessment Graded Approach

Weighted Sums Evaluation

Evaluation Criteria	Weight 'W'	Process: ______ Scale 'S'	'WxS'	Process: ______ Scale 'S'	'WxS'	Process: ______ Scale 'S'	'WxS'	Process: ______ Scale 'S'	'WxS'	Process: ______ Scale 'S'	'WxS'
Environmental, Safety, & Health Hazards	Site Assigns										
Quantity of Waste Generated	" "										
Site Liabilities	" "										
Economic Factors - Process & Waste Costs (Unit &/or Annual)	"										
Process By-Product Management	" "										
Other											
Subtotal											
WMin/PP Potential Multiplier		x		x		x		x		x	
Total											
PPOA Level											

8/93

Graded Approach Worksheet

The purpose of this worksheet is to determine the PPOA level for each of the facility processes. To begin, a list of these processes or areas should be generated for each facility. Then for each item listed, complete one column on this worksheet. For consistency, each facility should establish site-specific weights for each of the criteria. Once each item has received a weighted sum value, then each facility should establish the dividing line from which to require informal (Level II) or formal PPOAs (Level III).

Weighted Sums Instructions:

a. The values in the Weight column (designated by 'W') represent the facility's priority for the criteria.

b. In the Scale column for each process (designated by 'S'), rate each criteria by assigning a value from 0-10 (lowest to highest).

c. In the 'W x S' column for each process, enter the product of the weight and scale.

d. Sum the 'W x S' column for each process to obtain a subtotal.

e. Calculate the process ratio for waste generated/input material used (0 - 1). This is the multiplier.

f. Multiply the subtotal by the multiplier and enter the product in the Total column for each process.

g. Determine the level of PPOA required by comparing the Total weighted sums value with the site guidelines in the following table.

Weighted Sums Total	PPOA Level Required
If 0 to (?)	Level II Informal PPOA
If ≥ (?)	Level III Formal PPOA

APPENDIX E

LEVEL II EXAMPLE PPOA

PPOA-1

Original Issue Date: 8/31/91
Revision No.:
Revision Date:

Pollution Prevention Opportunity Assessment

Team & Scope

Assessment ID Code: SNL/CA MS001

Assessment Title: Machine and Fabrication Shop

Name	Job Classification	Phone
* Alice Johnson-Duarte	WMin Coordinator	4-3266
Andy Cardiel	Shop Supervisor	4-2544
Charlie Schmitz	Machinist	4-2315
Kim Shepodd	Waste Manager	4-1475

* Team Leader

Assessment Scope:

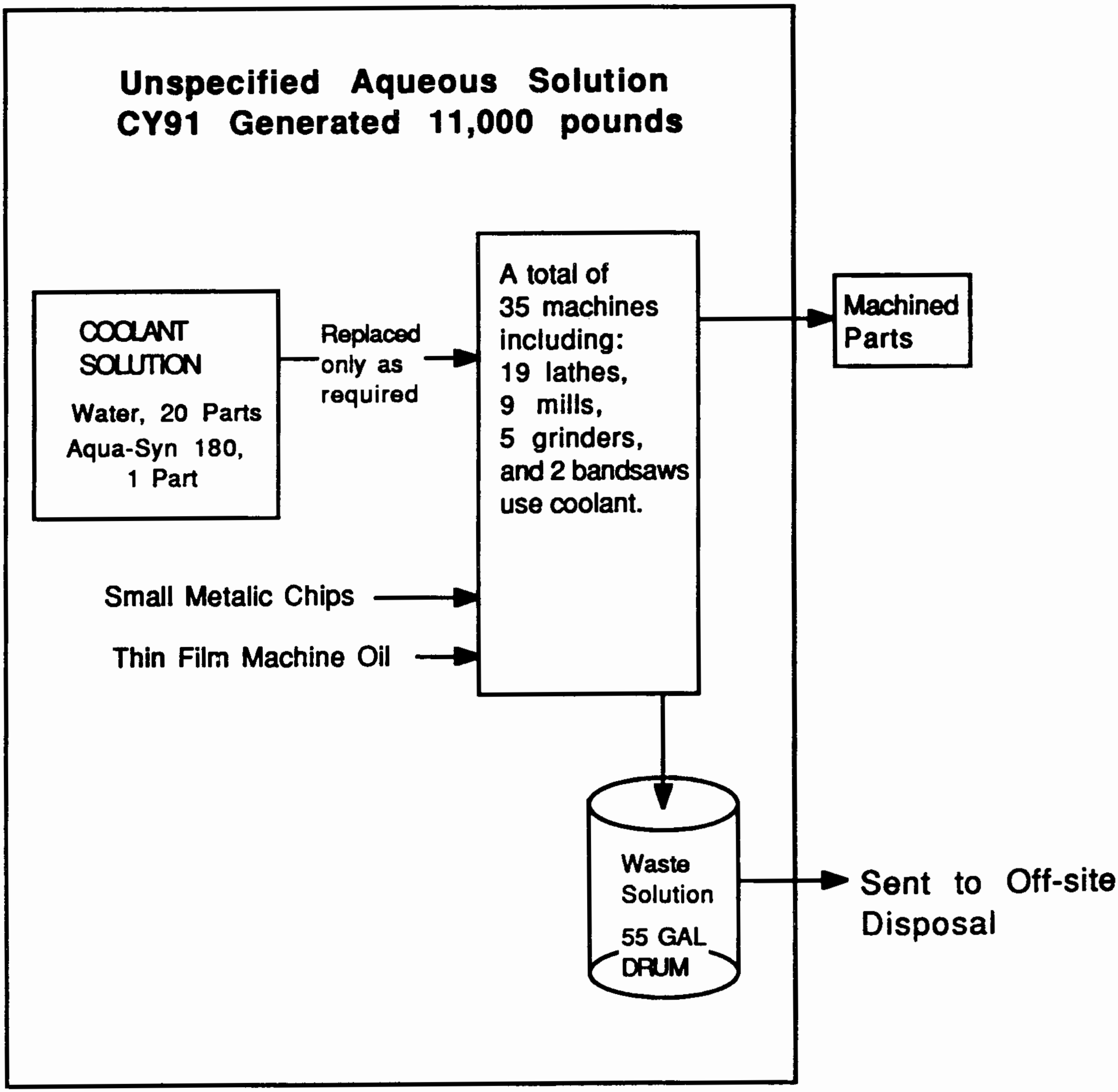
The Machining and Fabrication Shop is a support function whose principal purpose is machining parts requiring a quick turn-around, restriction of access due to classification, and/or close liaison with the designer and engineer. The shop maintains equipment suitable to perform turning, milling and grinding operations. The major hazardous waste stream generated by this facility is the spent coolant used in the machining process. The diluted Aqua-Syn 180 itself is a non-hazardous material per 29CFR 1910.1200(c); however, in the machining process it is mixed with small amounts of machine oil and metal shavings. The coolant is routinely changed after 3 to 4 months of service except as noted in the shop's operating procedures.

Potential for Pollution Prevention / Waste Minimization or Recommendations:

There are limited operational and administrative pollution prevention opportunities to reduce the spent coolant waste.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT
PROCESS FLOW DIAGRAM

PWA ASSESSMENT ID CODE: SNL/CA MS001
TITLE: Machine and Fabrication Shop



PPOA-2

Pollution Prevention Opportunity Assessment

Material & Waste Stream Summary

Assessment ID Code: SNL/CA MS001

Title: Machine and Fabrication Shop

Input Material Name/No.	Annual Quantity Used	% Product	% Recycled	Total Releases % Air	% Liquid	% Solid
Water	10400.0			5	95	
Aqua-Syn	520.0			1	99	
Metalic chips	65.0					100
Machine oil	15.0				100	

Totals/Page: 11000.0

Total Annual Quantity 11000.0

Does the process require further analysis based on the site's Priority Material/Waste Stream List?

● Yes ○ No

☒ Level II ☐ Level II

9/16/93

PPOA-3

Pollution Prevention Opportunity Assessment

Option Summary

Assessment ID Code: SNL/CA MS001

Title: Machine and Fabrication Shop

Option No. 1

Description

One consideration for an operational improvement would be to recycle the spent coolant. According to industrial sources, a reduction of approximately 50% in the present amount of coolant disposed of.

Type	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty
Recycling	● Yes ○ No	Fair	$25,000.00	$100.00	5,000.00

Option No. 2

Description

Analyze the spent coolant solution for contaiminants and determine if it is indeed hazardous.

Type	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty
Disposal	○ Yes ● No	Poor	$5,000.00	$100.00	1,0000

PPOA-4

Date
8/31/91

Pollution Prevention Opportunity Assessment

Final Summary

Assessment ID Code SNL/CA MS001

Title: Machine and Fabrication Shop

Assessment:
A Level I and Level II PWA were completed on the Machining and Fabrication Shop coolant waste stream. The machinist responsible for the operational maintenance of the machine shop equipment had limited suggestions for reducing the amount of spent coolant generated. Recycling and treatment options were generated and evaluated. Assumptions made during this assessment were: the level of activity of the machine shop is relatively stable; the coolant must be changed on a periodic basis which is dependent on use and/or time and; disposal costs are relatively stable.

Conclusions:
The PWA team concluded the options are not economically feasible at this time since: 1) option one would require a considerable investment with the possibility of increasing the actual amount of coolant waste caused by contamination; 2) the recycling equipment presently available is not designed to treat the small quantity of spent coolant generated; 3) a conservative approach regarding waste management is consistent with the site's policy.

Recommendations:
The Line Management will continue monitoring the amount of waste generated and the availability of recycling equipment for improvement in the economical feasibility of implementation.

APPENDIX F

LEVEL III EXAMPLE PPOA

Worksheet 1

Level III

Original Issue Date: 01-Dec-1993
Revision No.: 0
Revision Date:

Pollution Prevention Opportunity Assessment

PPOA Team

PPOA Title: Polyurethane Foam Mixing and Curing

PPOA ID Code(s): G517-034-Machine_Mix

Name	Job Classification	Phone
*Bill Harrison	Process Engineer	X1234
John Taylor	Area Supervisor	X1235
Albert Green	Foam Machine Operator	X1235
Mary White	Foam Machine Operator	X1235
Violet Jones	Area Production Planner	X1236

*Team Leader

Additional Resources	Name	Phone
PPOA Coordinator	Nancy Notrebmep	X5432
Waste Management	Hakim Senoj	X5433
Industrial Hygiene		
Environmental Protection	Tim Sregge	X5434
Safety		
Fire Protection		
Process Engineering		
Materials Engineering		
Utilities Engineering		
Facilities Engineering		
Maintenance (Equipment)		
Analytical Lab Testing	Dottie Muldune	X5431
Scheduling		
Purchasing		

Worksheet 2

Level III

Revision No.: ______
Revision Date: ______

Pollution Prevention Opportunity Assessment

Process Description

PPOA Title: Polyurethane Foam Mixing and Curing

PPOA ID Code(s): G517-034-Machine_Mix

Process Location: Main Building #105, Post FN33

Process Description:

The foam mixing process is a process in which the required material components are metered and mixed at a defined ratio. The ratio of the two component streams is set and calibrated by production personnel. The materials are then mixed during the dispense cycle by the action of a motorized impeller. The mixed material "foam" is transferred manually to a mold and cured at temperatures from 165 to 350 deg. F. for four to six hours. Input materials include polyol resins, isocyanates, cleaning solvent and processing supplies. Five foam dispensing units are used. They range in age from four to fifteen years. The cure ovens are ventilated as is the foam pouring area. The foam machine operators have sufficient training to operate the dispensing units. Their previous training did not emphasize pollution prevention.
Waste streams include solid and liquid waste from the foaming operations as well as air emissions from the foam pouring and curing activities.

Description of Major Product(s) of Process:

Molded Polyurethane Foam Products

Worksheet 3
Style 1
Level III

Revision No. : 0
Revision Date: ________

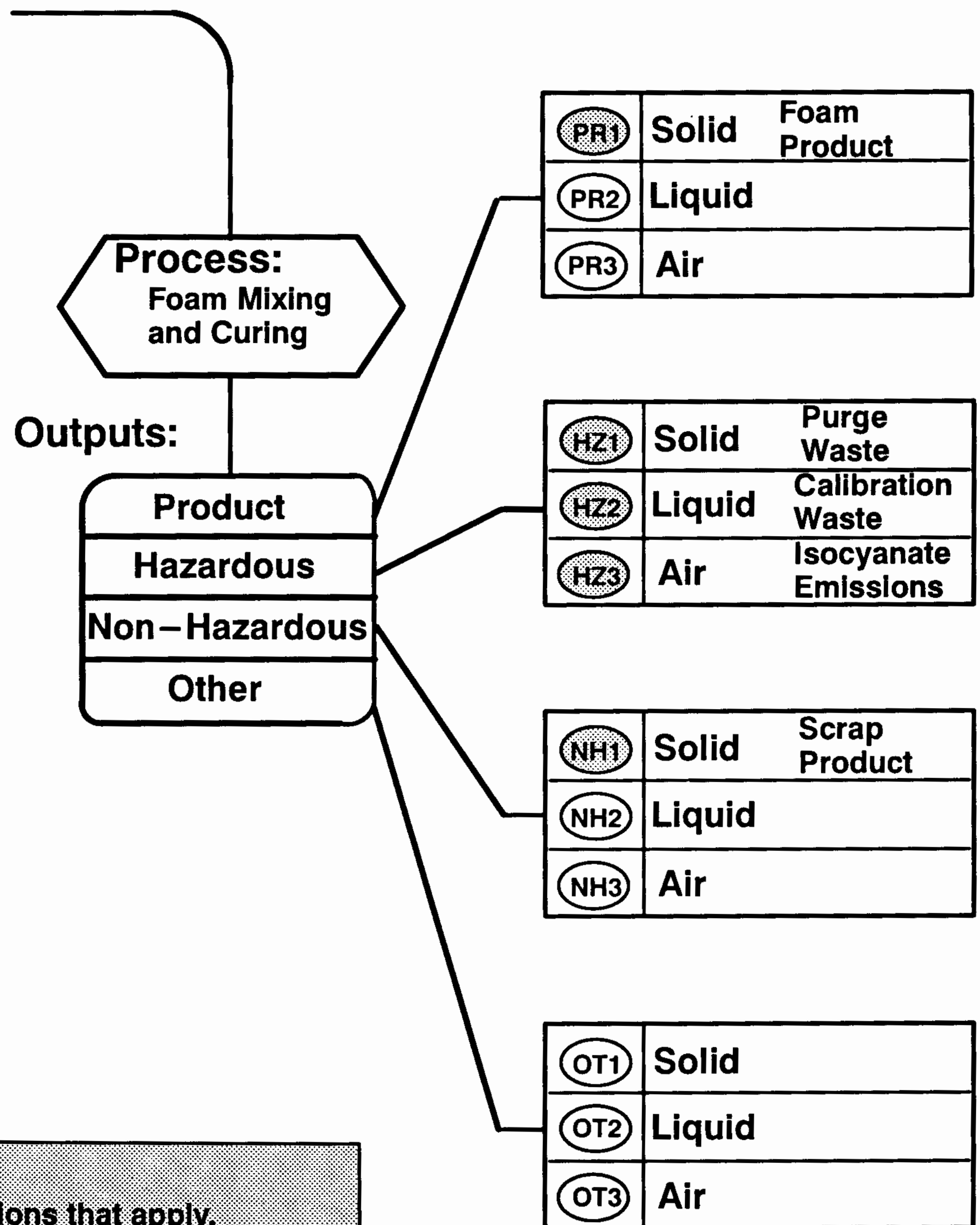
Pollution Prevention Opportunity Assessment

Process Flow Diagram

PPOA Title or PPOA ID Code(s): G517–034–Machine_Mix

Inputs:

Isocyanate Comp.
Resin Component
Solvent
Supplies



Highlight those sections that apply.
Use Worksheet 4 to identify and quantify the appropriate stream.

