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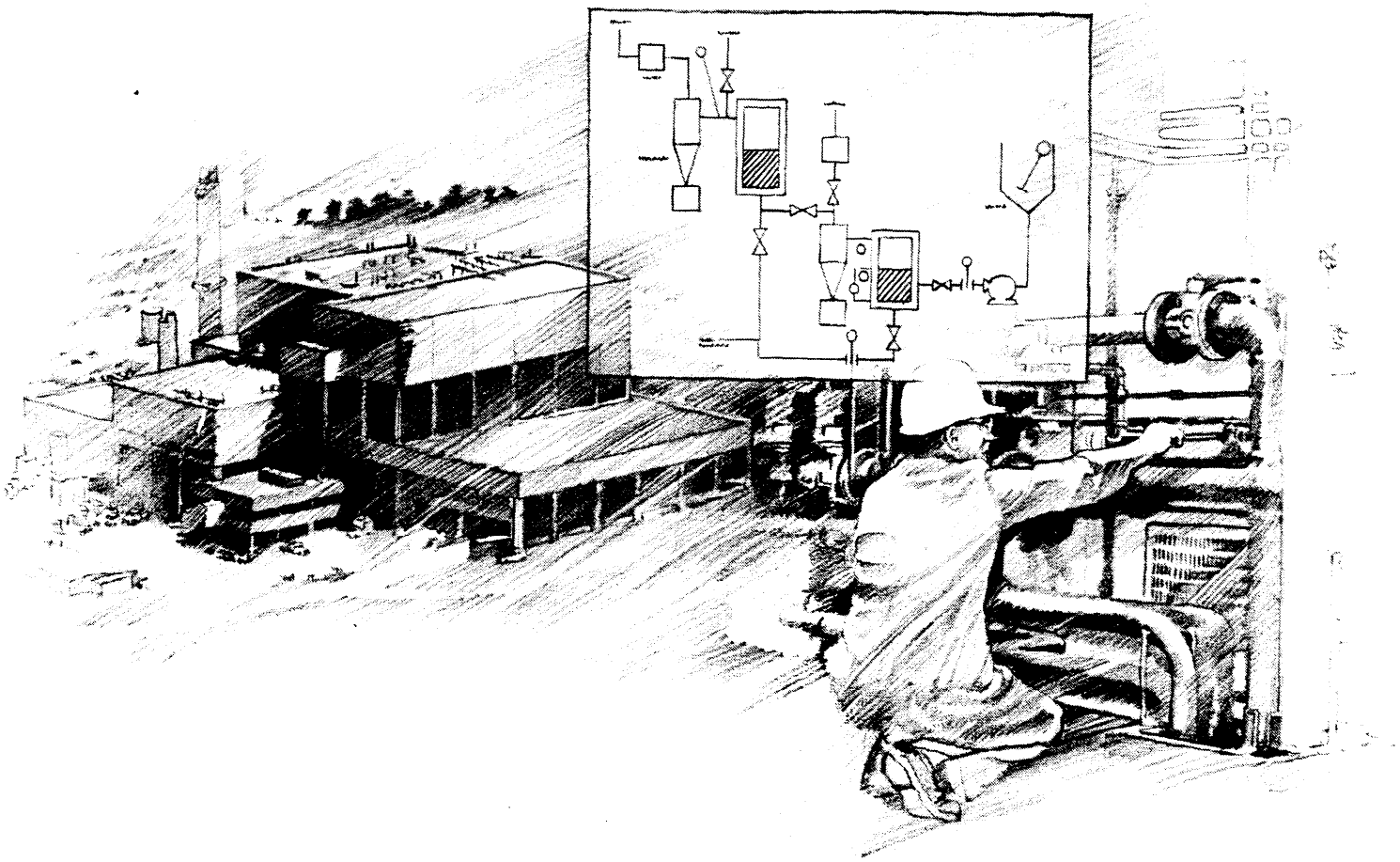
Facility Pollution Prevention Guide



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APPENDIX

FIGURES

LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
DOE	Department of Energy
EPA	Environmental Protection Agency
ES&H	Environmental, Safety, & Health
MNCAW	Materials Not Categorized As Waste
MSDS	Material Safety Data Sheet
NPDES	National Pollutant Discharge Elimination System
ODC	Ozone Depleting Compound
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated biphenyl
PM/WSL	Priority Material/Waste Stream List
POTW	Publicly Owned Treatment Works
PPOA	Pollution Prevention Opportunity Assessment
PWA	Process Waste Assessment
VOC	Volatile Organic Compound
WMin/PP	Waste Minimization/Pollution Prevention

ACKNOWLEDGMENT

In July, 1988, DOE Defense Programs recognized the need for a waste minimization program that would focus beyond pollution control and the traditional media-by-media approach to containment and treatment of environmental releases. Defense Programs was proactive in initiating a Waste Minimization Program that included the completion of process waste assessments as a means to identify opportunities which would reduce the generation of waste.

The Waste Minimization Program evolved to a Pollution Prevention Program through the auspices of the DOE Defense Programs' Pollution Prevention Strategic Plan issued in April, 1992. The Strategic Plan reiterated the hierarchy of preferred environmental practices outlined in the Pollution Prevention Act of 1990 (i.e. source reduction, recycling, treatment, and finally, disposal).

The first Model PWA Guidance was assembled by Defense Programs' contractors based on the published EPA guidance and previous work performed at the Y-12 Plant. The manual was originally issued in February 1990, and distributed throughout the Weapons Complex. This is the first revision to the document, and it replaces the term "PWA" with a more positive term, "Pollution Prevention Opportunity Assessment". The new term avoids the implication that assessments should be limited to process wastes, rather, they should address all releases.

The following DOE personnel and DOE contractors assisted in the suggestions for this revision. Their time and effort were greatly appreciated.

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I. INTRODUCTION

A. PURPOSE OF GUIDANCE

The purpose of this document is to provide a guide for DOE sites to conduct pollution prevention opportunity assessments (PPOAs), commonly known through the DOE as process waste assessments (PWAs). This will avoid the implication that assessments should be limited to process wastes - PPOAs address all releases. This guidance describes those activities and methods that can be employed to characterize all waste generating processes and identifies opportunities to reduce or eliminate waste generation. The document also includes a methodology to evaluate proposed modifications to site processes and other options to minimize waste and prevent pollution.

B. GUIDANCE SCOPE AND OBJECTIVES

PPOAs will be conducted as part of an ongoing program to identify opportunities to eliminate or reduce the generation of waste. A PPOA documents the amount of material that is disposed of as waste during operations. It provides a summary of material usage, process by-products, and waste generation; and it targets those processes and operations that need to be improved or replaced to promote waste minimization and pollution prevention. The assessment also establishes a basis to prioritize modifications to site processes or other pollution prevention options that are developed during the assessment.