Worksheet 4

Level III

Pollution Prevention Opportunity Assessment

Revision No.: 0
Revision Date:
Page 1 of 1

Material Balance Summary

Time frame
From: 01–Jan–92
To: 31–Dec–92

PPOA Title or PPOA ID Code(s): G517–034–Machine_Mix

Material Description	Total Input	OUTPUT QUANTITY (Units: lbs.)										
		Total Output	Stream ID Code Foam Product PR1	Stream ID Code Purge Waste HZ1	Stream ID Code Calibration Waste HZ2	Stream ID Code Isocyanate Emissions HZ3	Stream ID Code Scrap Product NH1	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code
Isocyanate	313.6	124.5		98.3	24.4	1.8					
Resin	186.4	73.5		58.9	14.6						
Solvent	80.0	80.0		80.0							
Supplies	94.0	94.0		94.0							
Foam	0.0	302.0	237.0				65.0				
Totals/Subtotals	674.0	674.0	237.0	331.2	39.0	1.8	65.0				

Worksheet 5

Level III

Revision No.: 0

Revision Date: ______

Pollution Prevention Opportunity Assessment

Material Cost

PPOA Title or PPOA ID Code(s): G517-034-Machine_Mix

Material	Stock Number (if applicable)	Cost Per Unit	Annual Cost
Isocyanate Component		$1.96/lb	$614.65
Resin Component		$2.25/lb	$419.40
Solvent		$0.27/lb	$ 21.60
Supplies (paper cups, etc.)		$0.57/lb	$ 53.60
		Total / Subtotal	$1109.25

Waste Disposal Cost:

Material / Waste Stream	Waste Stream Category	Cost Per Unit	Annual Cost
Waste Liquid	Haz. Liquid	$4.60/lb	$179.40
Waste Solid	Haz. Solid	$2.97/lb	$983.66
Scrap Product	Non Haz. Solid	$0.69/lb	$ 44.85
		Total / Subtotal	$1207.91

Worksheet 6

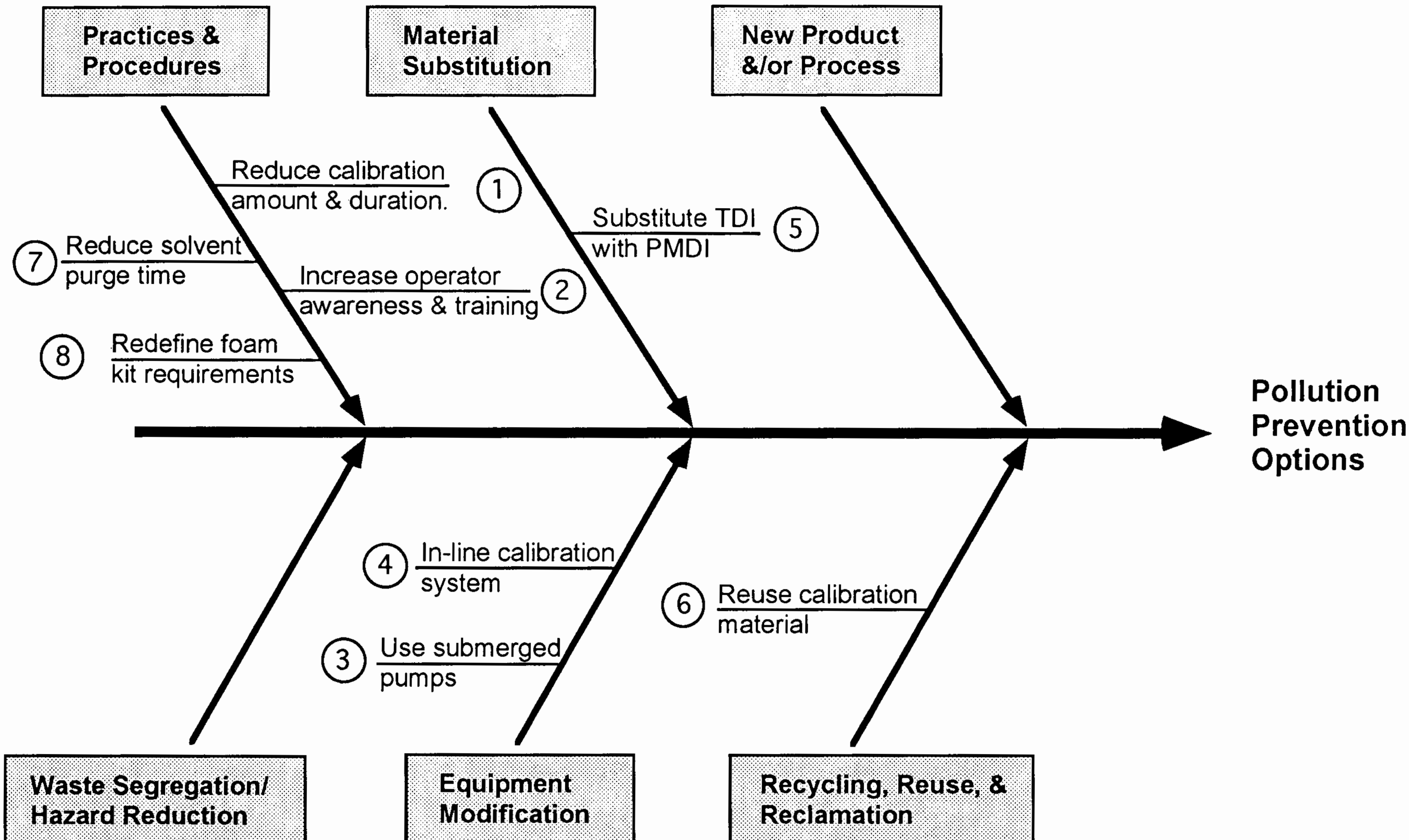
Level III

Revision No.: 0
Revision Date:

Pollution Prevention Opportunity Assessment

Option Generation

PPOA Title or PPOA ID Code(s): G517-034-Machine-Mix



Worksheet 7

Level III

Revision No.: 0
Revision Date:____
Page 1 of 2

Pollution Prevention Opportunity Assessment

Option Description

PPOA Title or PPOA ID Code(s): G517-034-Machine_Mix

Option Name and Description
(Include input materials, products affected, and anticipated reduction quantity.)

Option No. 1 : Calibration Reduction. Reduce the amount and duration of the calibration shots for the foam dispensers. Use new analytical methods "nitrogen testing" to justify the reduced level.

Consider: Yes X No__

Practices & Procedures X
Material Substitution ____
New Product &/or Process ____
Waste Segregation/Hazard Reduction ____
Equipment Modification ____
Recycling, Reuse, & Reclamation ____

Option No. 2 : Increase Awareness and Training. Conduct training session to increase pollution prevention awareness. Instruct in the importance of the individual in the waste generation process.

Consider: Yes X No__

Practices & Procedures X
Material Substitution ____
New Product &/or Process ____
Waste Segregation/Hazard Reduction ____
Equipment Modification ____
Recycling, Reuse, & Reclamation ____

Option No. 3 : Use Submerged Pumps. Replace gear pumps on foam machines with in-tank pumps. Leakage will be into material tanks. This will eliminate material waste and exposure as the result of clean-up

Consider: Yes X No__

Practices & Procedures ____
Material Substitution ____
New Product &/or Process X
Waste Segregation/Hazard Reduction ____
Equipment Modification ____
Recycling, Reuse, & Reclamation ____

Option No. 4 : In-Line Calibration System. Purchase new foam equipment with "in-line" calibration capability. This would replace the open cup method and would reduce the liquid and solid waste streams

Consider: Yes X No__

Practices & Procedures ____
Material Substitution ____
New Product &/or Process ____
Waste Segregation/Hazard Reduction ____
Equipment Modification X
Recycling, Reuse, & Reclamation ____

Worksheet 7

Level III

Revision No.: 0
Revision Date: ____

Pollution Prevention Opportunity Assessment

Option Description

PPOA Title or PPOA ID Code(s): G517-034-Machine_Mix

Option Name and Description
(Include input materials, products affected, and anticipated reduction quantity.)

Option No. 5 : Substitute for TDI. Lessen the toxicity of the waste stream by replacing TDI isocyanate with a PMDI based foam system. PMDI is not a carcinogen and is not a RCRC Hazardous waste.

Consider: Yes X No__

Practices & Procedures		Waste Segregation/Hazard Reduction	
Material Substitution	X	Equipment Modification	
New Product &/or Process		Recycling, Reuse, & Reclamation	

Option No. 6 : Reuse Calibration Material. Retain spent calibration material for use on low end product requirements. This could include machine tryout parts, or foam billets used as base material for holding fixtures.

Consider: Yes X No__

Practices & Procedures		Waste Segregation/Hazard Reduction	
Material Substitution		Equipment Modification	
New Product &/or Process		Recycling, Reuse, & Reclamation	X

Option No. 7 : Reduce Solvent Purge Time. Reset the solvent timers on the foam machine to the absolute minimum to flush the mix head. Subsequent soaking of mixer blade and housing can also reduce the required amount.

Consider: Yes X No__

Practices & Procedures	X	Waste Segregation/Hazard Reduction	
Material Substitution		Equipment Modification	
New Product &/or Process		Recycling, Reuse, & Reclamation	

Option No. 8 : Redefine Foam Kit Requirements. Set-up separate material numbers for resin and isocyanate components so ratio/usage of material will be balanced. Current "matched set" distribution result in waste of excess component.

Consider: Yes X No__

Practices & Procedures	X	Waste Segregation/Hazard Reduction	
Material Substitution		Equipment Modification	
New Product &/or Process		Recycling, Reuse, & Reclamation	

Pollution Prevention Opportunity Assessment

Options Cost Evaluation

PPOA Title or PPOA ID Code(s): G517-034-Machine_Mix

	Option No.: 1	Option No.: 2	Option No.: 3	Option No.: 4	Option No.: 5
Implementation Costs					
Purchased Equipment			$500	$75,000	
Installation			$100	$10,000	
Materials					
Utility Connections				$2000	
Engineering	$250	$100	$150	$3000	$1000
Development					$500
Start up / Training	$100	$100	$150	$5000	
Administrative	$50	$50			
Other					
Total Implementation Cost	$400	$250	$900	$95,000	$1500
Incremental Operating Costs					
Change in Raw Materials	$215	$100	$150	$750	$500
Change in Maintenance			($150)		
Change in Labor	$500			$500	
Change in Disposal	$50	$50	$100	$600	$500
Other					
Annual Operating Savings/(Cost)	$765	$150	$100	$1850	$1000
Incremental Intangible Costs					
Penalties and Fines					
Future Liabilities					
Other					
Annual Intangible Savings/(Cost)	$0	$0	$0	$0	$0
Total Annual Savings/(Cost)	$765	$150	$100	$1850	$1000
Payback Period	0.5 yrs	1.6 yrs	9.0 yrs	51 yrs	1.5 yrs

Worksheet 8

Level III

Revision No.: 0
Revision Date: ______

Pollution Prevention Opportunity Assessment

Options Cost Evaluation

PPOA Title or PPOA ID Code(s): G517-034-Machine_Mix

	Option No.: 6	Option No.: 7	Option No.: 8	Option No.:	Option No.:
Implementation Costs					
Purchased Equipment					
Installation					
Materials					
Utility Connections					
Engineering	$200	$150	$150		
Development					
Start up / Training		$150			
Administrative			$150		
Other					
Total Implementation Cost	$200	$300	$300		
Incremental Operating Costs					
Change in Raw Materials		$15			
Change in Maintenance					
Change in Labor					
Change in Disposal	$180	$125	$350		
Other					
Annual Operating Savings/(Cost)	$180	$140	$350		
Incremental Intangible Costs					
Penalties and Fines					
Future Liabilities					
Other					
Annual Intangible Savings/(Cost)	$0	$0	$0		
Total Annual Savings/(Cost)	$180	$140	$350		
Payback Period	1.1 yrs	2.1 yrs	0.9 yrs		

Worksheet 9

Level III

Revision No.: 0
Revision Date: ______
Page 1 of 2

Pollution Prevention Opportunity Assessment

Weighted Sums Option Evaluation

PPOA Title or PPOA ID Code(s): G517-034-Machine_Mix

Criteria	Weight 'W'	Option No.: 1 Scale 'S'	'WxS'	Option No.: 2 Scale 'S'	'WxS'	Option No.: 3 Scale 'S'	'WxS'	Option No.: 4 Scale 'S'	'WxS'	Option No.: 5 Scale 'S'	'WxS'
Public Health, Safety, & Environment	10	8	80	6	60	6	60	7	70	8	80
Employee Health & Safety	10	8	80	7	70	5	50	8	80	9	90
Regulatory Compliance	8	7	56	7	56	8	64	7	56	9	72
Economic	6	8	48	9	54	7	42	5	30	8	48
Implementation Period	4	7	28	9	36	6	24	6	24	7	28
Improved Operation / Product	2	5	10	8	16	7	14	8	16	8	16
Other											
Subtotal			302		292		254		276		334
Likelihood of Technical Success (Multiplier)		X	0.8	X	1.0	X	0.9	X	0.9	X	1.0
Likelihood of Useful Results (Multiplier)		X	0.9	X	0.9	X	0.9	X	0.9	X	1.0
Total			217		262		205		224		339
Rank			7		4		8		5		1

Worksheet 9

Level III

Revision No.: 0
Revision Date:
Page 2 of 2

Pollution Prevention Opportunity Assessment

Weighted Sums Option Evaluation

PPOA Title or PPOA ID Code(s): G517-034-Machine_Mix

Criteria	Weight 'W'	Option No.: 6 Scale 'S'	'WxS'	Option No.: 7 Scale 'S'	'WxS'	Option No.: 8 Scale 'S'	'WxS'	Option No.: Scale 'S'	'WxS'	Option No.: Scale 'S'	'WxS'
Public Health, Safety, & Environment	10	6	60	8	80	6	60				
Employee Health & Safety	10	7	70	8	80	7	70				
Regulatory Compliance	8	6	48	7	56	7	56				
Economic	6	7	42	9	54	8	48				
Implementation Period	4	7	28	9	36	8	32				
Improved Operation / Product	2	7	14	6	12	9	18				
Other											
Subtotal			262		318		284				
Likelihood of Technical Success (Multiplier)		X	0.9	X	1.0	X	1.0	X		X	
Likelihood of Useful Results (Multiplier)		X	0.9	X	0.9	X	1.0	X		X	
Total			212		286		284				
Rank			6		2		3				

Worksheet 10
Level III

Revision No.: 0 .
Revision Date: ______

Pollution Prevention Opportunity Assessment
Final Report Check Sheet

PPOA Title or PPOA ID Code(s): G517-034-Machine_Mix

Requirement	***Completed***
Title Page	X
PPOA Title	
PPOA ID Code(s)	
Team members	
Issue date/revision date/revision no.	
Executive Summary	X
Process description	
Process assessment	
Option summary and analysis	
Conclusions	
Recommendations	
Introduction	X
Background of evaluation	
Process Description	X
Associated equipment	
Process flow diagram	
Process Assessment	X
Methodology	
Material Balance	
Unusual occurrences	
Option Summary and Analysis	X
Option description and rank	
Upstream/Downstream impacts	
Material usage	
Anticipated reduction	
Estimated costs	
Estimated benefits	
Feasibility	
Waste streams affected	
Conclusion	X
Concluding evaluation	
Option analysis decisions	
Concerns	
Options already implemented	
Lessons learned	
Recommendations	X
Future work	
New equipment	
Implementation strategies	
Worksheets	X
1-10	

APPENDIX G

MODEL PPOA WORKSHEETS

Worksheet 1

Level III

Original Issue Date: ________
Revision No.: ________
Revision Date: ________

Pollution Prevention Opportunity Assessment

PPOA Team

PPOA Title: ______________________________

PPOA ID Code(s): ______________________________

Name	Job Classification	Phone
*		

*Team Leader

Additional Resources	Name	Phone
PPOA Coordinator		
Waste Management		
Industrial Hygiene		
Environmental Protection		
Safety		
Fire Protection		
Process Engineering		
Materials Engineering		
Utilities Engineering		
Facilities Engineering		
Maintenance (Equipment)		
Analytical Lab Testing		
Scheduling		
Purchasing		

Worksheet 1

Worksheet 1 provides the identification of the PPOA assessment team. For the PPOA to be successful, employees involved with the process should be members of the team. The assessment team needs a leader, members, and additional resources, as required.

The team leader should have technical knowledge of the process, knowledge of the current production operations, and the personnel involved. The leader shall assemble the team to perform the assessment. Team members may include process engineers, product engineers, knowledgeable department personnel such as production operator(s), and material experts. Additional resources may be called in to provide information not available within the team. The size of the team may be large for complicated processes, but should be kept to a minimum to maintain focus.

1. **Original Issue Date:** List the original issue date of the PPOA.

2. **Revision No.:** List the revision number for this worksheet. {Original issue = 0.}

3. **Revision Date:** List the most recent revision date for this worksheet.

4. **PPOA Title:** List the PPOA title selected by the team.

5. **PPOA ID Code(s):** List the PPOA ID Code(s) selected by the team.

6. **Name, Job Classification, Phone:** To facilitate team meetings and for future reference, this information should be completed when the PPOA team is formed.

Worksheet 2

Level III

Revision No.: ________
Revision Date: ________

Pollution Prevention Opportunity Assessment

Process Description

PPOA Title: ______________________________

PPOA ID Code(s): ______________________________

Process Location: ______________________________

Process Description: ______________________________

Description of Major Product(s) of Process: ______________________________

Worksheet 2

Worksheet 2 provides a brief description of the process. The main elements of the process description are the process location, input materials, equipment, summary of operations performed, process controls, operator training, major products, and the waste streams affected.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title:** List the PPOA Title given on Worksheet 1.

4. **PPOA ID Code(s):** List the PPOA ID Code(s) given on Worksheet 1.

5. **Process Location:** List the best descriptor of the process location. It may be a department, building, room, etc..

6. **Process Description:** The process description should detail important attributes of the process. Equipment, summary of operations performed, process controls, input materials, and operator training (qualification or certification) should be included.

7. **Description of Major Product(s) of Process:** Describe the major products which result from this process or the reason the process is being perfromed.

Worksheet 3
Style 1
Level III

Revision No. : ____________
Revision Date: ____________

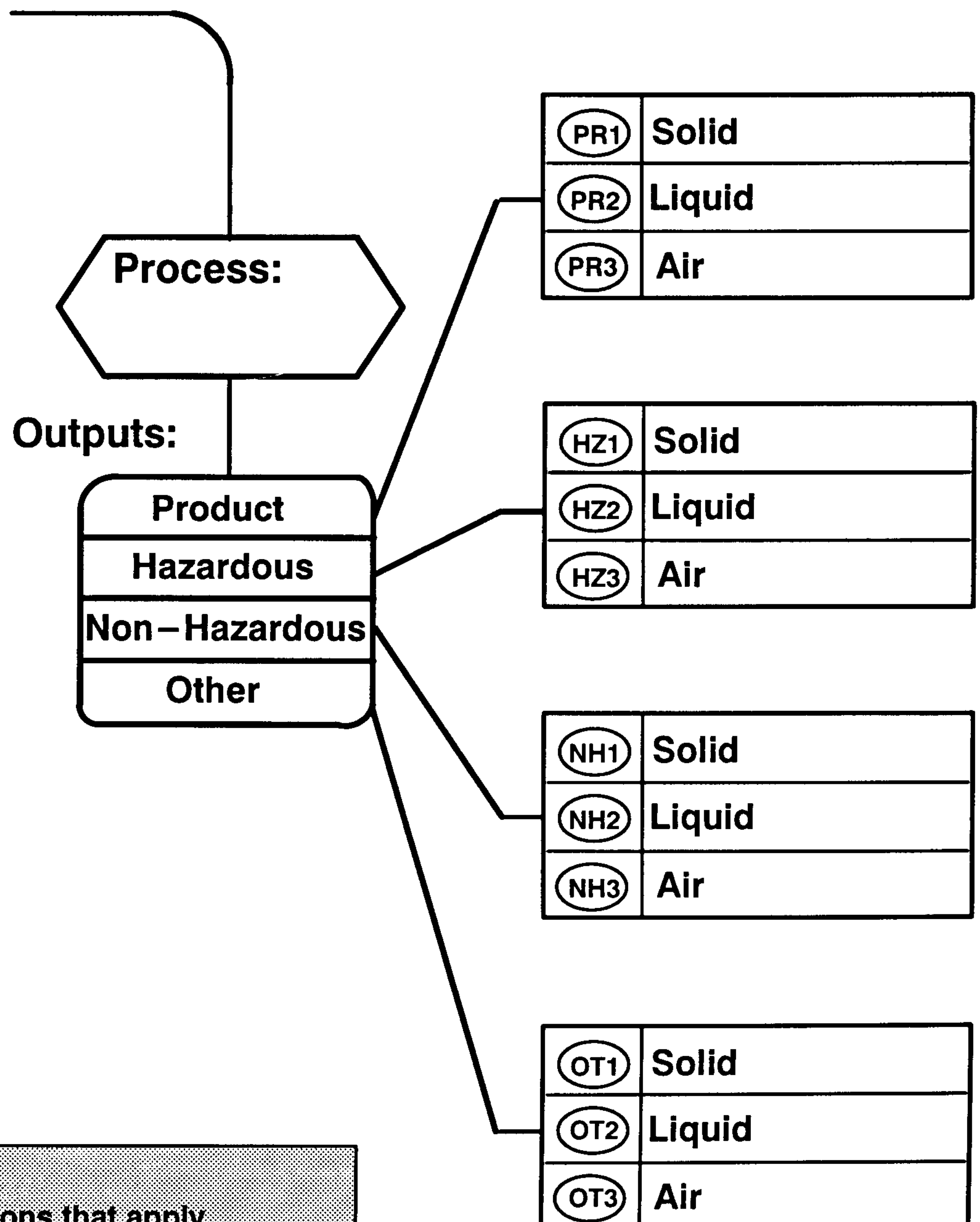
Pollution Prevention Opportunity Assessment

Process Flow Diagram

PPOA Title or PPOA ID Code(s): ____

Inputs:

____
____
____
____
____
____
____



Highlight those sections that apply.
Use Worksheet 4 to identify and
quantify the appropriate stream.