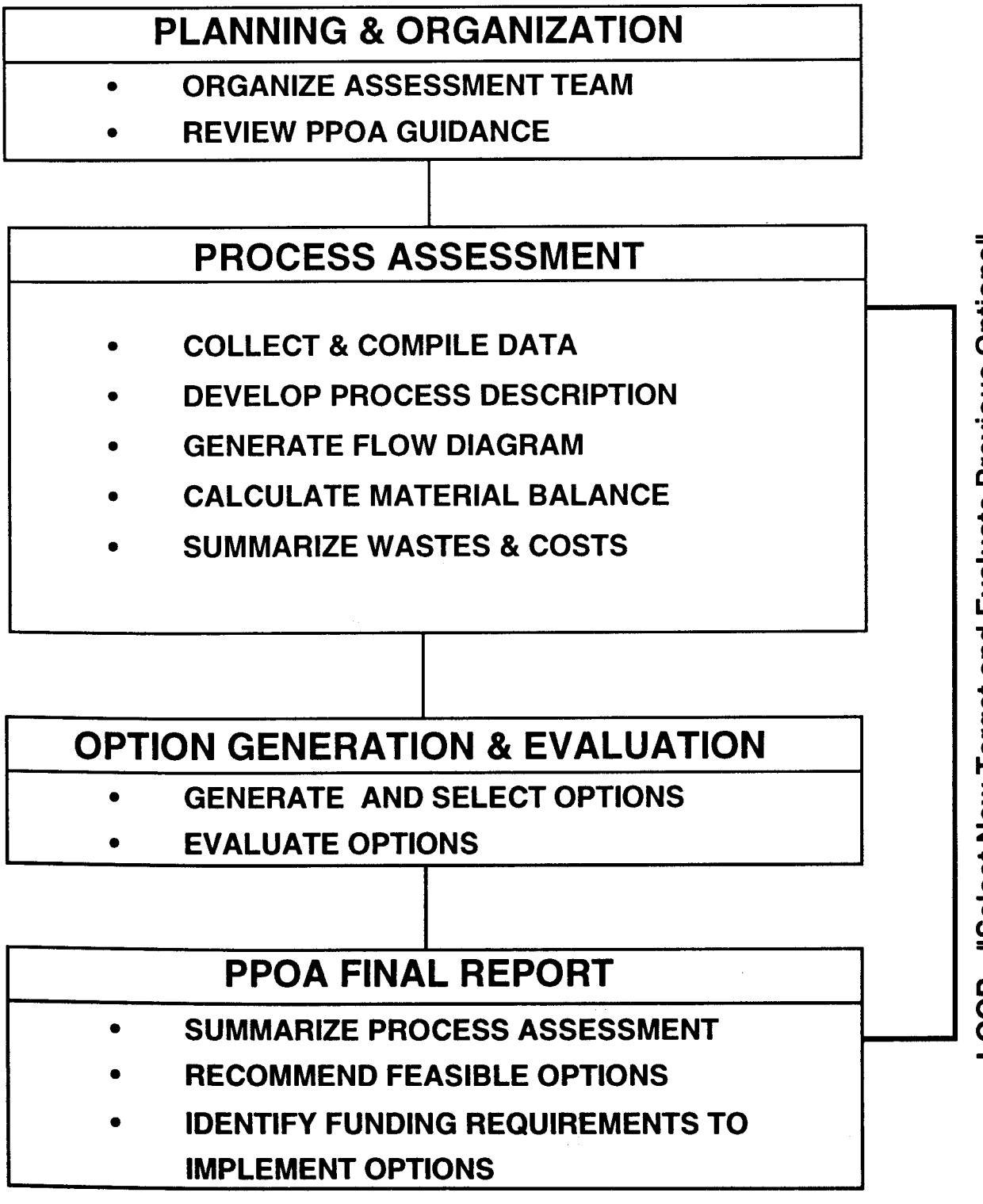
The objective of a PPOA is to document a facility's processes, operating procedures, and waste streams in a manner that will permit the identification of the best improvements to avoid or minimize waste generation. This guide shall not be used as an audit tool. The assessment consists of a systematic approach which may include the following:

- GRADED APPROACH LEVEL DETERMINATION
- ORGANIZATION OF PPOA TEAMS
- ASSESSMENT OF PROCESSES AND WASTE STREAMS
- DEVELOPMENT AND EVALUATION OF POLLUTION PREVENTION OPTIONS
- RECOMMENDATIONS OF POLLUTION PREVENTION OPTIONS & FINAL REPORT

A step-by-step process for completing a PPOA is shown in Figure 1. These steps are sequential and should be performed in that order for best results.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT FLOW CHART

FIGURE 1



II. GRADED APPROACH

A. INTRODUCTION

The DOE Complex is comprised of numerous sites located in many different states. These facilities range from single-mission to multiple-disciplinary facilities, and vary in size from quite small to very large. The facilities as a whole represent a tremendous diversity of technologies, processes and activities. Due to this diversity, there is also a wide variety and number of waste streams generated. Many of these waste streams are small and intermittent, and not of consistent composition. The value added of detailed analysis for individual, small waste streams is often not sufficient to justify the cost, nor is the analysis necessarily meaningful since many of these waste streams are constantly changing.

Although waste minimization activities have been implemented at DOE sites, these efforts are not being sufficiently documented. A DOE survey of PPOA activities across several sites indicated that these waste minimization practices need to be documented so that waste generation baselines can be more accurately established. Furthermore, the documentation can ensure that the site receives credit for accomplishing waste minimization.

The PPOA Graded Approach addresses these complexities and recognizes that processes vary in the quantity of pollution they generate, as well as in the perceived risk and hazards associated with an operation. It also recognizes the variance due to the cost and function of the final product. Therefore, the graded approach is intended to provide a **cost-effective** and **flexible** methodology which allows individual sites to prioritize their local concerns and align their efforts with the resources allocated, while also providing some consistency throughout the DOE to perform PPOAs. In order to achieve this, the approach has defined three levels of effort to satisfy the requirement of completing a PPOA. This section documents the minimum amount of effort required, Level I, Activity Characterization, and provides a systematic approach using the Weighted Sums Evaluation to determine if additional and more detailed analysis should be conducted for either a Level II, Informal Assessment, or a Level III, Formal Assessment.

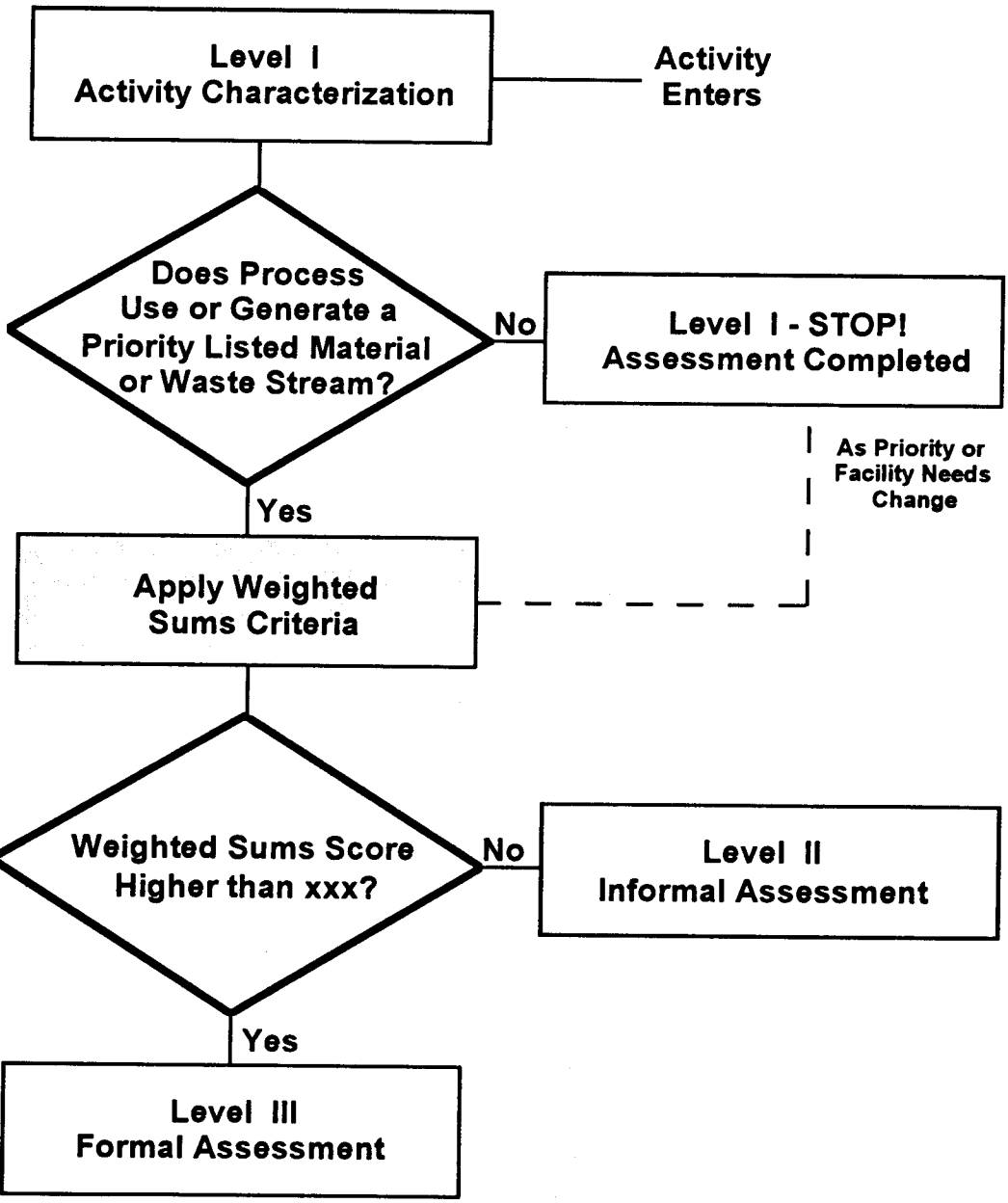
If used properly, the graded approach will allow a site to concentrate its shrinking resources on the most important waste problems first. While all of the site's waste streams and processes will be assessed, the most critical areas will be assessed first and to the greatest extent.

B. GRADED APPROACH LOGIC DIAGRAM & PRIORITY MATERIAL /WASTE STREAM LIST

Figure 2, the Graded Approach Logic Diagram, illustrates graphically how the graded approach methodology works. The diagram starts at the top with the Level I, minimum effort assessment and works down to an informal and/or formal assessment. The methodology shown in the logic diagram allows flexibility and provides a consistent

FIGURE 2

Pollution Prevention Graded Approach Logic Diagram



structure. A site must develop the priority material / waste stream list (PM/WSL) to use the graded approach. This list is not limited to the requirements specified below but can include any other additional concerns. (See Appendix A for an additional list of considerations.) The priority list provides the site an opportunity to identify their individual regulatory and/or prioritized needs to cost-effectively determine if additional, more detailed analysis is necessary. DOE has established requirements and suggestions for this list as follows.

PRIORITY MATERIAL / WASTE STREAM LIST

Required or Mandatory PM/WSL:

- Waste of any amount for which an approved disposal method does not exist (i.e., mixed wastes, classified waste, etc.)
- Waste which is equal to 5% or more of the facility's total waste stream (Total waste = Manifest records (Hazardous) + Radioactive + Mixed)
- Clean Air Act, Class I Materials (ODCs - Ozone Depleting Compounds)
- EPA's 33/50 Materials
- Known Human Carcinogens (ACGIH, Type 1)

Suggested Additions to PM/WSL:

- Federal, State, & Local Requirements
- Permitted Waste & Materials (e.g., VOCs, NPDES, POTW, etc.)
- Site Health Risks for Hazardous Materials & Hazardous Wastes (e.g., OSHA - Suspect carcinogens, teratogens, explosives, PCBs, Asbestos, etc.)
- Municipal Solid Waste
- Materials Not Categorized As Waste Inventory (MNCAW)

C. LEVEL I - ACTIVITY CHARACTERIZATION

Level I, Activity Characterization, requires a minimal amount of descriptive, quantitative, and qualitative information to document each of the facility's processes and activities which are defined as "Any existing or planned operation or activity (including remediation projects) which generates waste or pollution to the air, land, or water." In gathering this information, the facility begins the initial step to determine whether any waste reduction or pollution prevention opportunities exist. The collection of this information will also provide the basis to determine whether or not any of the facility's

processes/activities necessitate further analysis per the graded approach methodology. Therefore the principle objectives of Level I are to:

- define the process,
- document Waste Minimization / Pollution Prevention (WMin/PP) activities (past or current),
- determine the level of effort that should be performed for a cost-effective Pollution Prevention Opportunity Assessment Program, and
- provide information to determine if more analysis is necessary.

Level I Required Documentation

1. A brief process description / simple flow diagram;
2. A quantitative estimate of the material inputs, products, by-products, and wastes;
3. A preliminary evaluation of WMin/PP potential; and
4. A decision to determine if further analysis is necessary.

Level I process assessments will establish the site's baseline of operational information. These process/activity descriptions should include input materials, process products, by-products and/or waste generated. Identification of these elements and estimates of quantities is made using the best available information source, or combination of sources. Possible information sources are listed in Appendix B.

In addition to the descriptive information, the potential for WMin/PP can be initially evaluated based on the activity or process expert's knowledge. These recommendations should be included in the Level I documentation. If opportunities do exist and are easily implemented, then the actions taken or planned to be taken should be documented. Furthermore, for WMin/PP options identified and implemented, upstream / downstream impacts should also be included in the documentation.

After collecting the process/activity information, it is necessary to determine whether the process/activity continues to a Level II or III analysis as defined by the graded approach logic diagram and the site's priority material / waste stream list.

If the process does not contain any of the materials or waste streams on the priority list, then the Level I documentation satisfies the PPOA requirement. Conversely, those processes/activities which are captured by the site's priority list are included in the Weighted Sums Evaluation to determine the next level of effort to be performed.

A completed example Level I Activity Characterization is shown in Appendix C. PPOA Worksheets 1S-3S can be used to document the information required in a Level I assessment.

D. GRADED APPROACH WEIGHTED SUMS EVALUATION

The graded approach methodology continues when the site selects a core team to determine which processes require Level II and Level III assessments. The core team

should be cross-functional and consist of key site personnel with knowledge about the site's processes, waste management, and regulations. The team's objectives are to assign weights to the criteria, to determine the numeric value that distinguishes a Level II from a Level III, and to provide consistency in scoring across processes. The form to aid in this evaluation (weighted sums) is shown in Figure 3. (Appendix D contains the weighted sums form, criteria, and instructions.) First the site assigns a weight to each criteria listed in the first column of the weighted sums. Then, for each process being evaluated, the team determines a scale for the five listed criteria and a multiplier. From the products and sums, a total point value is assigned. Finally, the team determines the cut-off value for which Level II assessments will be completed versus Level III assessments. Processes identified by the Weighted Sums Evaluation which require a Level III, Formal Assessment, are those processes that are critical to the site's priorities and would benefit by the allocation of resources to examine how to best implement pollution prevention technologies to these critical areas.

E. LEVEL II - INFORMAL ASSESSMENT

After completing the Graded Approach Weighted Sums Evaluation, the facility has distinguished which processes/activities require the Level II, Informal Assessment. The principal objectives of Level II are to:

- develop and screen WMin/PP opportunities and
- recommend viable options for implementation.

This level of effort does not require the collection of new data. Much of the documentation has already been completed in the Level I assessment. However, due to some aspect of the process, the facility needs to further explore the WMin/PP opportunities available to reduce the quantity of waste or the risk/hazard associated with the operation.

Level II Required Documentation

{1.} Brief process description / simple flow diagram;
{2.} Quantitative estimate of the material inputs, products, by-products, and wastes;
{3.} Preliminary evaluation of WMin/PP potential;
4. WMin/PP options identification and evaluation;
5. Consideration of potential upstream / downstream impacts; and
6. Recommendations for option implementation.

{} - denotes those items already completed in Level I, Activity Characterization

Further suggested reading for Level II information can be found in sections IV: A-C and V: A-B. A completed example Level II, Informal Assessment, is shown in Appendix E. PPOA Worksheets 1S-5S can be used to complete the requirements of a Level II assessment.