Worksheet 3

Worksheet 3 provides a process flow diagram for the PPOA. The flow diagram should identify all PPOA ID Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

4. **Process Flow Diagram**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then sub-categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each sub-category of waste.

5. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information requested on Worksheet 4. A brief waste description may be recorded in the box to the right of the Stream ID Code.

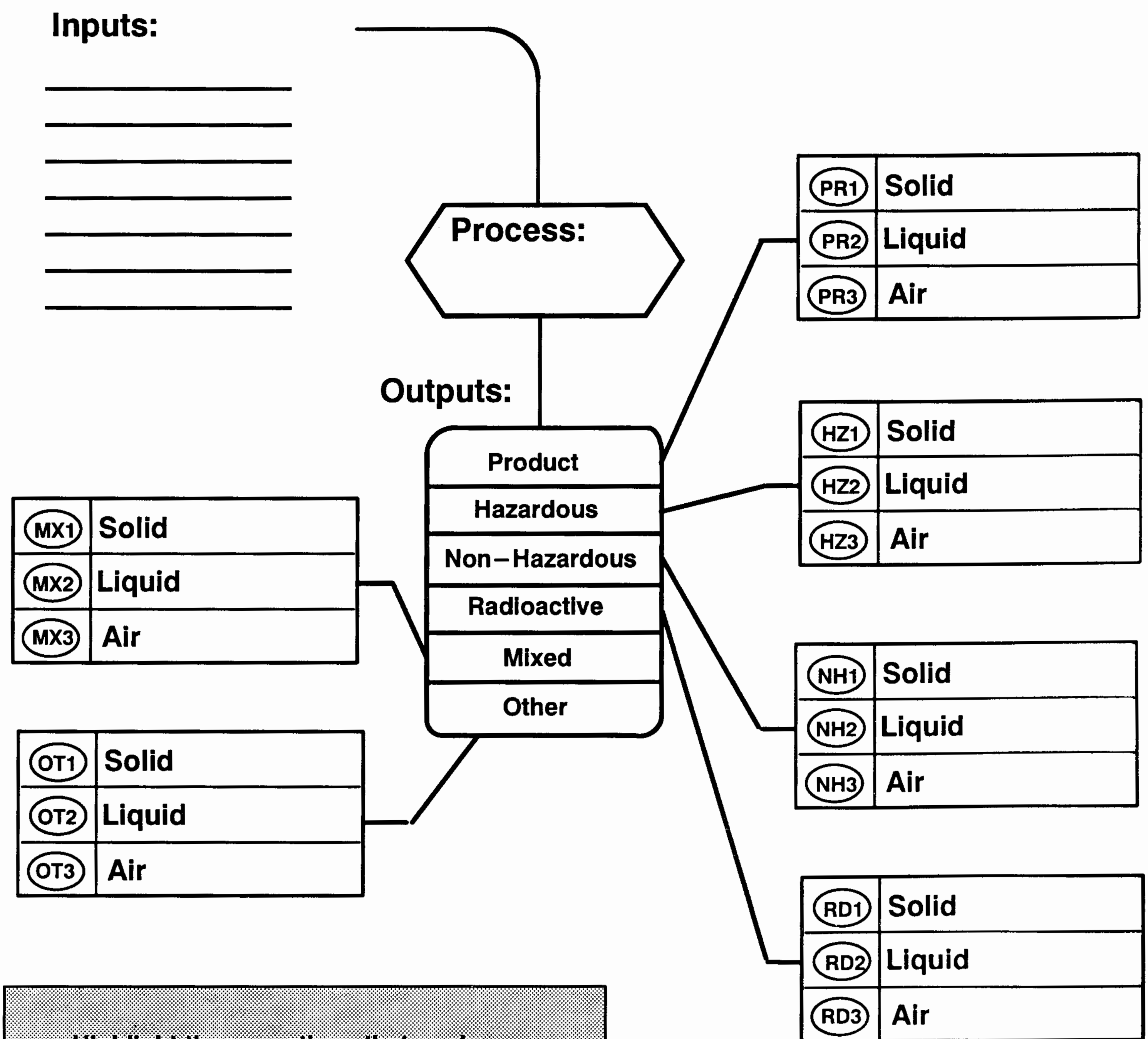
Worksheet 3
Style 2
Level III

Revision No.: ______
Revision Date: ______

Pollution Prevention Opportunity Assessment

Process Flow Diagram

PPOA Title or PPOA ID Code(s): ____________________



Highlight those sections that apply.
Use Worksheet 4 to identify and quantify the appropriate stream.

Worksheet 3

Worksheet 3 provides a process flow diagram for the PPOA. The flow diagram should identify all PPOA ID Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

4. **Process Flow Diagram**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then sub-categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each sub-category of waste.

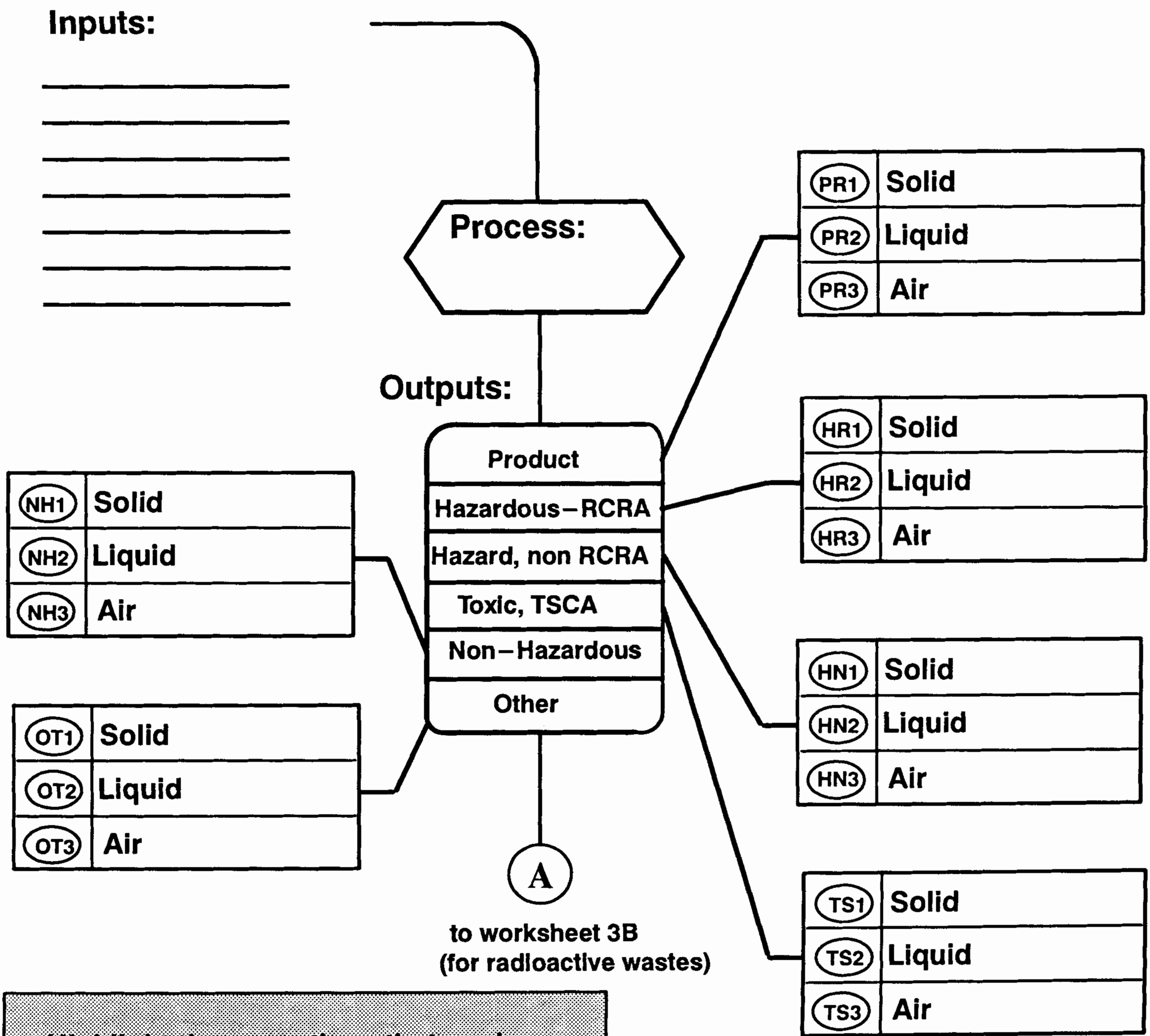
5. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information requested on Worksheet 4. A brief waste description may be recorded in the box to the right of the Stream ID Code.

Worksheet 3A
Style 3
Level III

Revision No.: ______
Revision Date: ______

Pollution Prevention Opportunity Assessment
Process Flow Diagram

PPOA Title or PPOA ID Code(s): ______________________



Highlight those sections that apply.
Use Worksheet 4 to identify and
quantify the appropriate stream.

11/93

Worksheet 3A

Worksheet 3 provides a process flow diagram for the PPOA. The flow diagram should represent all PPOA ID Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

4. **Process Flow Diagram**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each category of waste.

5. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information requested on Worksheet 4. A brief waste description may be recorded in the box to the right of the Stream ID Code.

DOE Definitions:

Hazardous Waste - Waste, which because of its quantitiy, concentration, or physical, chemical or infectious nature may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness, or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous waste can be further defined as:

RCRA-regulated - solid waste not specifically excluded from regulation under 40 CFR 261.4, or delisted by petition, that is either a listed hazardous waste (40 CFR 261.30 - 261.33) or exhibits the characteristics of a hazardous waste (40 CFR 261.20 - 261.24).

Non RCRA-regulated - any other hazardous waste not specifically regulated under TSCA or RCRA, which may be regulated by the state or local authorities, such as used oil.

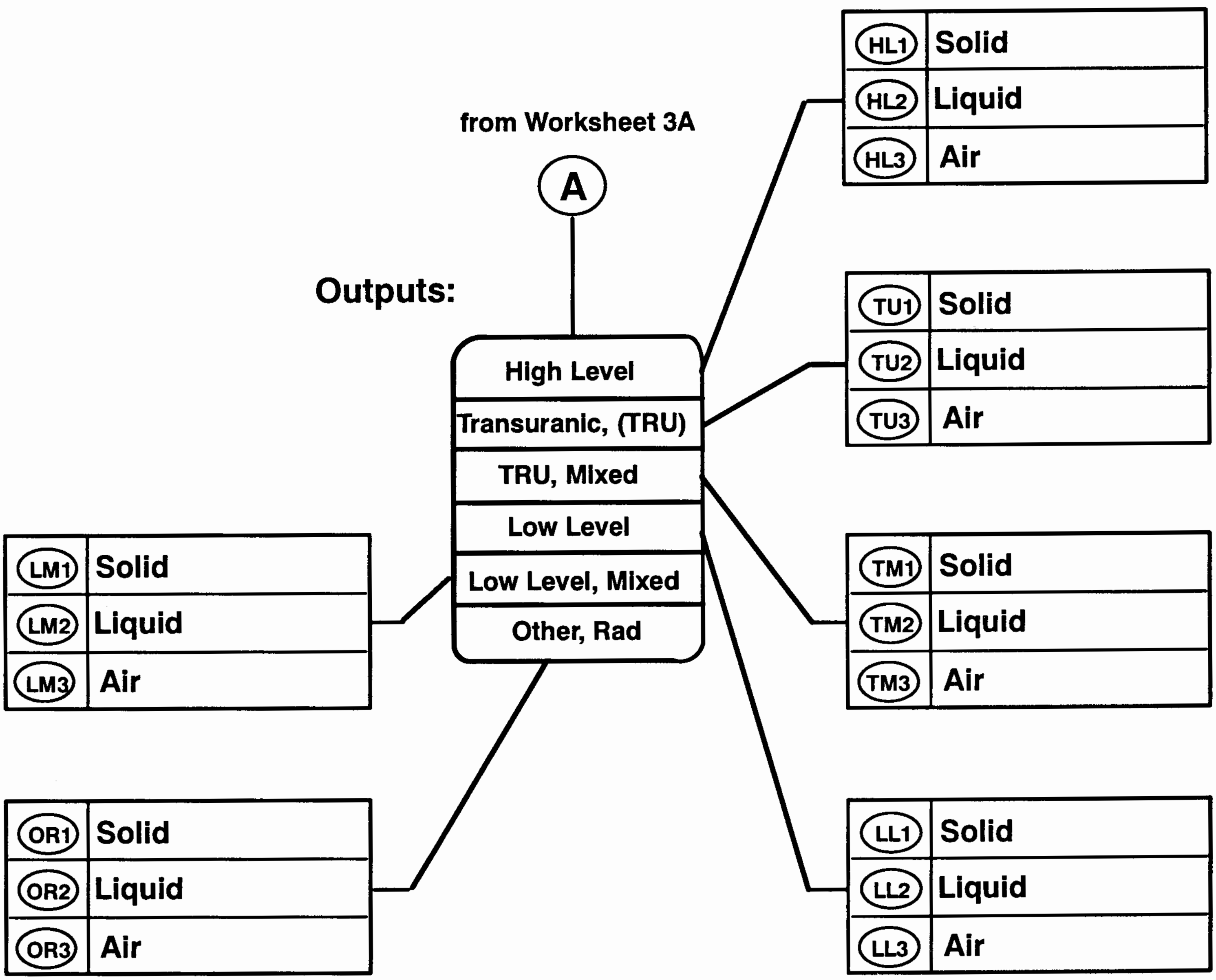
TSCA Waste - Individual chemical wastes (both liquid and solid), such as polychlorinated biphenyls (PCBs).

Worksheet 3B
Style 3
Level III

Revision No. : ____________
Revision Date: ____________

Pollution Prevention Opportunity Assessment
Process Flow Diagram

PPOA Title or PPOA ID Code(s): ______________________________



Highlight those sections that apply.
Use Worksheet 4 to identify and
quantify the appropriate stream.

Worksheet 3B

Worksheet 3 provides a process flow diagram for the PPOA. The flow diagram should represent all PPOA ID Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

4. **Process Flow Diagram**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each category of waste.

5. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information requested on Worksheet 4. A brief waste description may be recorded in the box to the right of the Stream ID Code.

DOE Definitions:

High Level Waste- Irradiated reactor fuel, liquid wastes resulting from operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and solids into which such liquid wastes have been converted. (10 CFR 60.2)

Transuranic Waste - Waste that is contaminated with alpha-emitting radionuclides with (1) an atomic number greater than 92 (heavier than uranium); (2) half-lives greater than 20 years; and (3) concentrations greater than 100 nanocuries per gram of waste.

Transuranic Mixed Waste: - Waste which contains both transuranic waste and hazardous components, as defined by the Atomic Energy Act and RCRA, respectively.

Low Level Waste: - Radioactive Waste not classified as high level waste, transuranic waste, spent nuclear fuel, or by-product material [specified as uranium or thorium tailings and waste in accordance with DOE Order 5820.2A].

Low Level Mixed Waste: - Waste which contains both low level waste and hazardous components, as defined by the Atomic Energy Act and RCRA, respectively.

Worksheet 4

Level III

Pollution Prevention Opportunity Assessment

Mass Balance Summary

Revision No.: ____________
Revision Date: ____________
Page ________ of ________

Time frame
From: ________
To: ________

PPOA Title or PPOA ID Code(s): ______________________________

Material Description	Total Input	OUTPUT QUANTITY (Units: _____) Total Output	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code
Totals/Subtotals											

Worksheet 4

A material balance is a summation of the total quantity of input material to a process and the releases to the environment, another process, or made into product. The purpose of Worksheet 4 is to tabulate this information and total the inputs and outputs for all streams.

1. **Revision No.:** List the revision number of the PPOA.

2. **Revision Date**: List the most recent revision date for the PPOA worksheet.

3. **PPOA Title/PPOA ID Code(s)**: List the PPOA Title or ID Code(s) given on Worksheet 1.

4. **Page ____of ____:** Indicate the page number for this worksheet and the number of pages for this worksheet.

5. **From/To**: Report the dates (month and year) for the time period covered. An annual period is suggested for purposes of averaging and documenting performance toward facility goals.

6. **Material Description:** List the material name and stock number (optional) or the output product if different than originating material.

7. **Units ____:** Enter the unit of measure for the input/output summary. A consistent unit of measurement is suggested. If requirements dictate mixing units, designate the units for a particular column under the Stream ID Code heading.

8. **Total Input:** For the material described in the far left column enter the weight of material used in the process during the time frame specified.

9. **Total Output:** For the material specified in the Material Description column enter the weight of the output. This is the sum of all waste streams and any product generated. For processes where chemical reactions take place, input materials are consumed or changed to different compounds, a separate entry in the Material Description column is required to adequately define the output. In these cases, the input and output quantities will not balance for the listed material in that row.

10. **Output Quantity:** Use these columns to break down the total output into output categories. Refer to Worksheet 3 for the appropriate Stream ID Code for the output type. Enter the Stream ID Code at the top of the column (e.g., HZ1 for a hazardous solid waste stream), then enter the discharge amount for the material described in the Material Description column that relates to that Stream ID Code. Continue across the worksheet for all Stream ID Code(s) utilized in Worksheet 3.