Date: _____

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FIGURE 3
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											

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F. LEVEL III - FORMAL ASSESSMENT

In addition to the information completed in the Level I assessment, the Level III requires considerably more documentation to complete the PPOA. For example, both the process description and a corresponding block flow diagram are required to illustrate the basis of generation. The use of narratives, calculations, photographs, illustrations, figures and/or data sufficient to convey an understanding of the process are certainly recommended. The Level III assessment also requires collection of quantitative data for a material balance. A material balance should be completed to account for all waste generated. This information, if not already available, may need to be tracked to accurately establish the current process waste generation information necessary to complete the WMin/PP options analysis.

The primary objectives of the Level III Assessment are to:

- conduct a detailed analysis of the process for WMin/PP opportunities and
- document the results of the process evaluation in a written report.

Level III Required Documentation

{1.} Brief process description / simple flow diagram;
{2.} Quantitative estimate of the material inputs, products, by-products, and wastes;
{3.} Preliminary evaluation of WMin/PP potential;
4. Process description;
5. Flow diagram;
6. Material balance;
7. WMin/PP options identification;
8. Analysis of WMin/PP options generated: economic, technical, upstream / downstream impacts, and other benefits;
9. Prioritized list of options; and
10. Formal report with documentation and recommendations for option implementation.

{} - denotes those items already completed in Level I, Activity Characterization

A completed example Level III, Formal Assessment, is shown in Appendix F.

The following sections of this guidance describe the details necessary to achieve the requirements of a Level III, Formal Assessment. Each of these sections can also be used as a reference for the information required in the Informal Assessment and Activity Characterization, Levels II and I, respectively. Blank Model Worksheets have been included in Appendix G to help guide a team through the PPOA requirements. They are only suggested forms - they are not requirements. A site may prefer to modify them to fit their individual site needs. Model PPOA Worksheets 1-10 were developed for the Level III assessment, PPOA Worksheets 1S-3S were developed for Level I, and Worksheets 1S-5S were developed for a Level II.

III. POLLUTION PREVENTION OPPORTUNITY ASSESSMENT TEAMS

The Waste Minimization and Pollution Prevention Awareness Program Plan states that assessments of all waste-generating operations at the site will be conducted by PPOA teams. The team leader should have the authority to complete the assessment, line responsibility, familiarity with the site's process and waste management operations, and proven technical and problem-solving abilities (e.g. Value Engineering Specialist).

The remainder of each assessment team should be drawn from line staff, or subcontractor organizations that can furnish the type of specialized expertise that will be needed to conduct the assessment. Each PPOA team should consist of a small core of individuals familiar with the site's operations, who will direct the assessment efforts and guide the data gathering. The careful selection of personnel to conduct the assessment is essential. Experienced people familiar with the site's operations are crucial to completing an accurate and timely assessment. Subsets of this team are satisfactory for Levels I and II of the graded approach. Other personnel with specialized skills will be used on a part-time, as-needed basis. Each team may include members who have knowledge in the following areas:

- process operations;
- federal, state, and local hazardous waste statutes and regulations;
- operation and waste minimization principles and techniques;
- quality control requirements;
- purchasing procedures;
- material control/inventory procedures; and/or
- value engineering skills.

Model Worksheets 1 and 1S can be used to record the PPOA team members and the assessment title and identification (ID) code. The PPOA ID Code should be unique for each PPOA at the site. For uniformity, the site should determine the structure of this code.

PPOA team leaders should receive training on the procedures, methodologies, techniques and documentation requirements for PPOAs before the assessments are conducted. The team leader needs to have clear authority from the WMin/PP Coordinator or line management to select other team members, obtain support services, and to direct the efforts of the assessment team in its interaction with operating personnel. The team should be given unrestricted access to all facility personnel and information that may, in the team's estimation, be relevant to the assessment.

IV. ASSESSMENT OF PROCESSES AND WASTE STREAMS

A. INITIAL DATA GATHERING

For each assigned process, the PPOA team begins with gathering data about that process and associated waste streams. The boundaries of the process must be established. The team should consider the following process boundary criteria: (1) the process must have a distinct starting and ending point, (2) the process input materials must be accounted for, (3) the time frame must be considered, and (4) the process must be manageable - an appropriate size to collect information and provide focus. The team will collect information through interviews and the review of process documents that will permit a thorough understanding of the process to be assessed and the development of a written analysis on how that process generates waste (see Appendix B for sources of additional information). The team should also visit the process areas to witness how the process is conducted and to validate the written information that has been collected.

Each PPOA team should develop and/or collect information as defined in the graded approach level. The following assessment tools may be used:

- process descriptions,
- process flow diagrams,
- material balances, and/or
- waste stream characterizations for assessment area or process.

Additional guidance may be found in the EPA *Facility Pollution Prevention Guide* (Reference #8 of Appendix H) to complete the PPOA.

PPOA team members may identify ways to reduce waste during the data collection phase. It is at this point that observations about operations, schedules, and procedures can be noted which may easily be changed to prevent waste. These changes can have a wide impact. The knowledge and experience of team members and their colleagues will help to develop these ideas into potential options. The team members should also make effective use of technical literature from equipment vendors and trade associations; the experience of plant engineers, operators, and consultants; and the databases available from environmental agencies.

B. PROCESS DESCRIPTION

The PPOA will include a general description of each process step in the waste generating operation. The narrative should describe the following:

- purpose of the process;
- material and equipment used in the process;
- equipment layout;
- personnel and their experience / training level; and
- products, by-products, and waste streams generated.

Model Worksheets 2 and 2S can be used to complete the process description. Chemicals and other materials purchased or otherwise introduced into the process should be identified. The description should also include other information that adequately describes the process and may be relevant to WMin/PP planning. For example, process or product specifications, requirements, assumptions, and upstream and downstream impacts may have a critical bearing on waste generation and should be included in the description.

To further understand the process, the team may perform a function analysis as explained in the DOE/Defense Program's *Prioritization of Pollution Prevention Options Using Value Engineering* (Reference #13 of Appendix H). The principal objective of function analysis is to discover the basic purposes of a process in contrast to its secondary or support uses. It aids the team in determining the process' primary functions and in minimizing or eliminating secondary functions which, in turn, may produce unnecessary wastes. The function analysis can help answer the question as to whether this process is actually necessary.

C. PROCESS FLOW DIAGRAM

The analytical work of the waste assessment effort starts with the development of a simple process flow diagram for the operation being assessed. The requirement for this flow diagram is based on the maxim that a picture is worth a 1000 words. It is also the foundation upon which the material balance is built. The process flow diagram should identify the major steps within an operation and diagram the flow of materials into and out of each step during the process. The diagram should indicate the following:

- process steps,
- material inputs, and
- process outputs (e.g., product, by-products and waste streams).

The diagram should also characterize the streams according to the nature of the release and waste classification, including but not limited to the following:

- air,
- liquid,
- solid,
- radioactive,
- mixed,
- hazardous, and/or
- non-hazardous.

Model Worksheets 3 and 2S can be used for the completion of the process flow diagram. There are three styles to chose from for Model Worksheet 3 depending on the complexity of the analysis and whether radioactive materials and waste streams are involved.

D. MATERIAL BALANCE

The PPOA shall account for all input materials that enter the process which are either consumed, transferred, or disposed of as waste. This accounting, which is called a "material balance", will be indicated on the process flow diagram and transferred to a spreadsheet. A material balance is a tool which is used to provide an input/output summary of the process being assessed. Closing the balance on an unknown stream can help identify the constituents in that stream. The material balance should indicate the following:

- amount of input materials introduced into the process,
- amount of materials consumed,
- amount of materials withdrawn as a product or by-product, and
- amount of materials flowing out of a process as a waste stream.

Using the best available information, the material balance should be closed (i.e., all input materials and transfers should be accounted for in the product, by-product and waste streams). The purpose of closing the balance is to identify streams which are difficult to quantify, e.g. fugitive and point-source emission streams. The material balance should show the average material flows over a representative time period which is logical for the site's operations. For example, it may be appropriate to gather data for Operation A from monthly averages, while a longer time span may be more appropriate for Operation B. Material balances performed over the duration of a complete production run are typically the easiest to construct and are reasonably accurate.