11. **Totals/Subtotals:** Sum the Total Input, Total Output, and Output columns. Record the sum at the bottom row of the last worksheet. Subtotals are recorded at the bottom row for other pages of the worksheet. The Total Input column should equal the Total Output column unless there is system accumulation. The Total Output column should also be the sum of all the Stream ID Code output streams.

Stream ID Codes:

Designator	Style 1	Style 2	Style 3
Product	PR	PR	PR
Hazardous	HZ	HZ	
Non-Hazardous	NH	NH	NH
Radioactive		RD	
Mixed		MX	
Other	OT	OT	OT
Hazardous, RCRA			HR
Hazardous, Non-RCRA			HN
Toxic, TSCA			TS
High Level			HL
Transuranic, TRU			TU
TRU, Mixed			TM
Low Level			LL
Low Level, Mixed			LM
Other, Radioactive			OR

Solid Stream = 1, Liquid Stream = 2, Air Stream = 3

Style refers to the version of Worksheet 3 used.

Worksheet 5
Level III

Revision No.: ______
Revision Date: ______
Page _____of ______

Pollution Prevention Opportunity Assessment

Material Cost

PPOA Title or PPOA ID Code(s): ____

Input Material Cost:

Material	Stock Number (if applicable)	Cost Per Unit	Annual Cost
		Total / Subtotal	

Waste Disposal Cost:

Material / Waste Stream	Waste Stream Category	Cost Per Unit	Annual Cost
		Total / Subtotal	

Worksheet 5

Worksheet 5 details the cost of the PPOA input materials (use the quantities from Worksheet 4) and the cost of disposal for these materials. The material cost may be obtained from Purchasing or Stores. The cost of disposal may be obtained from Waste Management or Accounting. Annual Cost is calculated from the amount of material placed in the process or from the amount of disposed material, multiplied by the cost per unit.

1. Revision No.: List the revision number for this worksheet.

2. Revision Date: List the most recent revision date for this worksheet.

3. Page_____of_____: Indicate the number of this page and the total number of pages for this worksheet.

4. PPOA Title or PPOA ID Code(s): List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

5. Input Material Cost: List the material, stock number (if applicable), cost per unit ($/lb., $/gal, etc.), and the annual cost for this process.

6. Waste Disposal Cost: List the material or waste stream, waste stream category, (e.g., hazardous liquid), stock number if applicable, the cost per unit ($/lb., $/gal, etc.) , and annual cost.

7. Totals / Subtotals: Record the sum of the annual costs for the materials or waste streams listed. There will be a total for both the input material cost and waste disposal cost.

Worksheet 6

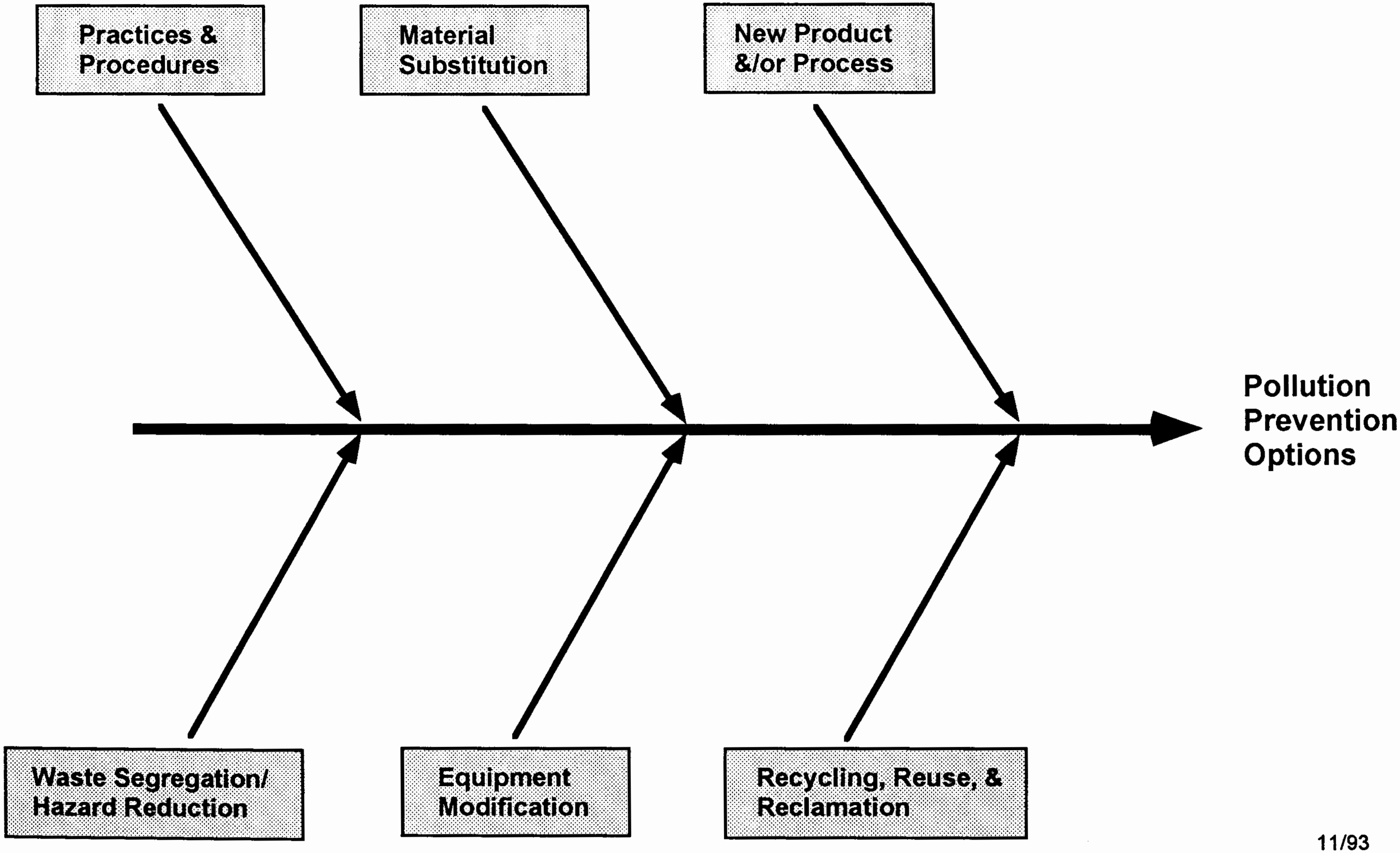
Level III

Revision No.: ________
Revision Date: ________

Pollution Prevention Opportunity Assessment

Option Generation

PPOA Title or PPOA ID Code(s): ______________________________



Worksheet 6

Worksheet 6 provides a tool for option generation. The purpose of this diagram (sometimes referred to as a Fishbone Diagram) is to help generate pollution prevention ideas. It is especially useful in a brainstorming session to group ideas undersimilar pollution prevention categories. It also helps insure that all of the pollution prevention categories are considered.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s):** List the PPOA title or PPOA ID Code(s) given on Worksheet 1.

4. **Brainstorming ideas:** Using the Fishbone Diagram, briefly document ideas for pollution prevention.

The following definitions clarify each of the major categories.

Practices & Procedures -- Good operating practices and procedures apply to the human aspect of operations. They are largely efficiency improvements. Examples are: Pollution Prevention Programs, personnel training, material handling & inventory practices, material loss prevention, scrap reduction, cost accounting, production scheduling, etc.

Material Substitution -- Changes to the input materials of the process. The result is a reduction or elimination of a pollutant or hazard.

New Product &/or Process -- Product changes which result in the reduction or elimination of waste. In addition, a different process can be used to create the same product with the intent of minimizing waste.

Waste Segregation/Hazard Reduction -- Actions taken to segregate waste streams to prevent nonhazardous waste from being designated and handled as hazardous. Hazard reduction can result from changes to the physical, chemical, or biological character or composition of the waste. These include neutralization, toxicity reduction, or volume reduction.

Equipment Modification -- Changes that occur to the equipment used in a process. These could include minor adjustments, additions, or complete replacements.

Recycling -- A material is recycled if it is used, reused, or reclaimed: (1) if it is used for something other than its original purpose, (2) if it goes back into the original process, or (3) if it is chemically or physically treated for use or reuse.

Worksheet 7
Level III

Revision No.: _____
Revision Date:_____
Page _____of_____

Pollution Prevention Opportunity Assessment

Option Description

PPOA Title or PPOA ID Code(s): ____

Option Name and Description
(Include input materials, products affected, and anticipated reduction quantity.)

Option No. _____ : ____

____

____

____

____ **Consider: Yes__No__**

Practices & Procedures _______ Waste Segregation/Hazard Reduction _____
Material Substitution _________ Equipment Modification _____
New Product &/or Process _____ Recycling, Reuse, & Reclamation _____

Option No. _____ : ____

____

____

____

____ **Consider: Yes__No__**

Practices & Procedures _______ Waste Segregation/Hazard Reduction _____
Material Substitution _________ Equipment Modification _____
New Product &/or Process _____ Recycling, Reuse, & Reclamation _____

Option No. _____ : ____

____

____

____

____ **Consider: Yes__No__**

Practices & Procedures _______ Waste Segregation/Hazard Reduction _____
Material Substitution _________ Equipment Modification _____
New Product &/or Process _____ Recycling, Reuse, & Reclamation _____

Option No. _____ : ____

____

____

____

____ **Consider: Yes__No__**

Practices & Procedures _______ Waste Segregation/Hazard Reduction _____
Material Substitution _________ Equipment Modification _____
New Product &/or Process _____ Recycling, Reuse, & Reclamation _____

Worksheet 7

The purpose of this worksheet is to further document the pollution prevention options identified on Worksheet 6. The process by which options are identified should occur in an environment that encourages creativity and independent thinking. Brainstorming sessions are effective ways for individuals to generate options. Consideration of the options generated in a brainstorming session can lead to questions. Answering these questions may require additional research. Listed below are some of the sources that can help to answer questions and/or generate additional options.

- Literature searches
- Technical conferences
- Equipment exhibitions
- Trips to other plants
- Vendor surveys
- Contact with design engineers
- Contact with personnel in other departments who have participated in similar PPOAs
- Materials engineers
- Benchmarking

1.Revision No.: List the revision number for this worksheet.

2. Revision Date: List the most recent revision date for this worksheet.

3. PPOA Title or PPOA ID Code: List the PPOA Title or PPOA ID Code given on Worksheet 1.

4. Page ___ of ___: Indicate the number of this page and the total number of pages for this worksheet.

5. Option: Options generated should be numbered consecutively and placed on this worksheet (reference Worksheet 6). They may or may not be evaluated. Briefly describe each option, affected materials and product, any roadblocks to implementation, upstream and downstream impacts if implemented, and anticipated reduction quantity.

6. Consider Yes/No: If the suggestion is worth further consideration, check 'Yes'. If the suggestion will not be pursued, check 'No' and indicate briefly in the Option Description why not.

7. Practices & Procedures, Material Substitution, New Product &/or Process, Waste Segregation/ Hazard Reduction, Equipment Modification, and Recycling, Reuse, & Reclamation: Check the appropriate descriptions. See Worksheet 6 for definitions.

Worksheet 8
Level III

Revision No.: ________
Revision Date: ________
Page ________ of ________

Pollution Prevention Opportunity Assessment

Options Cost Evaluation

PPOA Title or PPOA ID Code(s): ______________________________

	Option No.:	Option No.:	Option No.:	Option No.:	Option No.:
Implementation Costs					
Purchased Equipment					
Installation					
Materials					
Utility Connections					
Engineering					
Development					
Start up / Training					
Administrative					
Other					
Total Implementation Cost					
Incremental Operating Costs					
Change in Raw Materials					
Change in Maintenance					
Change in Labor					
Change in Disposal					
Other					
Annual Operating Savings/(Cost)					
Incremental Intangible Costs					
Penalties and Fines					
Future Liabilities					
Other					
Annual Intangible Savings/(Cost)					
Total Annual Savings/(Cost)					
Payback Period					

Worksheet 8

This worksheet provides a method to compare and contrast the pollution prevention options generated on Worksheet 6 from a cost perspective. The three major cost categories for weighing options are: Implementation Costs, Incremental Operating Costs, and Incremental Intangible Costs. These costs are totaled for each option considered from Worksheet 7. This worksheet will aid in completing the economic evaluation portion of Worksheet 9.

1. **Revision No.:** List the revision for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **Page ____of____:** Indicate the number of this page and the total number of pages for this worksheet.

4. **PPOA Title or PPOA ID Code(s):** List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

5. **Implementation Cost:** These are the one-time, first-year costs associated with the implementation of each option. Installation costs should be reported as an estimate. Implementation Cost may include materials, utility connections, site preparation, installation, engineering, procurement, start-up, training, permitting, initial catalysts and chemicals, and working capital; minus the salvage value of any existing equipment.

6. **Annual Operating Savings/(Costs):** These are the costs associated with day-to-day operations. List the incremental costs compared to the current process costs (positive for savings or negative for increased costs) that would be incurred if this option is implemented. Incremental operating costs could include waste disposal, raw material consumption, ancillary catalysts and chemicals, labor, maintenance and supplies, insurance, incremental revenues from increased / decreased production, and incremental revenues from marketable by-products.

7. **Annual Intangible Savings/(Cost):** These include hidden, liability, and other costs not immediately obvious for each option. List the incremental costs compared to the current process costs (positive for savings or negative for increased costs) that would be incurred if this option is implemented. These costs could include penalties and fines, future liabilities (storage, transportation, and disposal of hazardous waste), reporting, consulting fees, monitoring/testing, record keeping, preparedness and protective equipment, medical surveillance, manifesting, inspections, and corporate/public image.

8. **Total Annual Cost/Savings:** This is the sum of the **Annual Operating Savings/(Cost)** and the **Annual Intangible Savings/(Cost)**.

9. **Payback Period:** Divide the **Total Implementation Cost** by the **Total Annual Savings/(Cost)**.

Worksheet 9

Level III

Revision No.: ________
Revision Date: ________
Page ______ of ________

Pollution Prevention Opportunity Assessment

Weighted Sums Option Evaluation

PPOA Title or PPOA ID Code(s): ______________________________

Criteria	Weight 'W'	Option No.: ____ Scale 'S'	'WxS'	Option No.: ____ Scale 'S'	'WxS'	Option No.: ____ Scale 'S'	'WxS'	Option No.: ____ Scale 'S'	'WxS'	Option No.: ____ Scale 'S'	'WxS'
Public Health, Safety, & Environment	10										
Employee Health & Safety	10										
Regulatory Compliance	8										
Economic	6										
Implementation Period	4										
Improved Operation / Product	2										
Other											
Subtotal											
Likelihood of Technical Success (Multiplier)		x		x		x		x		x	
Likelihood of Useful Results (Multiplier)		x		x		x		x		x	
Total											
Rank											

Many pollution prevention options will be identified in a successful assessment. At this point, it is necessary to identify those options that offer real potential to minimize waste and reduce costs. Worksheet 9 serves as a screening tool to prioritize or eliminate suggested options.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **Page ____ of ____:** Indicate the number of this page and the total number of pages for this worksheet.

4. **PPOA Title or PPOA ID Code(s):** List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

Additional Instructions:

a. The values in the Weight column (designated by 'W') represent the facility's priority for the criteria.

b. In the Scale column for each option (designated by 'S'), rate each criteria by assigning a value from 0-10 (lowest to highest). Use the definitions which follow to help determine a value.

c. In the 'W x S' column for each option, enter the product of the weight and scale.

d. Sum the 'W x S' column for each option to obtain a subtotal.

e. Multiply the subtotal for each option by the Likelihood of Technical Success.

f. Multiply the value in step e. above for each option by the Likelihood of Useful Results.

g. Enter the product found in step f. in the Total column for each option.

h. Assign a priority rank for each option; #1 for the highest score, #2 for the next highest, and so on.

Worksheet 9 -- (Scale & Multiplier Definitions)

Scale Factor Definitions (0-10)

	Public Health, Safety, & Environment -- Health or safety risk to the general public or damage to the environment.
10	Reduce the risk of loss of life or long-term environmental damage. High concentrations of hazardous materials.
8	Reduce the risk of long-term disability or moderate environmental damage. Moderate concentrations of hazardous materials.
6	Reduce the risk of short-term disability or unplanned releases to the environment. Low concentrations of hazardous materials.
4	No effect.
0	Negative effect.

	Employee Health & Safety -- Health or safety risk to an employee, contractor, or visitor.
10	Reduce the risk of loss of life through an accident or long-term exposure.
8	Reduce the risk of permanent or long-term disability through an accident or long-term exposure.
6	Reduce the risk of short-term disability or lost-time through an accident or long-term exposure.
4	No effect.
0	Negative effect.

	Regulatory Compliance -- Risk of non-compliance to regulatory laws with respect to employees or managers.
10	Reduce the risk and avoid criminal penalties.
8	Reduce the risk and avoid civil penalties.
6	Reduce the risk.
4	No effect.
0	Negative impact.

	Economic -- Potential for cost savings and payback period.
10	Large savings and short payback.
8	Moderate savings and moderate payback.
6	Positive cost savings and extented payback.
4	No cost savings and no possibility of payback.
0	Negative cost savings.

	Implementation Period -- Potential for rapid implementation of pollution prevention options.
10	Immediate (e.g., within 1 month).
8	Short-term (e.g., within 1 year).
6	Intermediate (e.g., within 2 years).
4	Long-term (e.g., within 3 years).
0	Greater than 3 years.

	Improved Operation / Product -- Quality improvement to process or product.
10	Significant improvement.
8	Moderate improvement.
6	Positive improvement.
4	No improvement.
0	Negative effect.

Worksheet 9 -- (Scale & Multiplier Definitions)

Multiplier Definitions (0-1)

Likelihood of Technical Success	
1	High likelihood: No major technical breakthrough required. Well-designed plans to meet objectives and successful track record exists.
0.5	Medium likelihood: Technical advancements may be necessary. Key issues are identified but no specific contingency plans have been made.
0.1	Low likelihood: Major technical breakthroughs are required. Adequate plans for meeting objectives or key problems have not been identified.

Likelihood of Useful Results	
1	High likelihood: Project has demonstrated that it can meet production requirements. There is a high confidence that implementation will not create unacceptable risks. Benefits outweigh the costs.
0.5	Medium likelihood: Project has not yet demonstrated that it can meet production requirements. There are reservations that implementation can be achieved without creating unacceptable risks. Benefits do not clearly outweigh the costs.
0.1	Low likelihood: The option is not capable of demonstrating that it can meet production requirements. Serious reservations are present that implementation can be achieved without creating unacceptable risks. Costs significantly outweigh the benefits.

Worksheet 10
Level III

Revision No.:______
Revision Date:______
Page _____ of _____

Pollution Prevention Opportunity Assessment
Final Report Check Sheet

PPOA Title or PPOA ID Code(s): ____________________

Requirement	***Completed***
Title Page	____
PPOA Title	
PPOA ID Code(s)	
Team members	
Issue date/revision date/revision no.	
Executive Summary	____
Process description	
Process assessment	
Option summary and analysis	
Conclusions	
Recommendations	
Introduction	____
Background of evaluation	
Process Description	____
Associated equipment	
Process flow diagram	
Process Assessment	____
Methodology	
Material Balance	
Unusual occurrences	
Option Summary and Analysis	____
Option description and rank	
Upstream/Downstream impacts	
Material usage	
Anticipated reduction	
Estimated costs	
Estimated benefits	
Feasibility	
Waste streams affected	
Conclusion	____
Concluding evaluation	
Option analysis decisions	
Concerns	
Options already implemented	
Lessons learned	
Recommendations	____
Future work	
New equipment	
Implementation strategies	
Worksheets	____
1-10	

Worksheet 10

A final report is required for each PPOA. The final report is a compilation of essential facts about the process, pollution prevention options, feasibility and impact of those options, and future implementation costs. The report documents the work performed and identifies funding requirements necessary to implement pollution prevention options. The length of the final report will depend on the complexity of the PPOA.

1. Revision No.: List the revision number for this worksheet.

2. Revision Date: List the most recent revision date for this worksheet.

3. Page____of____: Indicate the number of this page and the total number of pages for this worksheet.

4. PPOA Title or PPOA ID Code(s): List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

5. While writing the final report, check the blank next to each major **requirement** as all elements of that task are **completed**.

Title Page	Uniquely identify the PPOA, including team members and issue/revision date.
Executive Summary	This should be an overview of all of the elements of the final PPOA report. It should relate to the reader any information that is critical about this PPOA.
Introduction	Present background information and efforts taken to initiate the PPOA.
Process Description	Detail process flow and associated equipment. Include process flow diagram, if desired.
Process Assessment	Describe the approach used to complete the PPOA. Document any assumptions made. Include information on the material balance.
Option Summary & Analysis	Present the options generated, impacts if implemented, and their respective pollution prevention possibilities.
Conclusion	Provide closure to the report. The team's consensus on the benefits achieved from this PPOA or any concerns respective to the process should be included.
Recommendations	Describe any actions that will be taken to further advance the results of this PPOA.

Worksheet 1S

Level I

Date: ________

Page ______ of ______

Pollution Prevention Opportunity Assessment

Team & Process Description

Title:

PPOA ID Code:

Team Members (*Leader)	Job Classification	Phone
*		

Process Description:

Potential for Pollution Prevention or Recommendations:

Worksheet 1S

This worksheet provides the scope and identification of the pollution prevention opportunity assessment (PPOA) team. For the PPOA to be successful, employees involved with the activity being assessed should be members of the team. The assessment team needs a leader, members, and additional resources, as required.

The team leader should have technical knowledge of the area's operations and the personnel involved. The leader shall assemble the team to perform the assessment. Team members may include engineers, waste generators, waste management specialists, scientists, laboratory technicians, and other line personnel. Additional resources may be utilized to provide information not available within the team. The size of the team may be large for complicated operations, but should be kept to a minimum to maintain focus.

1. **Date:** List the initiation date for this PPOA.

2. **Title:** List the PPOA title selected by the team.

3. **PPOA ID Code:** List the PPOA ID Code selected by the team. This should be a unique identifier.

4. **Team Members, Job Classification, Phone:** To facilitate team meetings and for future reference, this information should be completed when the PPOA team is formed.

5. **Process Description:** This should detail important attributes of the operation. Equipment, summary of operations performed, controls, input materials, and operator training (qualification or certification) may be included.

6. **Potential for Pollution Prevention or Recommendations:** For this process, describe the potential for pollution prevention, source reduction, and/or waste minimization. (Is there any pollution prevention potential for the following changes: material substitution, procedures, process parameters, equipment, general practices, recycling, reuse, reclamation, etc.?) Are there any recommendations for this process?

Worksheet 2S

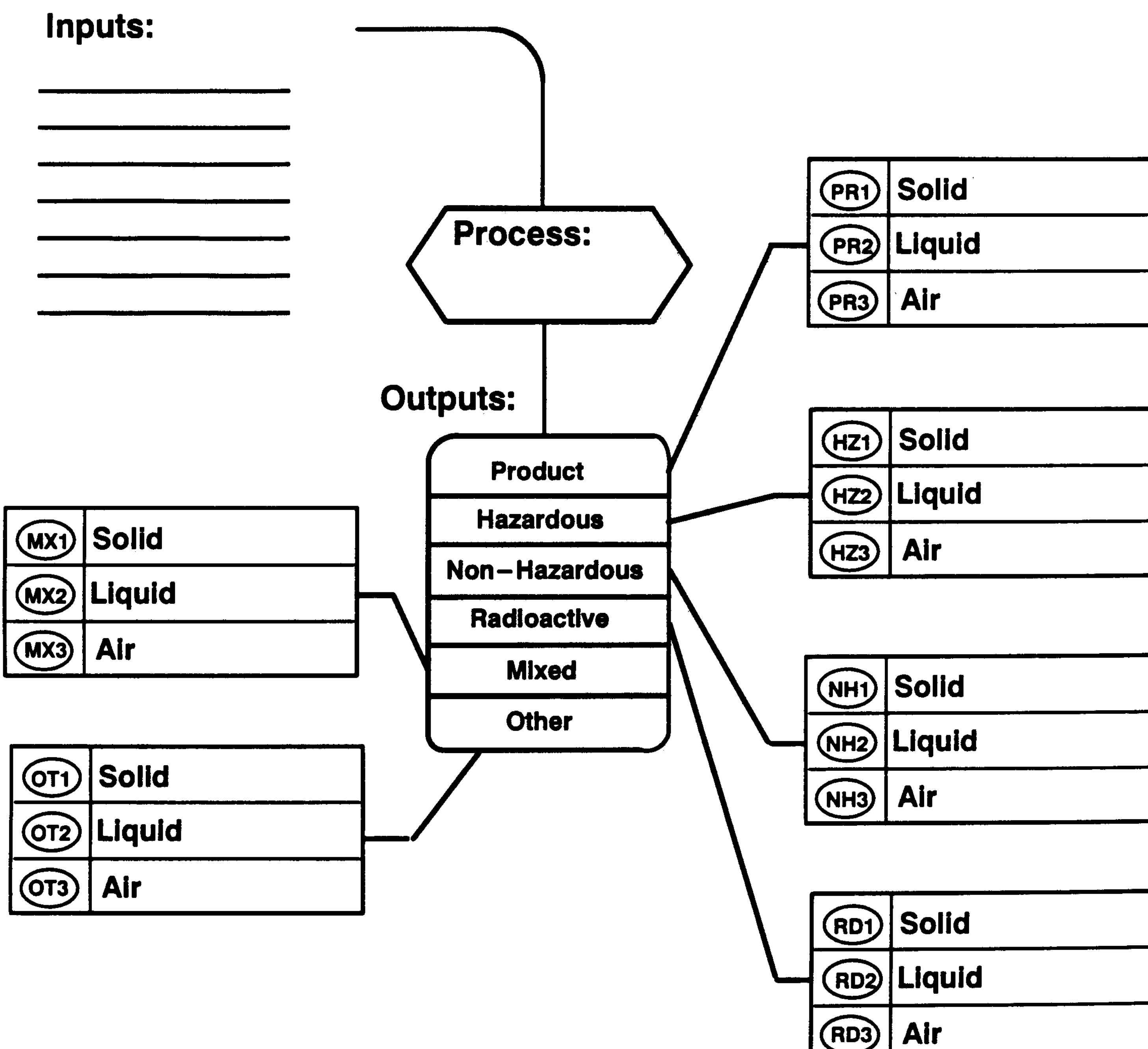
Level I

Date: ______

Pollution Prevention Opportunity Assessment

Process Flow Diagram

Title or Assessment ID Code: ________________________________



Worksheet 2S

This worksheet provides a method to document the process flow diagram for the assessment. The flow diagram should identify all Assessment Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Title or Assessment ID Code(s)**: List the PPOA Title or PPOA ID Code given on Worksheet 1S.

2. **Page ____of ____:** Indicate the page number for this worksheet and the number of pages for this worksheet.

3. **Inputs**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then sub-categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each sub-category of waste.

4. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information. A brief waste description may be recorded in the box to the right of the Stream ID Code. The code information is summarized in the table below:

Stream ID Codes

Designator	Code
Product	PR
Hazardous	HZ
Non-Hazardous	NH
Radioactive	RD
Mixed	MX
Other	OT

Solid Stream = 1, Liquid Stream = 2, Air Stream = 3

Worksheet 3S

Level I

Pollution Prevention Opportunity Assessment

Material & Waste Stream Summary

Title: ____________________

PPOA ID Code: ____________________

Input Material	Annual Quantity Used	% Product	% Recycled	Total Releases		
				% Air	% Liquid	% Solid

Does the process require further analysis based on the site's Priority Material/Waste Stream List?

Yes ________ No ________

Level II ________ Level III ________

Worksheet 3S

This worksheet provides a brief summary of the input materials and output streams from the operation or activity being assessed. Its purpose is to provide the pollution prevention team an overview of the waste streams resulting from the PPOA.

1. **Title:** List the PPOA title given on Worksheet 1S.

2. **Assessment ID Code:** List the PPOA ID Code given on Worksheet 1S.

3. **Input Material:** List the material names which enter the operation.

4. **Annual Quantity Used:** Enter the annual quantity used for each material listed - include the unit of measure, e.g., lbs, curies, etc. For input material from another process, it may be helpful to also identify the release components of those materials.

5. **% Product:** For each input material, estimate the percent of the annual quantity used which goes to product.

6. **% Recycled:** For each input material, estimate the percent of the annual quantity used which is recycled.

7. **% Air:** For each input material, estimate the percent of the annual quantity used which is an air waste stream.

8. **% Liquid:** For each input material, estimate the percent of the annual quantity used which is a liquid waste stream.

9. **% Solid:** For each input material, estimate the percent of the annual quantity used which is a solid waste stream.

10. **Does the process require further analysis based on the site's Priority Material/Waste Stream List?** Using your site's Priority Material/Waste Stream List and the DOE Graded Approach Logic Diagram, determine if further assessment is necessary. If yes, indicate the level of assessment required.

Worksheet 4S

Level II

Pollution Prevention Opportunity Assessment

Option Summary

Title or PPOA ID Code(s) ______________________________

____

Option No. __: ______________________________

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Type (*)	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty

Option No. __: ______________________________

____

____

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____

Type (*)	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty

Option No. __: ______________________________

____

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Type (*)	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty

(*) Type = Source Reduction, Recycling, Treatment, or Disposal

Worksheet 4S

This summary sheet serves as a method to record and evaluate the options that have been identified during brainstorming sessions or other option generating techniques.

1. **Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code given on Worksheet 1S.

2. **Option :** Options generated should be numbered consecutively. Briefly describe each option, affected materials, waste streams, upstream/downstream impacts if implemented, and anticipated reduction quantity if implemented.

3. **Type:** Indicate whether the option is source reduction, recycling, treatment, or disposal.

4. **Consider?:** If the option is worth further consideration, enter YES. If not, enter NO and briefly indicate in the Option Description why not.

5. **Feasibility**: Provide a brief description. (Excellent, good, fair, poor)

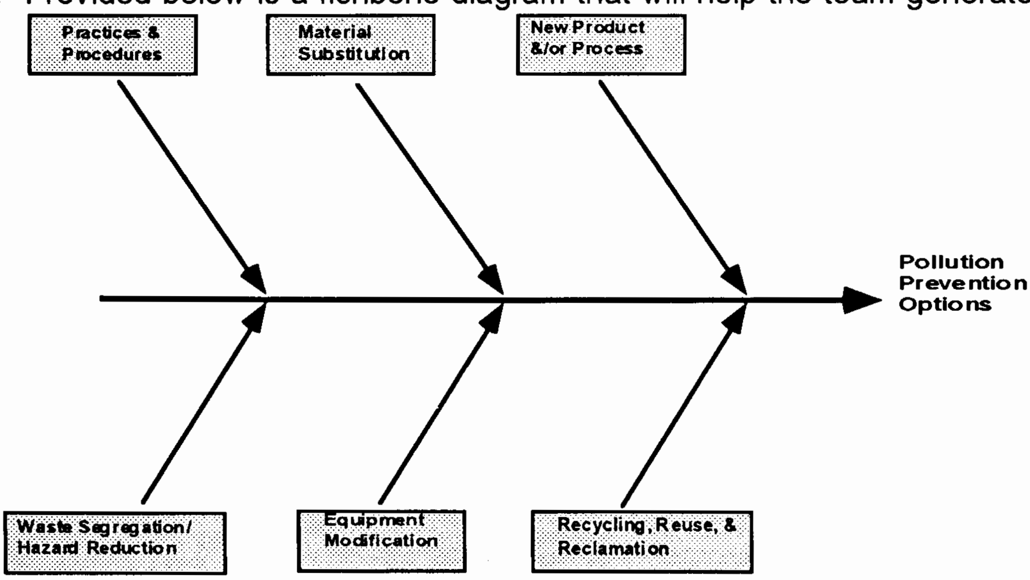
6. **Estimated Cost**: Estimate an implementation cost.

7. **Estimated Cost Savings**: Estimate the cost savings.

8. **Anticipated Reduction Qty.**: Estimate the weight or volume of the waste that will be reduced.

Note: Typically, it is difficult to estimate the anticipated waste reduction or cost avoidance in the initial phases of implementation because of many factors. However, for some options, especially in cases where the option provides complete elimination of a hazardous material or waste stream, these estimates can be accurately completed.

The process by which options are identified should occur in an environment that encourages creativity and independent thinking. Brainstorming sessions are effective ways for individuals to generate options. To make these sessions beneficial, research is often necessary. Provided below is a fishbone diagram that will help the team generate ideas.



Worksheet 5S

Level II

Date: __________

Page ______ of ______

Pollution Prevention Opportunity Assessment

Final Summary

Title: ______________________________

PPOA ID Code(s): ______________________________

Assessment: ______________________________

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Conclusions: ______________________________

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Recommendations: ______________________________

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Worksheet 5S

This sheet provides a brief summary of other pertinent information about the activity being assessed. Its purpose is to document how this assessment was performed, the conclusions reached by the team, and the recommendations for further actions.

1. **Date:** List the date this sheet was completed.

2. **Title:** List the title given on Worksheet 1S.

3. **PPOA ID Code(s):** List the ID Code(s) given on Worksheet 1S.

4. **Assessment:** Briefly describe the approach (methodology) used to complete this assessment and any assumptions made.

5. **Conclusions:** Briefly describe the waste streams or input material to be minimized, benefits achieved from this assessment, and any concerns (environmental or health risks) associated with the material or operation.

6. **Recommendations:** Briefly describe any actions that should or will be taken in respect to this assessment.

APPENDIX G

MODEL PPOA WORKSHEETS

Worksheet 1

Level III

Original Issue Date: ________
Revision No.: ________
Revision Date: ________

Pollution Prevention Opportunity Assessment

PPOA Team

PPOA Title: ____________________

PPOA ID Code(s): ____________________

Name	Job Classification	Phone
*		

*Team Leader

Additional Resources	Name	Phone
PPOA Coordinator		
Waste Management		
Industrial Hygiene		
Environmental Protection		
Safety		
Fire Protection		
Process Engineering		
Materials Engineering		
Utilities Engineering		
Facilities Engineering		
Maintenance (Equipment)		
Analytical Lab Testing		
Scheduling		
Purchasing		

Worksheet 1

Worksheet 1 provides the identification of the PPOA assessment team. For the PPOA to be successful, employees involved with the process should be members of the team. The assessment team needs a leader, members, and additional resources, as required.

The team leader should have technical knowledge of the process, knowledge of the current production operations, and the personnel involved. The leader shall assemble the team to perform the assessment. Team members may include process engineers, product engineers, knowledgeable department personnel such as production operator(s), and material experts. Additional resources may be called in to provide information not available within the team. The size of the team may be large for complicated processes, but should be kept to a minimum to maintain focus.

1. **Original Issue Date:** List the original issue date of the PPOA.

2. **Revision No.:** List the revision number for this worksheet. {Original issue = 0.}

3. **Revision Date:** List the most recent revision date for this worksheet.

4. **PPOA Title:** List the PPOA title selected by the team.

5. **PPOA ID Code(s):** List the PPOA ID Code(s) selected by the team.

6. **Name, Job Classification, Phone:** To facilitate team meetings and for future reference, this information should be completed when the PPOA team is formed.

Worksheet 2
Level III

Revision No.: ________
Revision Date: ________

Pollution Prevention Opportunity Assessment

Process Description

PPOA Title: ______________________________

PPOA ID Code(s): ______________________________

Process Location: ______________________________

Process Description: ______________________________

Description of Major Product(s) of Process: ______________________________

Worksheet 2

Worksheet 2 provides a brief description of the process. The main elements of the process description are the process location, input materials, equipment, summary of operations performed, process controls, operator training, major products, and the waste streams affected.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title:** List the PPOA Title given on Worksheet 1.

4. **PPOA ID Code(s):** List the PPOA ID Code(s) given on Worksheet 1.

5. **Process Location:** List the best descriptor of the process location. It may be a department, building, room, etc..

6. **Process Description:** The process description should detail important attributes of the process. Equipment, summary of operations performed, process controls, input materials, and operator training (qualification or certification) should be included.

7. **Description of Major Product(s) of Process:** Describe the major products which result from this process or the reason the process is being perfromed.