In its simplest form, the material balance is represented by the mass conservation principle:

Mass in = Mass out + Mass Accumulated

That is, materials placed into a process can be accounted for through products, by-products, air emissions, water discharges, spills, recycling streams, waste streams, scrap, out-of-shelf life materials, or out-of-specification materials. All materials (hazardous and non hazardous) should be accounted for in the input and output streams. The quantification units for the material balance should be consistent, i.e. pounds. The Material Safety Data Sheet (MSDS) can be helpful in converting materials into a common unit.

Measurement of Feed Materials: All input materials that are introduced into a process must be identified. The amount and type of the input materials can be determined by examining the following:

- procurement and inventory records;
- processing logs; and/or
- other records that show purchase, transfer, donation, or other receipt of materials by production unit.

Other examples of information sources are found in Appendix B.

Products and By-products: The material balance should indicate the amount of materials leaving the work unit as a product or by-product.

Transfer of Materials: Some materials may be used in a process and then transferred to another area or process for further processing. The material balance should account for the transfer of the materials.

E. MEASUREMENT OF WASTE

Information about the quantity and character of the waste streams is a critical component of the PPOA. Waste stream information should be obtained from sources such as:

- site tracking system,
- permits and permit applications,
- monitoring reports,
- hazardous waste manifests,
- emission factors,
- experiments,
- emission or toxic substance release inventories,
- hazardous waste reports,
- waste analyses, and/or
- environmental audit reports.

If the waste data is not available from the above sources, it may be necessary to monitor the process and record the needed information. Model Worksheet 4 can be used to record material balance data. The completed material balance should be a database of process information that represents the process area over a time period long enough to characterize that operation. The suggested time period to record this data is an annual basis to coincide with other site reporting requirements. If data was taken over a shorter time period, extrapolation can be used. The material balance will show the source of waste streams and the contribution that different activities make to the waste streams. It will serve as a baseline for tracking WMin/PP efforts and will provide data needed for evaluation of WMin/PP options. The process data used to calculate a baseline of operations should be as representative of current operations as possible.

Monitoring waste stream flows and compositions is something that should be done periodically. By tracking waste streams, seasonal variations in waste flows or single, large waste streams can be distinguished from continual, constant flows. Changes in waste generation cannot be meaningfully measured unless the information is collected both before and after a pollution prevention option is implemented.

F. WASTE STREAM CHARACTERIZATION

Each waste stream identified in the process flow diagram will be characterized, including but not limited to the following:

- source of waste;
- composition;
- rate of generation from work unit operation; and
- costs associated with treatment, storage, or disposal of wastes.

The waste stream characterization information is also part of Model Worksheet 4. The cost information for the input materials and waste streams can be recorded on Model Worksheet 5. After characterization, consideration should be given to each waste stream to determine where WMin/PP is most needed.

V. DEVELOPMENT AND EVALUATION OF WASTE MINIMIZATION/ POLLUTION PREVENTION OPTIONS

A. IDENTIFICATION OF WMIN/PP OPTIONS

Once the process and causes of waste generation are understood, the PPOA enters the creative phase. Following the collection of data and site inspections, the members of the team will have begun to identify possible ways to minimize waste or prevent pollution in the assessment process. Identifying potential options relies both on the expertise and creativity of the team members. Much of the requisite knowledge may come from their education and on-the-job experience, however, the use of technical literature, contacts, and other sources may also be employed.

The process by which pollution prevention options are identified should occur in an environment that encourages creativity and independent thinking by the members of the assessment team. The key to successful results is the deferral of any critical judgments or comments which might inhibit any of the team members. While the individual team members will suggest many potential options on their own, the process can be enhanced by using some of the common group decision techniques. These techniques allow the assessment team to identify options that the individual members might not have come up with on their own. Employees having practical experience with the process may have given thought to the process' input and output efficiencies or alternative operating methods. Therefore, creativity and brainstorming is strongly encouraged.

To identify WMin/PP options, the PPOA teams will utilize the following priorities:

- source-reduction options:
  - material substitution,
  - process changes,
  - product reformulating,
  - equipment changes,
  - operational improvements,
  - schedule changes,
  - affirmative procurement, and/or
  - administrative controls (e.g., inventory control, employee training, polices, etc.).

- recycling/reuse options

Each of these different approaches may generate many options or none, i.e., while operational improvements are a very broad approach, input or process changes may be difficult to control. Are there any processes / products upstream and downstream which could be affected by changes to the process or product? As these different approaches are discussed several questions should be repeatedly asked:

- Is this operation necessary?
- Why is this waste generated?
- Why do we do this operation in this manner?
- Why must we use these chemicals?
- Are there any non-hazardous substitutions available?

In addition to using the process expert's knowledge, there are numerous outside references to assist in developing a list of options. These include EPA publications, databases, and technical references; state and local environmental agency's publications, bibliographies, and technical assistance; as well as, published literature in technical magazines, trade journals, research briefs, vendor equipment information and chemical supplier information.

Model Worksheet 6 can be used in a team brainstorming session to generate the pollution prevention opportunities. Model Worksheets 7 and 4S can be used to record the detailed description for each of the options generated. The description should include the basic idea behind the option, affected materials and product, any roadblocks to implementation, and the anticipated reduction quantity.

B. PRELIMINARY SCREENING OF WMIN/PP OPTIONS

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. Since detailed evaluation of technical and economic feasibility is usually costly, the proposed options should be screened to identify those that deserve further evaluation. The screening procedure serves to eliminate suggested options that appear marginal, impractical, or inferior without a detailed and more costly feasibility

study. The screening procedures may include any combination of the following methods:

- information reviews by program managers,
- ballots by team members, and/or
- quantitative tools (e.g. weighted sum method).

Whatever method is used, the preliminary screening procedure should consider the following questions:

- Is implementation of the option cost effective?
- What is the principal benefit of the option?
- What is the expected change in the type or amount of waste generated (toxicity, reactivity, etc.)?
- Does it use existing technology?
- What kind of development effort is required?
- Will implementation be constrained by time?
- Does the option have a dependable performance record?
- Will the option effect product, employee health, or safety?
- What are the upstream/downstream impacts if implemented?

The results of the screening process will be a list of options that are candidates for more detailed technical and economic evaluation. It is important to document the decisions made in the screening process for future reference. Model Worksheet 7 can also be used to record the results from the initial screening process.

C. EVALUATION OF WMIN/PP OPTIONS

The PPOA team should perform an in-depth evaluation on the potential economic and technical feasibility of each option using Model PPOA Worksheets 8 and 9. The options will then be ranked in order of preferred implementation. The highest priority normally should be given to source-reduction projects, after which projects that recycle/reuse all or part of a waste stream or by-product will be considered.

Model Worksheet 8 evaluates each option from a cost perspective. The three major cost categories for weighing options are: Implementation Costs, Incremental Operating Costs, and Incremental Intangible Costs. EPA's *Pollution Prevention Benefits Manual* (Reference #12 of Appendix H) provides more detail on cost analysis and contains examples of each of these cost categories.

The following considerations must be fully evaluated to determine the recommended WMin/PP options. These include: economic evaluation including capital cost, operating cost, waste management costs and return on investment; expected change in the type or amount of waste generated (toxicity, reactivity, etc.); technical feasibility; avoided costs; effect on product, employee health and safety; permits, variances, and compliance schedule of applicable agencies; releases and discharges to all media; previous successes; implementation period; and/or ease of implementation.