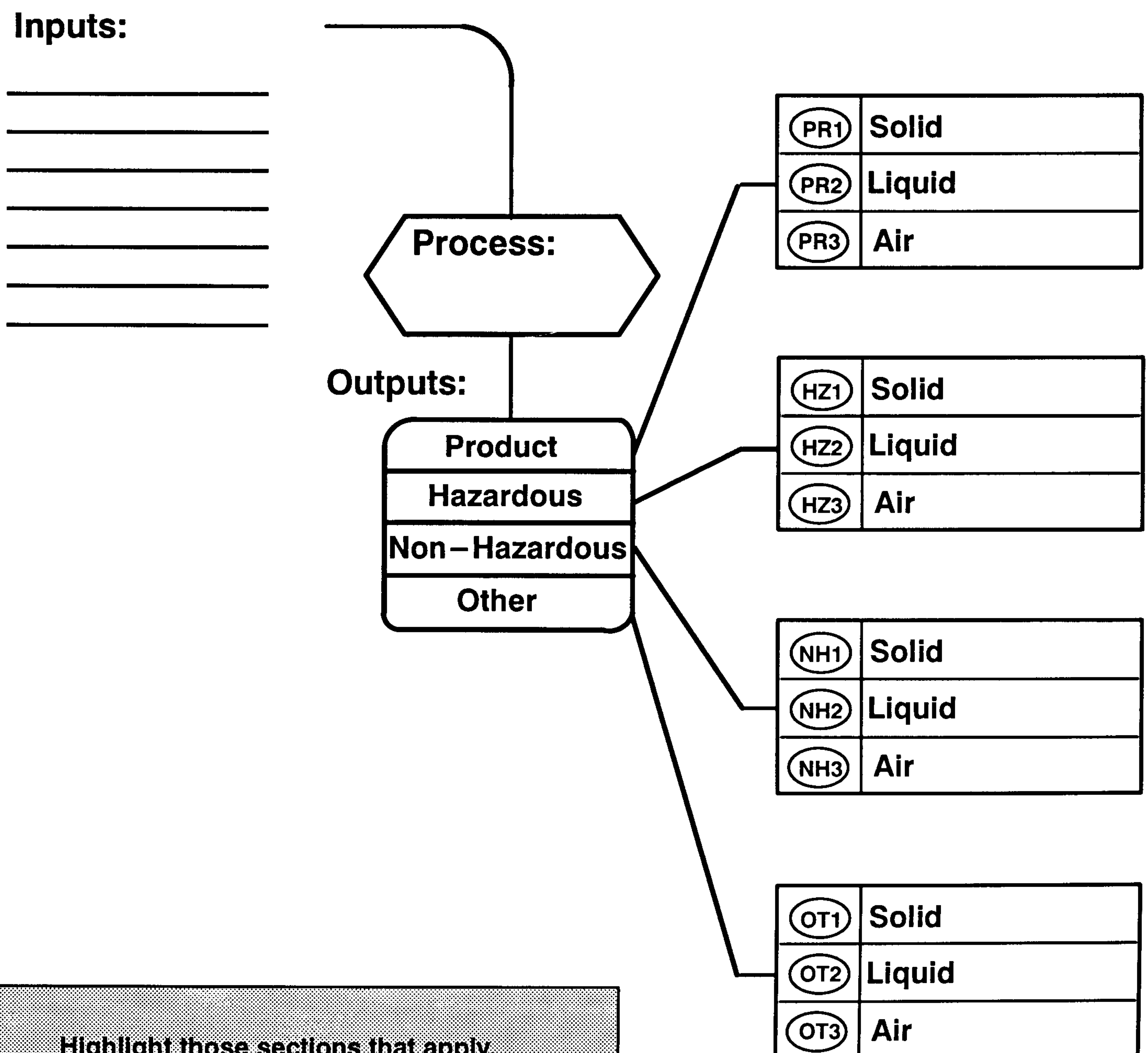
Worksheet 3
Style 1
Level III

Revision No. : ____________
Revision Date: ____________

Pollution Prevention Opportunity Assessment

Process Flow Diagram

PPOA Title or PPOA ID Code(s): ______________________________



Highlight those sections that apply.
Use Worksheet 4 to identify and quantify the appropriate stream.

11/93

Worksheet 3

Worksheet 3 provides a process flow diagram for the PPOA. The flow diagram should identify all PPOA ID Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

4. **Process Flow Diagram**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then sub-categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each sub-category of waste.

5. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information requested on Worksheet 4. A brief waste description may be recorded in the box to the right of the Stream ID Code.

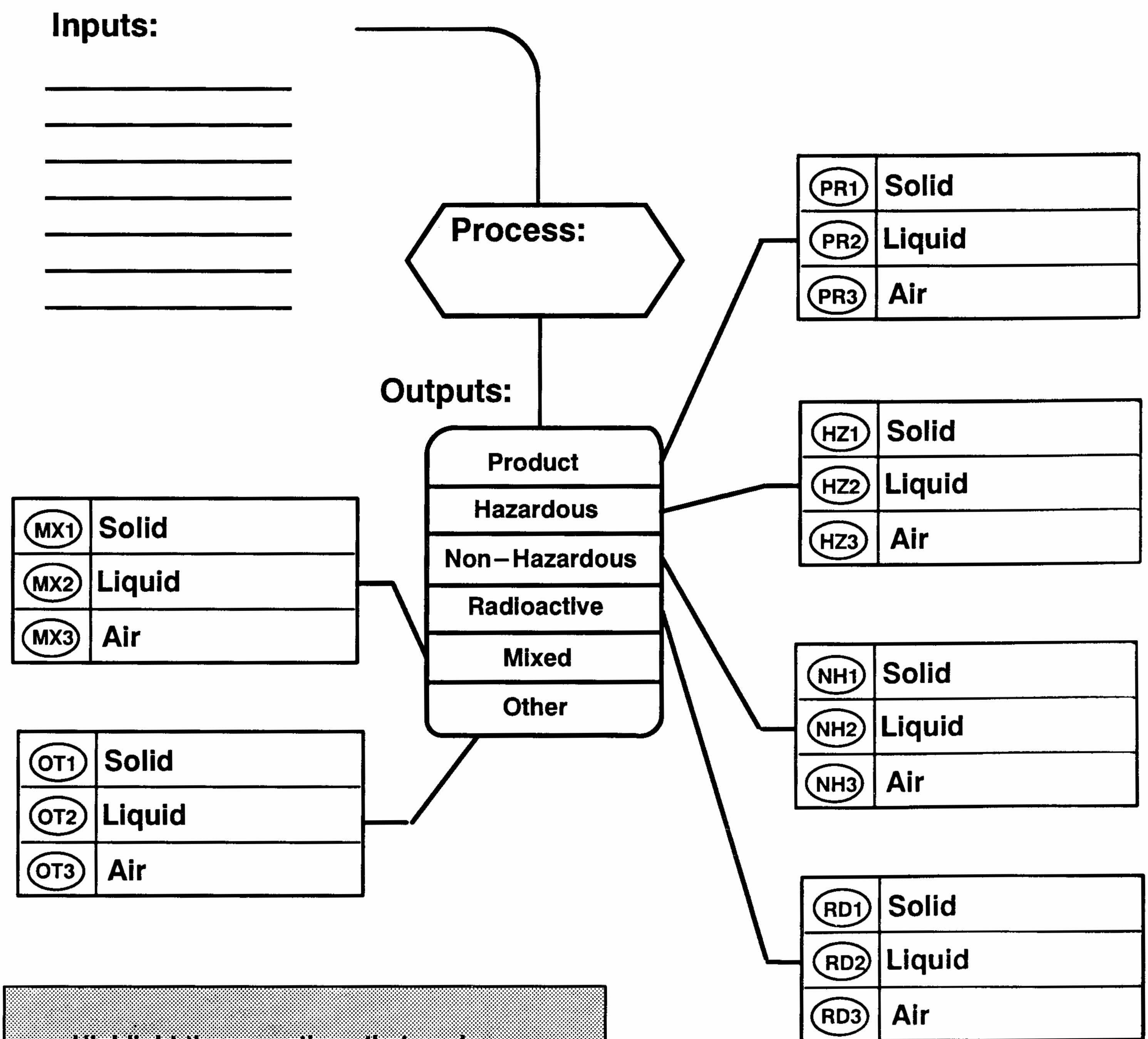
Worksheet 3
Style 2
Level III

Revision No.: ________
Revision Date: ________

Pollution Prevention Opportunity Assessment

Process Flow Diagram

PPOA Title or PPOA ID Code(s): ______________________________



Highlight those sections that apply.
Use Worksheet 4 to identify and
quantify the appropriate stream.

11/93

Worksheet 3

Worksheet 3 provides a process flow diagram for the PPOA. The flow diagram should identify all PPOA ID Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

4. **Process Flow Diagram**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then sub-categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each sub-category of waste.

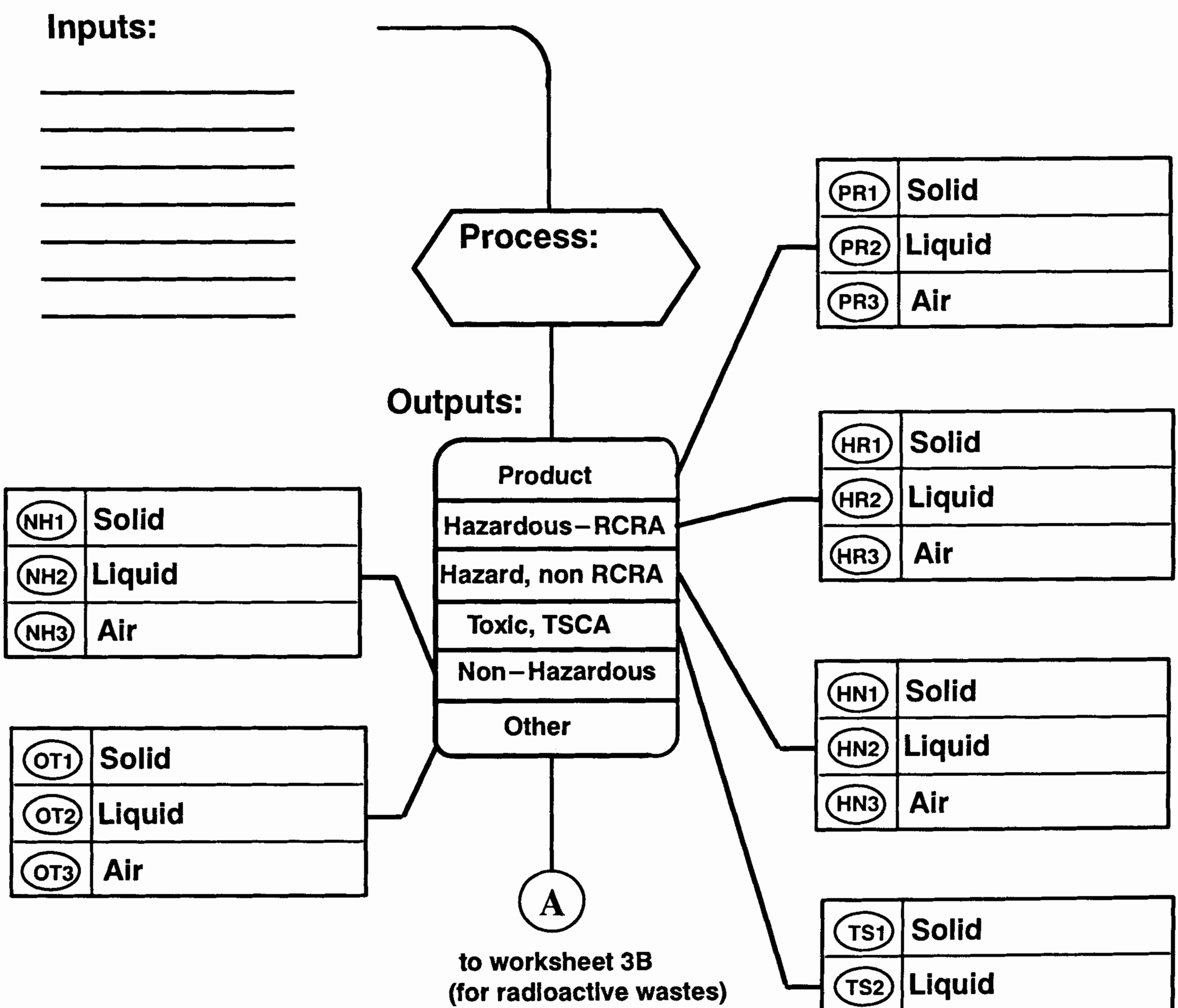
5. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information requested on Worksheet 4. A brief waste description may be recorded in the box to the right of the Stream ID Code.

Worksheet 3A
Style 3
Level III

Revision No.: ____________
Revision Date: ____________

Pollution Prevention Opportunity Assessment
Process Flow Diagram

PPOA Title or PPOA ID Code(s): ______________________________



Highlight those sections that apply.
Use Worksheet 4 to identify and quantify the appropriate stream.

Worksheet 3A

Worksheet 3 provides a process flow diagram for the PPOA. The flow diagram should represent all PPOA ID Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

4. **Process Flow Diagram**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each category of waste.

5. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information requested on Worksheet 4. A brief waste description may be recorded in the box to the right of the Stream ID Code.

DOE Definitions:

Hazardous Waste - Waste, which because of its quantitiy, concentration, or physical, chemical or infectious nature may (a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness, or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous waste can be further defined as:

RCRA-regulated - solid waste not specifically excluded from regulation under 40 CFR 261.4, or delisted by petition, that is either a listed hazardous waste (40 CFR 261.30 - 261.33) or exhibits the characteristics of a hazardous waste (40 CFR 261.20 - 261.24).

Non RCRA-regulated - any other hazardous waste not specifically regulated under TSCA or RCRA, which may be regulated by the state or local authorities, such as used oil.

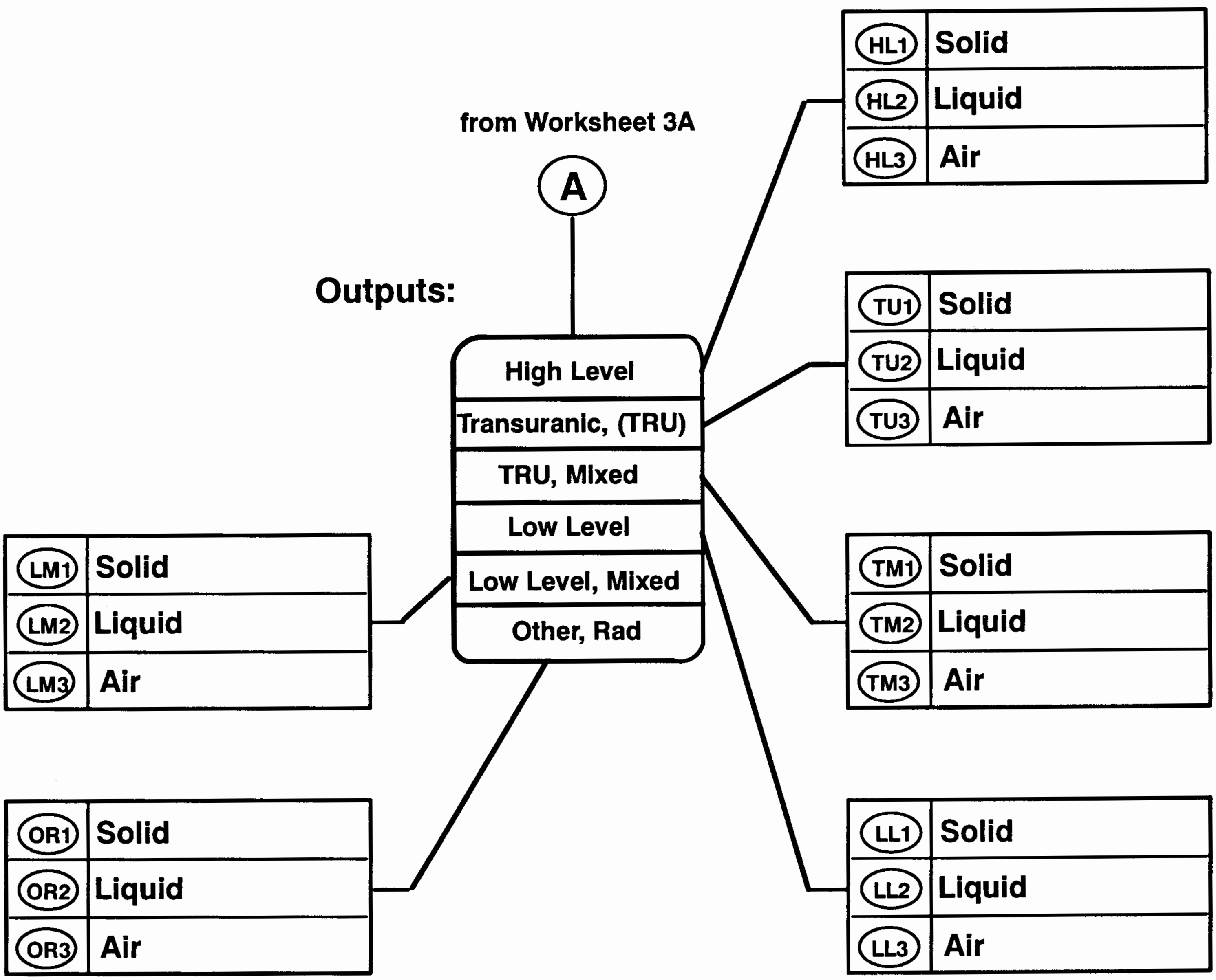
TSCA Waste - Individual chemical wastes (both liquid and solid), such as polychlorinated biphenyls (PCBs).

Worksheet 3B
Style 3
Level III

Revision No. :
Revision Date:

Pollution Prevention Opportunity Assessment
Process Flow Diagram

PPOA Title or PPOA ID Code(s): ______________________



**Highlight those sections that apply.
Use Worksheet 4 to identify and
quantify the appropriate stream.**

Worksheet 3B

Worksheet 3 provides a process flow diagram for the PPOA. The flow diagram should represent all PPOA ID Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

4. **Process Flow Diagram**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each category of waste.

5. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information requested on Worksheet 4. A brief waste description may be recorded in the box to the right of the Stream ID Code.

DOE Definitions:

High Level Waste- Irradiated reactor fuel, liquid wastes resulting from operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and solids into which such liquid wastes have been converted. (10 CFR 60.2)

Transuranic Waste - Waste that is contaminated with alpha-emitting radionuclides with (1) an atomic number greater than 92 (heavier than uranium); (2) half-lives greater than 20 years; and (3) concentrations greater than 100 nanocuries per gram of waste.

Transuranic Mixed Waste: - Waste which contains both transuranic waste and hazardous components, as defined by the Atomic Energy Act and RCRA, respectively.

Low Level Waste: - Radioactive Waste not classified as high level waste, transuranic waste, spent nuclear fuel, or by-product material [specified as uranium or thorium tailings and waste in accordance with DOE Order 5820.2A].