This evaluation is most easily accomplished and documented by the use of a simple matrix for scoring and ranking - the suggested evaluation is the weighted sums method shown on Model Worksheet 9. The DOE/DP *Prioritization of Pollution Prevention Options Using Value Engineering* (Reference #13 in Appendix H) also demonstrates how options can be evaluated and prioritized using this method. The evaluation matrix provides a means to quantify the important criteria that affect the site and is a quick visual representation of the factors affecting various WMin/PP options. The scoring system for each criteria, used in the matrix and some rational for selection or weighting of scores should be included in the formal report. Evaluation of this matrix would complete the final requirement for prioritizing the list of options for implementation. The formal report should provide sufficient detail to allow transfer of the measure to other generators with similar processes or operations.

VI. FINAL REPORT

A final report is required for each PPOA. The final report is a compilation of essential facts about the process, pollution prevention options, feasibility of those options, upstream/downstream impacts of those options, and future implementation costs. The final report documents the work performed, assumptions made during the assessment, and identifies funding requirements necessary to implement pollution prevention options. The length of the final report will depend on the complexity of the PPOA. For Level II assessments, Model Worksheet 5S can be used to complete the requirements of the final report.

For a Formal Assessment, Level III, each option will be ranked by the PPOA team according to its economic and technical feasibility using Model Worksheets 8 & 9. Economic feasibility will be a factor, but not the determining factor, in judging the relative merit of each WMin/PP option. The PPOA team will report the results of its evaluation, including final rankings and ranking criteria, to the Waste Minimization Committee or line management. The PPOA team will indicate its preferred options in the report.

Easily implemented options will be completed and documented in the final report. Options that require additional analysis and/or approval shall be addressed via the site's Waste Minimization and Pollution Prevention Program Plan.

Documentation of the WMin/PP options and recommendations should demonstrate a good faith effort undertaken to identify alternatives and should provide a narrative description of these factors in sufficient detail to allow transfer of the measure to other generators with similar processes or operations.

The final report and associated data will be maintained as permanent records for later reference and tracking information. PPOAs should be reviewed on an annual basis after the initial PPOA is completed and should be revised if significant process changes are made.

VII. APPENDIX

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

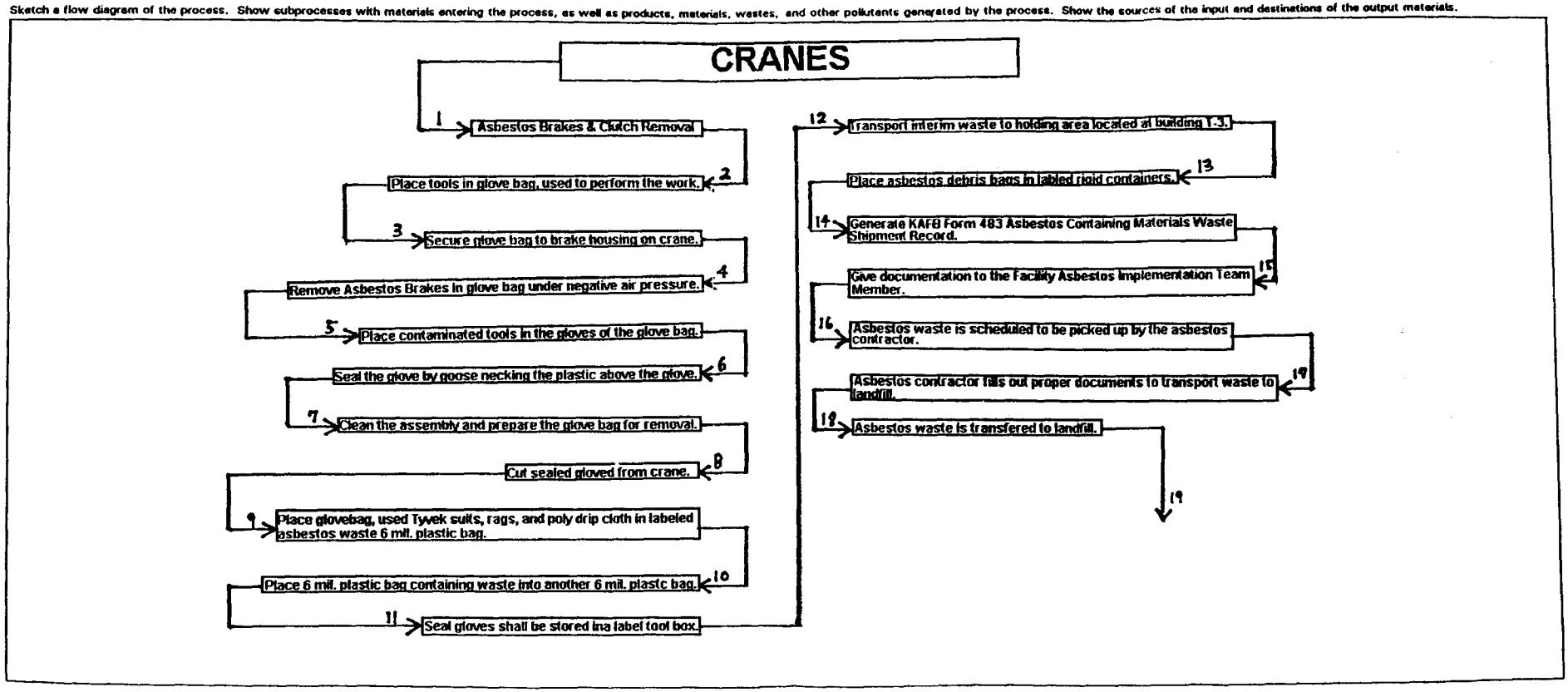
SNL/NM Organization: 7813-5 Process Name: Asbestos Brakes & Clutch Removal

DATA FORM 2

PROCESS FLOW DIAGRAM

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)

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 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

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 ☐ Radioactive/Mixed Solid Waste ☐ Waste Water Discharge ☐ 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)

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
☐ tetrachlorophenol
☐ pentachlorophenol
☐ tetrachlorobenzene
☐ pentachlorobenzene
☐ hexachlorobenzene

Is the waste any of the following? ☐ Yes ☒ No (check all that apply)

☐ waste water treatment sludge
☐ petroleum refining waste
☐ wood preserving process 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 inorganic chemicals
☐ waste from the production of organic chemicals
☐ waste from the production of explosives
☐ waste from the production of ink formulations
☐ waste from the production of pesticides
☐ waste from the production of metals
☐ waste from the production of pharmaceuticals
☐ coking waste
☐ 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 single best 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
PWA #: _____
(to be completed by WMSC)

Prepared by (MinNet Rep): Bernard Alexander Phone: 4-1365
Process Contact: Bernard Alexander Phone: 4-1365

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											

8/93

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:

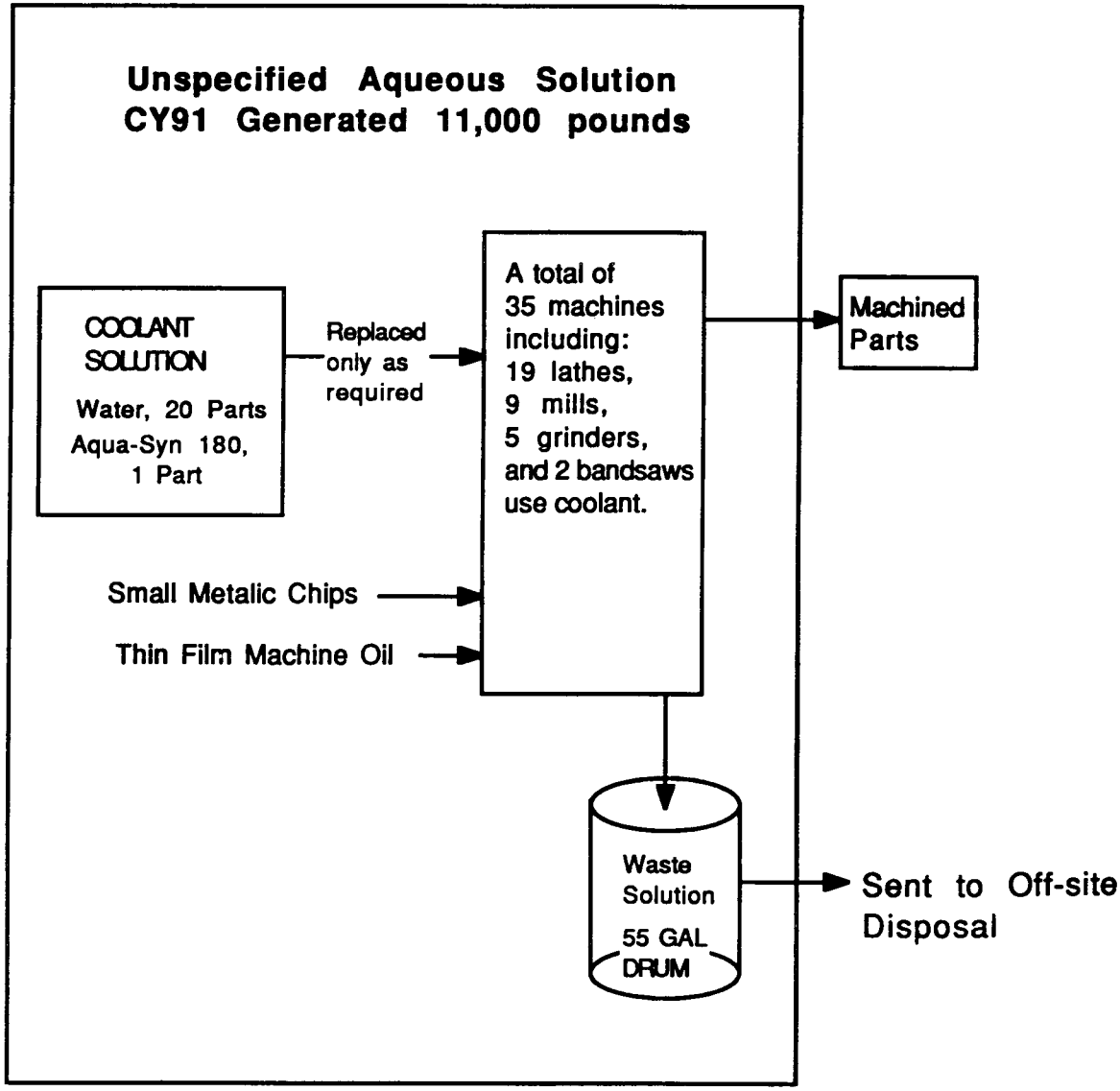
The Machining and Fabrication Shop is a support function whose principal purpose is machining parts requiring a quick turn-around, restriction of access due to classification, and/or close liaison with the designer and engineer. The shop maintains equipment suitable to perform turning, milling and grinding 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. **Description**

1 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. **Description**

2 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

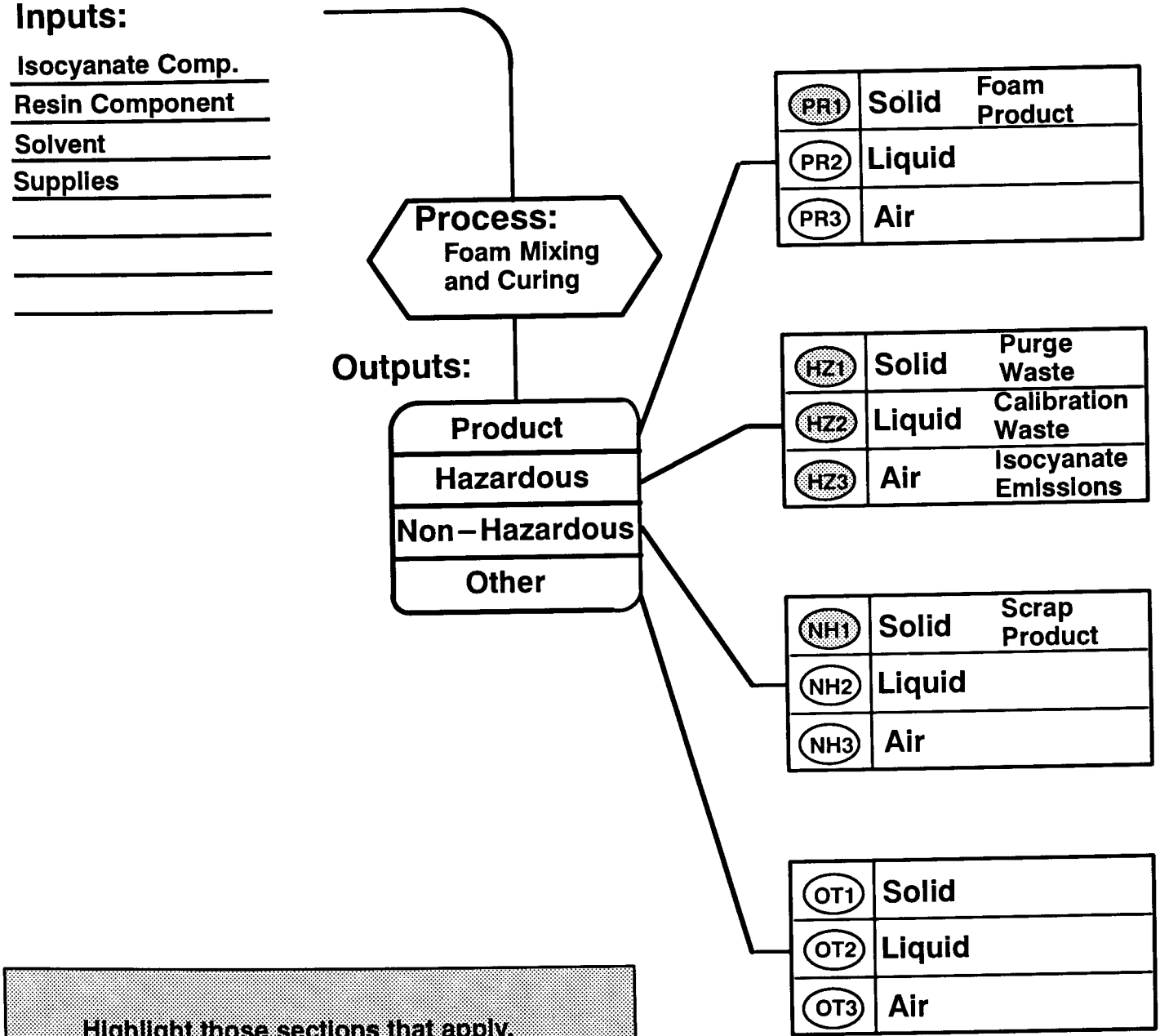
Worksheet 3
Style 1
Level III

Revision No. : 0
Revision Date: _____

Pollution Prevention Opportunity Assessment

Process Flow Diagram

PPOA Title or PPOA ID Code(s): G517-034-Machine_Mix



Highlight those sections that apply.
Use Worksheet 4 to identify and quantify the appropriate stream.