Low Level Mixed Waste: - Waste which contains both low level waste and hazardous components, as defined by the Atomic Energy Act and RCRA, respectively.

Worksheet 4

Level III

Pollution Prevention Opportunity Assessment

Mass Balance Summary

Revision No.: ____________

Revision Date: ____________

Page ________ of ________

Time frame

From: ________

To: ________

PPOA Title or PPOA ID Code(s): ______________________________

			OUTPUT QUANTITY (Units: _____)									
Material Description	Total Input	Total Output	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code	Stream ID Code
Totals/Subtotals											

Worksheet 4

A material balance is a summation of the total quantity of input material to a process and the releases to the environment, another process, or made into product. The purpose of Worksheet 4 is to tabulate this information and total the inputs and outputs for all streams.

1. **Revision No.:** List the revision number of the PPOA.

2. **Revision Date**: List the most recent revision date for the PPOA worksheet.

3. **PPOA Title/PPOA ID Code(s)**: List the PPOA Title or ID Code(s) given on Worksheet 1.

4. **Page ____of ____:** Indicate the page number for this worksheet and the number of pages for this worksheet.

5. **From/To**: Report the dates (month and year) for the time period covered. An annual period is suggested for purposes of averaging and documenting performance toward facility goals.

6. **Material Description:** List the material name and stock number (optional) or the output product if different than originating material.

7. **Units ____:** Enter the unit of measure for the input/output summary. A consistent unit of measurement is suggested. If requirements dictate mixing units, designate the units for a particular column under the Stream ID Code heading.

8. **Total Input:** For the material described in the far left column enter the weight of material used in the process during the time frame specified.

9. **Total Output:** For the material specified in the Material Description column enter the weight of the output. This is the sum of all waste streams and any product generated. For processes where chemical reactions take place, input materials are consumed or changed to different compounds, a separate entry in the Material Description column is required to adequately define the output. In these cases, the input and output quantities will not balance for the listed material in that row.

10. **Output Quantity:** Use these columns to break down the total output into output categories. Refer to Worksheet 3 for the appropriate Stream ID Code for the output type. Enter the Stream ID Code at the top of the column (e.g., HZ1 for a hazardous solid waste stream), then enter the discharge amount for the material described in the Material Description column that relates to that Stream ID Code. Continue across the worksheet for all Stream ID Code(s) utilized in Worksheet 3.

11. **Totals/Subtotals:** Sum the Total Input, Total Output, and Output columns. Record the sum at the bottom row of the last worksheet. Subtotals are recorded at the bottom row for other pages of the worksheet. The Total Input column should equal the Total Output column unless there is system accumulation. The Total Output column should also be the sum of all the Stream ID Code output streams.

Stream ID Codes:

Designator	Style 1	Style 2	Style 3
Product	PR	PR	PR
Hazardous	HZ	HZ	
Non-Hazardous	NH	NH	NH
Radioactive		RD	
Mixed		MX	
Other	OT	OT	OT
Hazardous, RCRA			HR
Hazardous, Non-RCRA			HN
Toxic, TSCA			TS
High Level			HL
Transuranic, TRU			TU
TRU, Mixed			TM
Low Level			LL
Low Level, Mixed			LM
Other, Radioactive			OR

Solid Stream = 1, Liquid Stream = 2, Air Stream = 3

Style refers to the version of Worksheet 3 used.

Worksheet 5
Level III

Revision No.: ______
Revision Date: ______
Page ______of ______

Pollution Prevention Opportunity Assessment

Material Cost

PPOA Title or PPOA ID Code(s): ______________________________

Input Material Cost:

Material	Stock Number (if applicable)	Cost Per Unit	Annual Cost
		Total / Subtotal	

Waste Disposal Cost:

Material / Waste Stream	Waste Stream Category	Cost Per Unit	Annual Cost
		Total / Subtotal	

Worksheet 5

Worksheet 5 details the cost of the PPOA input materials (use the quantities from Worksheet 4) and the cost of disposal for these materials. The material cost may be obtained from Purchasing or Stores. The cost of disposal may be obtained from Waste Management or Accounting. Annual Cost is calculated from the amount of material placed in the process or from the amount of disposed material, multiplied by the cost per unit.

1. Revision No.: List the revision number for this worksheet.

2. Revision Date: List the most recent revision date for this worksheet.

3. Page_____of_____: Indicate the number of this page and the total number of pages for this worksheet.

4. PPOA Title or PPOA ID Code(s): List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

5. Input Material Cost: List the material, stock number (if applicable), cost per unit ($/lb., $/gal, etc.), and the annual cost for this process.

6. Waste Disposal Cost: List the material or waste stream, waste stream category, (e.g., hazardous liquid), stock number if applicable, the cost per unit ($/lb., $/gal, etc.) , and annual cost.

7. Totals / Subtotals: Record the sum of the annual costs for the materials or waste streams listed. There will be a total for both the input material cost and waste disposal cost.

Worksheet 6

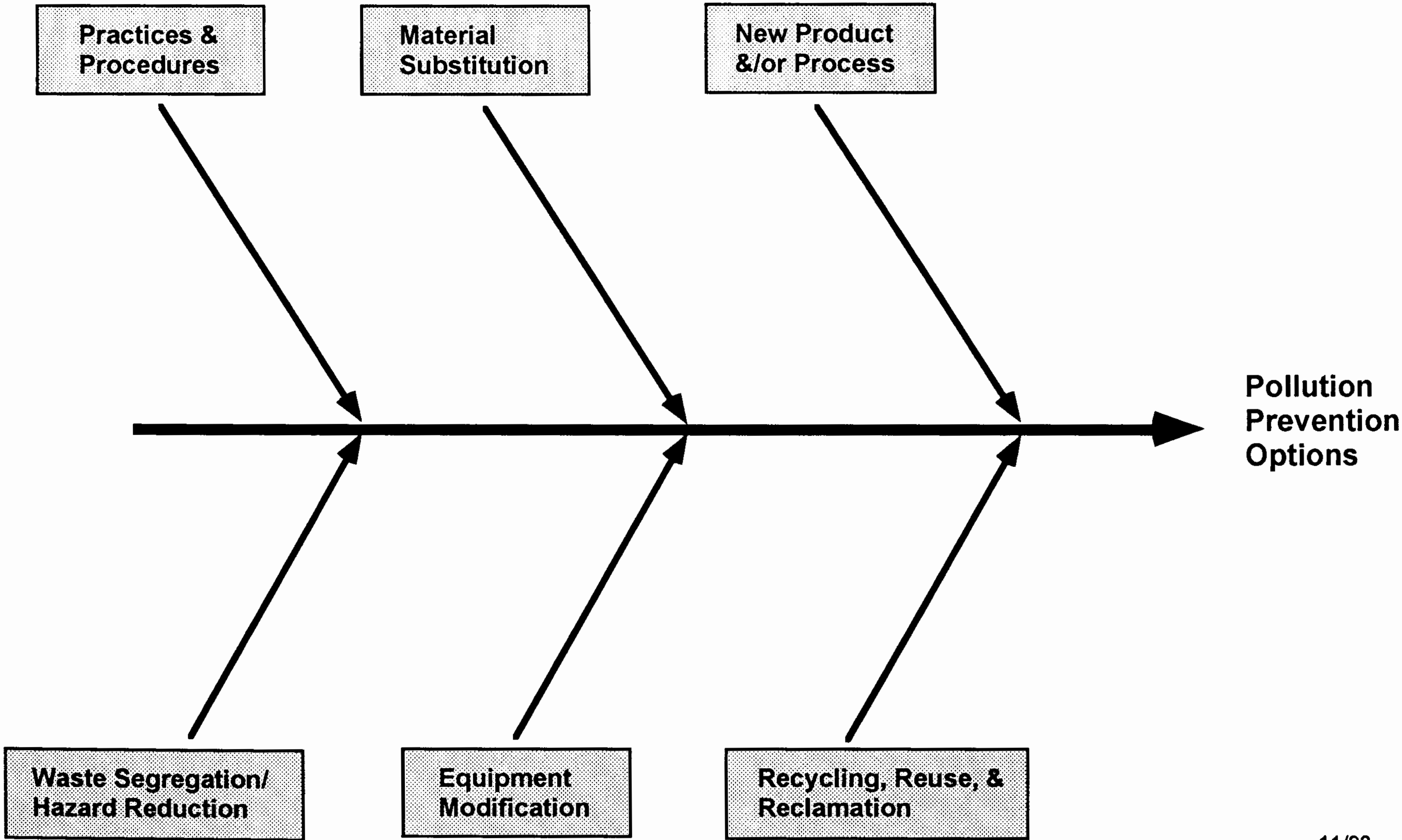
Level III

Revision No.: ________
Revision Date: ________

Pollution Prevention Opportunity Assessment

Option Generation

PPOA Title or PPOA ID Code(s): ______________________



Worksheet 6

Worksheet 6 provides a tool for option generation. The purpose of this diagram (sometimes referred to as a Fishbone Diagram) is to help generate pollution prevention ideas. It is especially useful in a brainstorming session to group ideas undersimilar pollution prevention categories. It also helps insure that all of the pollution prevention categories are considered.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **PPOA Title or PPOA ID Code(s):** List the PPOA title or PPOA ID Code(s) given on Worksheet 1.

4. **Brainstorming ideas:** Using the Fishbone Diagram, briefly document ideas for pollution prevention.

The following definitions clarify each of the major categories.

Practices & Procedures -- Good operating practices and procedures apply to the human aspect of operations. They are largely efficiency improvements. Examples are: Pollution Prevention Programs, personnel training, material handling & inventory practices, material loss prevention, scrap reduction, cost accounting, production scheduling, etc.

Material Substitution -- Changes to the input materials of the process. The result is a reduction or elimination of a pollutant or hazard.

New Product &/or Process -- Product changes which result in the reduction or elimination of waste. In addition, a different process can be used to create the same product with the intent of minimizing waste.

Waste Segregation/Hazard Reduction -- Actions taken to segregate waste streams to prevent nonhazardous waste from being designated and handled as hazardous. Hazard reduction can result from changes to the physical, chemical, or biological character or composition of the waste. These include neutralization, toxicity reduction, or volume reduction.

Equipment Modification -- Changes that occur to the equipment used in a process. These could include minor adjustments, additions, or complete replacements.

Recycling -- A material is recycled if it is used, reused, or reclaimed: (1) if it is used for something other than its original purpose, (2) if it goes back into the original process, or (3) if it is chemically or physically treated for use or reuse.

Worksheet 7

Level III

Revision No.: _____
Revision Date:_____
Page _____**of**_____

Pollution Prevention Opportunity Assessment

Option Description

PPOA Title or PPOA ID Code(s): ______________________________

Option Name and Description
(Include input materials, products affected, and anticipated reduction quantity.)

Option No. _____ **:** ______________________________

____

____

____

______________________________ **Consider: Yes__No__**

Practices & Procedures _______ Waste Segregation/Hazard Reduction _____
Material Substitution _________ Equipment Modification _____
New Product &/or Process _____ Recycling, Reuse, & Reclamation _____

Option No. _____ **:** ______________________________

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______________________________ **Consider: Yes__No__**

Practices & Procedures _______ Waste Segregation/Hazard Reduction _____
Material Substitution _________ Equipment Modification _____
New Product &/or Process _____ Recycling, Reuse, & Reclamation _____

Option No. _____ **:** ______________________________

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____

______________________________ **Consider: Yes__No__**

Practices & Procedures _______ Waste Segregation/Hazard Reduction _____
Material Substitution _________ Equipment Modification _____
New Product &/or Process _____ Recycling, Reuse, & Reclamation _____

Option No. _____ **:** ______________________________

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______________________________ **Consider: Yes__No__**

Practices & Procedures _______ Waste Segregation/Hazard Reduction _____
Material Substitution _________ Equipment Modification _____
New Product &/or Process _____ Recycling, Reuse, & Reclamation _____

Worksheet 7

The purpose of this worksheet is to further document the pollution prevention options identified on Worksheet 6. The process by which options are identified should occur in an environment that encourages creativity and independent thinking. Brainstorming sessions are effective ways for individuals to generate options. Consideration of the options generated in a brainstorming session can lead to questions. Answering these questions may require additional research. Listed below are some of the sources that can help to answer questions and/or generate additional options.

- Literature searches
- Technical conferences
- Equipment exhibitions
- Trips to other plants
- Vendor surveys
- Contact with design engineers
- Contact with personnel in other departments who have participated in similar PPOAs
- Materials engineers
- Benchmarking

1.Revision No.: List the revision number for this worksheet.

2. Revision Date: List the most recent revision date for this worksheet.

3. PPOA Title or PPOA ID Code: List the PPOA Title or PPOA ID Code given on Worksheet 1.

4. Page ___ of ___: Indicate the number of this page and the total number of pages for this worksheet.

5. Option: Options generated should be numbered consecutively and placed on this worksheet (reference Worksheet 6). They may or may not be evaluated. Briefly describe each option, affected materials and product, any roadblocks to implementation, upstream and downstream impacts if implemented, and anticipated reduction quantity.

6. Consider Yes/No: If the suggestion is worth further consideration, check 'Yes'. If the suggestion will not be pursued, check 'No' and indicate briefly in the Option Description why not.

7. Practices & Procedures, Material Substitution, New Product &/or Process, Waste Segregation/ Hazard Reduction, Equipment Modification, and Recycling, Reuse, & Reclamation: Check the appropriate descriptions. See Worksheet 6 for definitions.

Worksheet 8
Level III

Revision No.: ________
Revision Date: ________
Page ________of ________

Pollution Prevention Opportunity Assessment

Options Cost Evaluation

PPOA Title or PPOA ID Code(s): ________________________________

	Option No.:	Option No.:	Option No.:	Option No.:	Option No.:
Implementation Costs					
Purchased Equipment					
Installation					
Materials					
Utility Connections					
Engineering					
Development					
Start up / Training					
Administrative					
Other					
Total Implementation Cost					
Incremental Operating Costs					
Change in Raw Materials					
Change in Maintenance					
Change in Labor					
Change in Disposal					
Other					
Annual Operating Savings/(Cost)					
Incremental Intangible Costs					
Penalties and Fines					
Future Liabilities					
Other					
Annual Intangible Savings/(Cost)					
Total Annual Savings/(Cost)					
Payback Period					

Worksheet 8

This worksheet provides a method to compare and contrast the pollution prevention options generated on Worksheet 6 from a cost perspective. The three major cost categories for weighing options are: Implementation Costs, Incremental Operating Costs, and Incremental Intangible Costs. These costs are totaled for each option considered from Worksheet 7. This worksheet will aid in completing the economic evaluation portion of Worksheet 9.

1. **Revision No.:** List the revision for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **Page ____of____:** Indicate the number of this page and the total number of pages for this worksheet.

4. **PPOA Title or PPOA ID Code(s):** List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

5. **Implementation Cost:** These are the one-time, first-year costs associated with the implementation of each option. Installation costs should be reported as an estimate. Implementation Cost may include materials, utility connections, site preparation, installation, engineering, procurement, start-up, training, permitting, initial catalysts and chemicals, and working capital; minus the salvage value of any existing equipment.

6. **Annual Operating Savings/(Costs):** These are the costs associated with day-to-day operations. List the incremental costs compared to the current process costs (positive for savings or negative for increased costs) that would be incurred if this option is implemented. Incremental operating costs could include waste disposal, raw material consumption, ancillary catalysts and chemicals, labor, maintenance and supplies, insurance, incremental revenues from increased / decreased production, and incremental revenues from marketable by-products.

7. **Annual Intangible Savings/(Cost):** These include hidden, liability, and other costs not immediately obvious for each option. List the incremental costs compared to the current process costs (positive for savings or negative for increased costs) that would be incurred if this option is implemented. These costs could include penalties and fines, future liabilities (storage, transportation, and disposal of hazardous waste), reporting, consulting fees, monitoring/testing, record keeping, preparedness and protective equipment, medical surveillance, manifesting, inspections, and corporate/public image.

8. **Total Annual Cost/Savings:** This is the sum of the **Annual Operating Savings/(Cost)** and the **Annual Intangible Savings/(Cost)**.

9. **Payback Period:** Divide the **Total Implementation Cost** by the **Total Annual Savings/(Cost)**.

Worksheet 9

Level III

Revision No.: ________
Revision Date: ________
Page ______ of ________

Pollution Prevention Opportunity Assessment

Weighted Sums Option Evaluation

PPOA Title or PPOA ID Code(s): ____________________

Criteria	Weight 'W'	Option No.: ____ Scale 'S'	'WxS'	Option No.: ____ Scale 'S'	'WxS'	Option No.: ____ Scale 'S'	'WxS'	Option No.: ____ Scale 'S'	'WxS'	Option No.: ____ Scale 'S'	'WxS'
Public Health, Safety, & Environment	10										
Employee Health & Safety	10										
Regulatory Compliance	8										
Economic	6										
Implementation Period	4										
Improved Operation / Product	2										
Other											
Subtotal											
Likelihood of Technical Success (Multiplier)		x		x		x		x		x	
Likelihood of Useful Results (Multiplier)		x		x		x		x		x	
Total											
Rank											

Many pollution prevention options will be identified in a successful assessment. At this point, it is necessary to identify those options that offer real potential to minimize waste and reduce costs. Worksheet 9 serves as a screening tool to prioritize or eliminate suggested options.

1. **Revision No.:** List the revision number for this worksheet.

2. **Revision Date:** List the most recent revision date for this worksheet.

3. **Page ____ of ____:** Indicate the number of this page and the total number of pages for this worksheet.

4. **PPOA Title or PPOA ID Code(s):** List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

Additional Instructions:

a. The values in the Weight column (designated by 'W') represent the facility's priority for the criteria.

b. In the Scale column for each option (designated by 'S'), rate each criteria by assigning a value from 0-10 (lowest to highest). Use the definitions which follow to help determine a value.

c. In the 'W x S' column for each option, enter the product of the weight and scale.

d. Sum the 'W x S' column for each option to obtain a subtotal.

e. Multiply the subtotal for each option by the Likelihood of Technical Success.

f. Multiply the value in step e. above for each option by the Likelihood of Useful Results.

g. Enter the product found in step f. in the Total column for each option.

h. Assign a priority rank for each option; #1 for the highest score, #2 for the next highest, and so on.

Worksheet 9 -- (Scale & Multiplier Definitions)

Scale Factor Definitions (0-10)

	Public Health, Safety, & Environment -- Health or safety risk to the general public or damage to the environment.
10	Reduce the risk of loss of life or long-term environmental damage. High concentrations of hazardous materials.
8	Reduce the risk of long-term disability or moderate environmental damage. Moderate concentrations of hazardous materials.
6	Reduce the risk of short-term disability or unplanned releases to the environment. Low concentrations of hazardous materials.
4	No effect.
0	Negative effect.

	Employee Health & Safety -- Health or safety risk to an employee, contractor, or visitor.
10	Reduce the risk of loss of life through an accident or long-term exposure.
8	Reduce the risk of permanent or long-term disability through an accident or long-term exposure.
6	Reduce the risk of short-term disability or lost-time through an accident or long-term exposure.
4	No effect.
0	Negative effect.

	Regulatory Compliance -- Risk of non-compliance to regulatory laws with respect to employees or managers.
10	Reduce the risk and avoid criminal penalties.
8	Reduce the risk and avoid civil penalties.
6	Reduce the risk.
4	No effect.
0	Negative impact.

	Economic -- Potential for cost savings and payback period.
10	Large savings and short payback.
8	Moderate savings and moderate payback.
6	Positive cost savings and extented payback.
4	No cost savings and no possibility of payback.
0	Negative cost savings.

	Implementation Period -- Potential for rapid implementation of pollution prevention options.
10	Immediate (e.g., within 1 month).
8	Short-term (e.g., within 1 year).
6	Intermediate (e.g., within 2 years).
4	Long-term (e.g., within 3 years).
0	Greater than 3 years.

	Improved Operation / Product -- Quality improvement to process or product.
10	Significant improvement.
8	Moderate improvement.
6	Positive improvement.
4	No improvement.
0	Negative effect.

Worksheet 9 -- (Scale & Multiplier Definitions)

Multiplier Definitions (0-1)

	Likelihood of Technical Success
1	High likelihood: No major technical breakthrough required. Well-designed plans to meet objectives and successful track record exists.
0.5	Medium likelihood: Technical advancements may be necessary. Key issues are identified but no specific contingency plans have been made.
0.1	Low likelihood: Major technical breakthroughs are required. Adequate plans for meeting objectives or key problems have not been identified.

	Likelihood of Useful Results
1	High likelihood: Project has demonstrated that it can meet production requirements. There is a high confidence that implementation will not create unacceptable risks. Benefits outweigh the costs.
0.5	Medium likelihood: Project has not yet demonstrated that it can meet production requirements. There are reservations that implementation can be achieved without creating unacceptable risks. Benefits do not clearly outweigh the costs.
0.1	Low likelihood: The option is not capable of demonstrating that it can meet production requirements. Serious reservations are present that implementation can be achieved without creating unacceptable risks. Costs significantly outweigh the benefits.

Worksheet 10
Level III

Revision No.:______
Revision Date:______
Page ______ of ______

Pollution Prevention Opportunity Assessment
Final Report Check Sheet

PPOA Title or PPOA ID Code(s): ____

Requirement	***Completed***
Title Page	_____
PPOA Title	
PPOA ID Code(s)	
Team members	
Issue date/revision date/revision no.	
Executive Summary	_____
Process description	
Process assessment	
Option summary and analysis	
Conclusions	
Recommendations	
Introduction	_____
Background of evaluation	
Process Description	_____
Associated equipment	
Process flow diagram	
Process Assessment	_____
Methodology	
Material Balance	
Unusual occurrences	
Option Summary and Analysis	_____
Option description and rank	
Upstream/Downstream impacts	
Material usage	
Anticipated reduction	
Estimated costs	
Estimated benefits	
Feasibility	
Waste streams affected	
Conclusion	_____
Concluding evaluation	
Option analysis decisions	
Concerns	
Options already implemented	
Lessons learned	
Recommendations	_____
Future work	
New equipment	
Implementation strategies	
Worksheets	_____
1-10	

Worksheet 10

A final report is required for each PPOA. The final report is a compilation of essential facts about the process, pollution prevention options, feasibility and impact of those options, and future implementation costs. The report documents the work performed and identifies funding requirements necessary to implement pollution prevention options. The length of the final report will depend on the complexity of the PPOA.

1. Revision No.: List the revision number for this worksheet.

2. Revision Date: List the most recent revision date for this worksheet.

3. Page____of____: Indicate the number of this page and the total number of pages for this worksheet.

4. PPOA Title or PPOA ID Code(s): List the PPOA Title or PPOA ID Code(s) given on Worksheet 1.

5. While writing the final report, check the blank next to each major **requirement** as all elements of that task are **completed**.

Title Page	Uniquely identify the PPOA, including team members and issue/revision date.
Executive Summary	This should be an overview of all of the elements of the final PPOA report. It should relate to the reader any information that is critical about this PPOA.
Introduction	Present background information and efforts taken to initiate the PPOA.
Process Description	Detail process flow and associated equipment. Include process flow diagram, if desired.
Process Assessment	Describe the approach used to complete the PPOA. Document any assumptions made. Include information on the material balance.
Option Summary & Analysis	Present the options generated, impacts if implemented, and their respective pollution prevention possibilities.
Conclusion	Provide closure to the report. The team's consensus on the benefits achieved from this PPOA or any concerns respective to the process should be included.
Recommendations	Describe any actions that will be taken to further advance the results of this PPOA.

Worksheet 1S

Level I

Date: ________

Page ______ of ______

Pollution Prevention Opportunity Assessment

Team & Process Description

Title: ____

PPOA ID Code: ____

Team Members (*Leader)	Job Classification	Phone
*		

Process Description: ____

Potential for Pollution Prevention or Recommendations: ____

Worksheet 1S

This worksheet provides the scope and identification of the pollution prevention opportunity assessment (PPOA) team. For the PPOA to be successful, employees involved with the activity being assessed should be members of the team. The assessment team needs a leader, members, and additional resources, as required.

The team leader should have technical knowledge of the area's operations and the personnel involved. The leader shall assemble the team to perform the assessment. Team members may include engineers, waste generators, waste management specialists, scientists, laboratory technicians, and other line personnel. Additional resources may be utilized to provide information not available within the team. The size of the team may be large for complicated operations, but should be kept to a minimum to maintain focus.

1. **Date:** List the initiation date for this PPOA.

2. **Title:** List the PPOA title selected by the team.

3. **PPOA ID Code:** List the PPOA ID Code selected by the team. This should be a unique identifier.

4. **Team Members, Job Classification, Phone:** To facilitate team meetings and for future reference, this information should be completed when the PPOA team is formed.

5. **Process Description:** This should detail important attributes of the operation. Equipment, summary of operations performed, controls, input materials, and operator training (qualification or certification) may be included.

6. **Potential for Pollution Prevention or Recommendations:** For this process, describe the potential for pollution prevention, source reduction, and/or waste minimization. (Is there any pollution prevention potential for the following changes: material substitution, procedures, process parameters, equipment, general practices, recycling, reuse, reclamation, etc.?) Are there any recommendations for this process?

Worksheet 2S

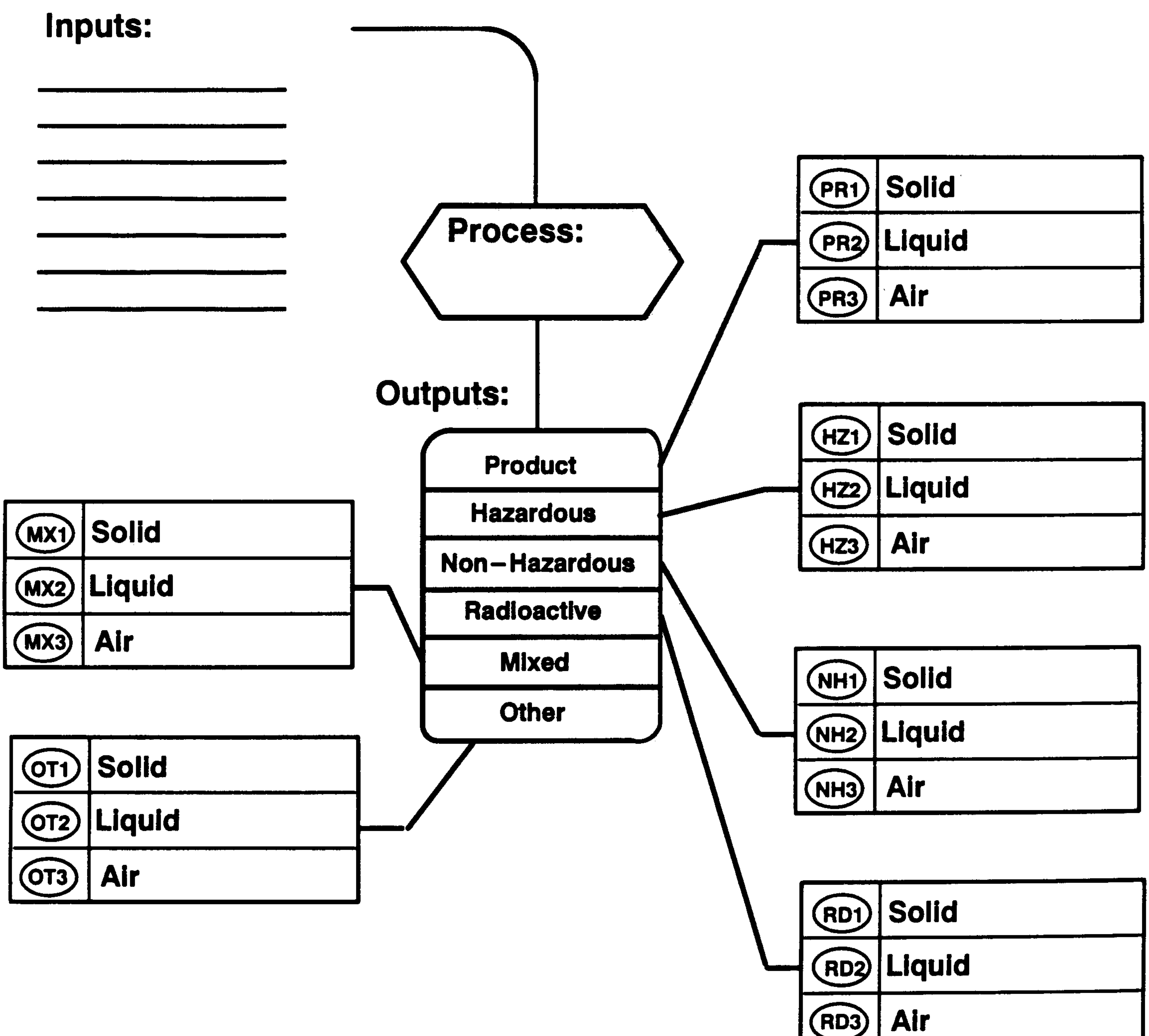
Level I

Date: ______

Pollution Prevention Opportunity Assessment

Process Flow Diagram

Title or Assessment ID Code: ______________________________



Worksheet 2S

This worksheet provides a method to document the process flow diagram for the assessment. The flow diagram should identify all Assessment Code(s) associated with the process, all input materials, and outputs (products/wastes). The flow diagram should track materials from the time they enter the process boundary until they leave. This diagram represents a very simplistic flow model; a more detailed diagram may be required to identify all waste streams, especially for complex, multi-step processes.

1. **Title or Assessment ID Code(s)**: List the PPOA Title or PPOA ID Code given on Worksheet 1S.

2. **Page ____of ____:** Indicate the page number for this worksheet and the number of pages for this worksheet.

3. **Inputs**: List the input materials on the lines provided. Fill in the Process Name box. Then highlight those outputs that are applicable to the process (e.g. Product, Hazardous, etc.). Then sub-categorize those outputs into solid, liquid, or air emission streams by highlighting the corresponding output stream. A **Stream ID Code** is provided for each sub-category of waste.

4. **Outputs:** The Stream ID Code provides a uniform coding scheme for the release information. A brief waste description may be recorded in the box to the right of the Stream ID Code. The code information is summarized in the table below:

Stream ID Codes

Designator	Code
Product	PR
Hazardous	HZ
Non-Hazardous	NH
Radioactive	RD
Mixed	MX
Other	OT

Solid Stream = 1, Liquid Stream = 2, Air Stream = 3

Worksheet 3S

Level I

Page ______ of ______

Pollution Prevention Opportunity Assessment

Material & Waste Stream Summary

Title: ______________________________

PPOA ID Code: ______________________________

Input Material	Annual Quantity Used	% Product	% Recycled	Total Releases % Air	Total Releases % Liquid	Total Releases % Solid

Does the process require further analysis based on the site's Priority Material/Waste Stream List? Yes ________ No ________

Level II ________ Level III ________

Worksheet 3S

This worksheet provides a brief summary of the input materials and output streams from the operation or activity being assessed. Its purpose is to provide the pollution prevention team an overview of the waste streams resulting from the PPOA.

1. **Title:** List the PPOA title given on Worksheet 1S.

2. **Assessment ID Code:** List the PPOA ID Code given on Worksheet 1S.

3. **Input Material:** List the material names which enter the operation.

4. **Annual Quantity Used:** Enter the annual quantity used for each material listed - include the unit of measure, e.g., lbs, curies, etc. For input material from another process, it may be helpful to also identify the release components of those materials.

5. **% Product:** For each input material, estimate the percent of the annual quantity used which goes to product.

6. **% Recycled:** For each input material, estimate the percent of the annual quantity used which is recycled.

7. **% Air:** For each input material, estimate the percent of the annual quantity used which is an air waste stream.

8. **% Liquid:** For each input material, estimate the percent of the annual quantity used which is a liquid waste stream.

9. **% Solid:** For each input material, estimate the percent of the annual quantity used which is a solid waste stream.

10. **Does the process require further analysis based on the site's Priority Material/Waste Stream List?** Using your site's Priority Material/Waste Stream List and the DOE Graded Approach Logic Diagram, determine if further assessment is necessary. If yes, indicate the level of assessment required.

Worksheet 4S

Level II

Pollution Prevention Opportunity Assessment

Option Summary

Title or PPOA ID Code(s) ______________________________

____

Option No. __: ______________________________

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Type (*)	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty

Option No. __: ______________________________

____

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____

Type (*)	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty

Option No. __: ______________________________

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Type (*)	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty

(*) Type = Source Reduction, Recycling, Treatment, or Disposal

Worksheet 4S

This summary sheet serves as a method to record and evaluate the options that have been identified during brainstorming sessions or other option generating techniques.

1. **Title or PPOA ID Code(s)**: List the PPOA Title or PPOA ID Code given on Worksheet 1S.

2. **Option :** Options generated should be numbered consecutively. Briefly describe each option, affected materials, waste streams, upstream/downstream impacts if implemented, and anticipated reduction quantity if implemented.

3. **Type:** Indicate whether the option is source reduction, recycling, treatment, or disposal.

4. **Consider?:** If the option is worth further consideration, enter YES. If not, enter NO and briefly indicate in the Option Description why not.

5. **Feasibility**: Provide a brief description. (Excellent, good, fair, poor)

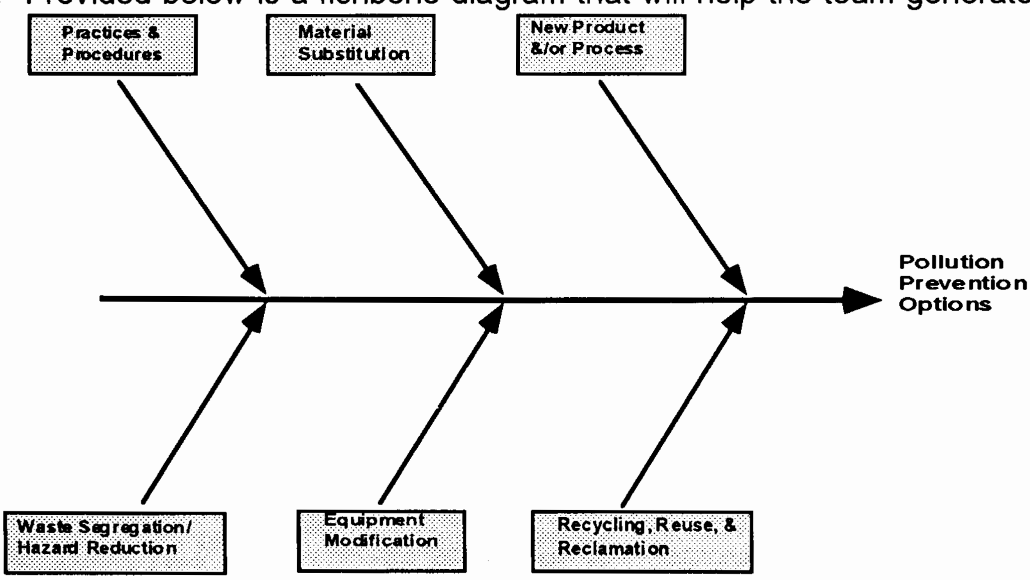
6. **Estimated Cost**: Estimate an implementation cost.

7. **Estimated Cost Savings**: Estimate the cost savings.

8. **Anticipated Reduction Qty.**: Estimate the weight or volume of the waste that will be reduced.

Note: Typically, it is difficult to estimate the anticipated waste reduction or cost avoidance in the initial phases of implementation because of many factors. However, for some options, especially in cases where the option provides complete elimination of a hazardous material or waste stream, these estimates can be accurately completed.

The process by which options are identified should occur in an environment that encourages creativity and independent thinking. Brainstorming sessions are effective ways for individuals to generate options. To make these sessions beneficial, research is often necessary. Provided below is a fishbone diagram that will help the team generate ideas.



Worksheet 5S

Level II

Date: ________

Page ______ **of** ______

Pollution Prevention Opportunity Assessment

Final Summary

Title: ____

PPOA ID Code(s): ____

Assessment: ____

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Conclusions: ____

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Recommendations: ____

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Worksheet 5S

This sheet provides a brief summary of other pertinent information about the activity being assessed. Its purpose is to document how this assessment was performed, the conclusions reached by the team, and the recommendations for further actions.

1. **Date:** List the date this sheet was completed.

2. **Title:** List the title given on Worksheet 1S.

3. **PPOA ID Code(s):** List the ID Code(s) given on Worksheet 1S.

4. **Assessment:** Briefly describe the approach (methodology) used to complete this assessment and any assumptions made.

5. **Conclusions:** Briefly describe the waste streams or input material to be minimized, benefits achieved from this assessment, and any concerns (environmental or health risks) associated with the material or operation.

6. **Recommendations:** Briefly describe any actions that should or will be taken in respect to this assessment.