Worksheet 4
Level III

Pollution Prevention Opportunity Assessment

Material Balance Summary

Revision No.: 0
Revision Date:

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	Total Output	OUTPUT QUANTITY (Units: lbs.) 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: _____
Page 1 of 1

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

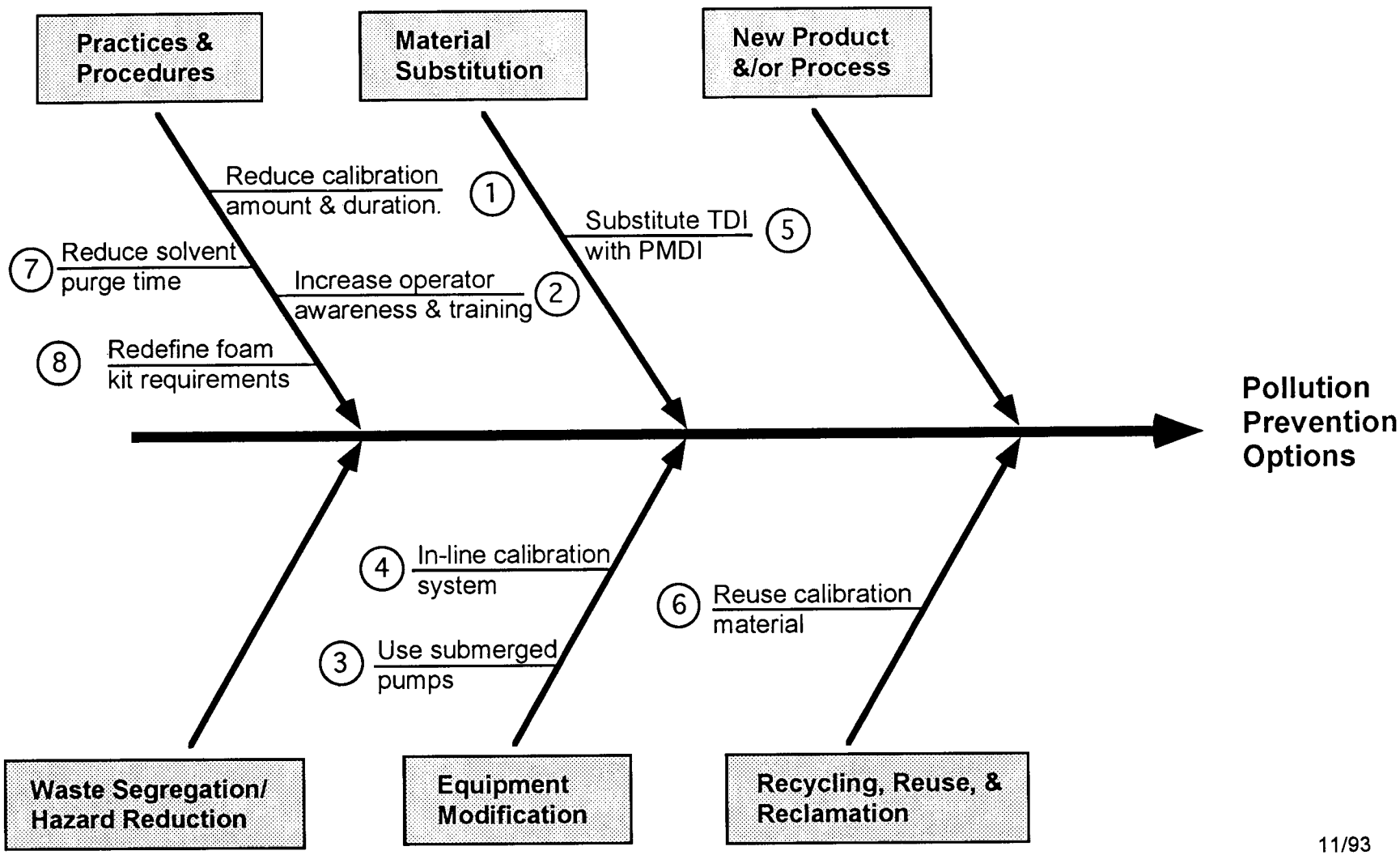
Level III

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	Waste Segregation/Hazard Reduction	
Material Substitution		Equipment Modification	
New Product &/or Process		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	Waste Segregation/Hazard Reduction	
Material Substitution		Equipment Modification	
New Product &/or Process		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		Waste Segregation/Hazard Reduction	
Material Substitution		Equipment Modification	
New Product &/or Process	X	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		Waste Segregation/Hazard Reduction	
Material Substitution		Equipment Modification	X
New Product &/or Process		Recycling, Reuse, & Reclamation	

Worksheet 7

Level III

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	

Worksheet 8

Level III

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

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: _____

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

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: _____

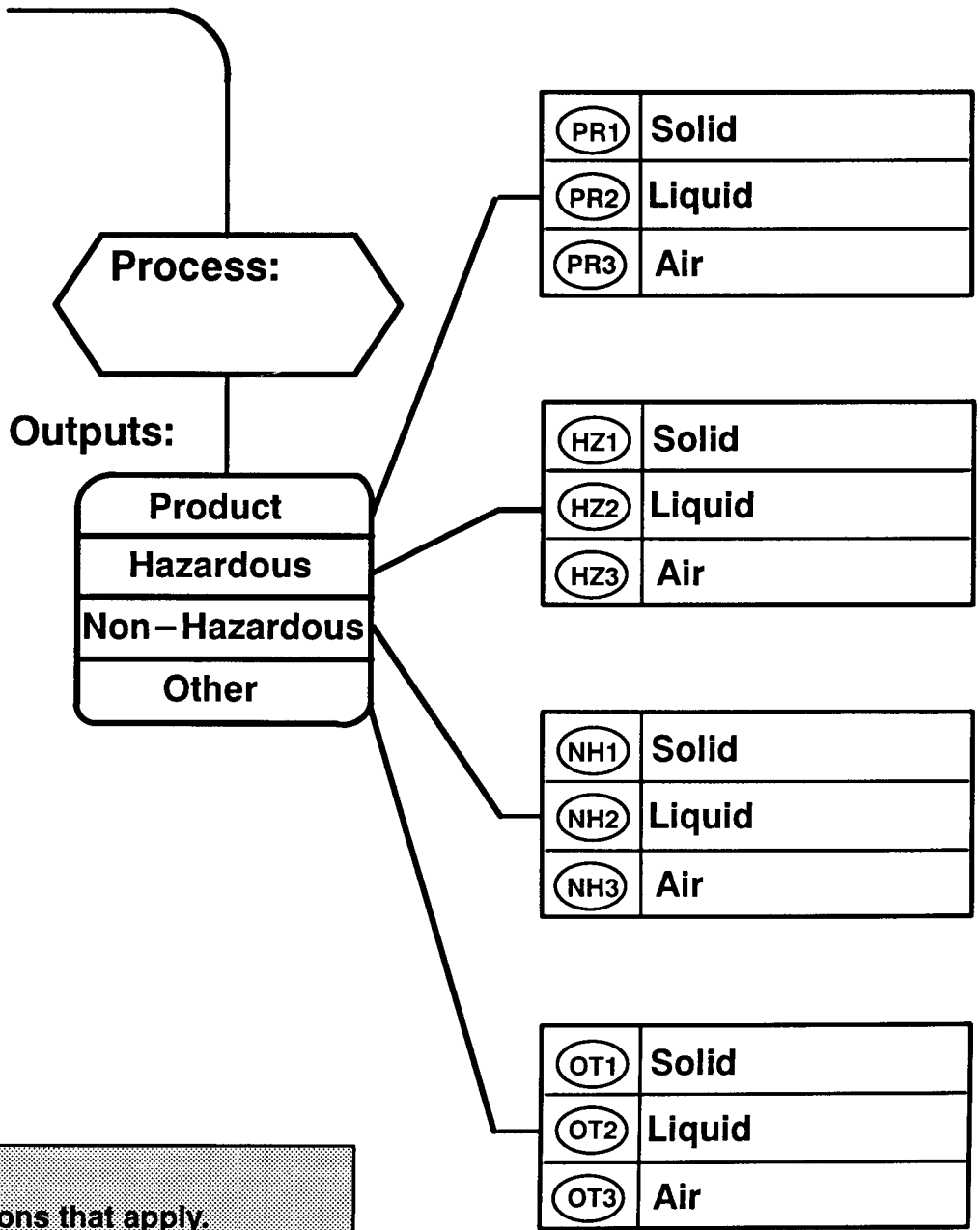
Pollution Prevention Opportunity Assessment

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.

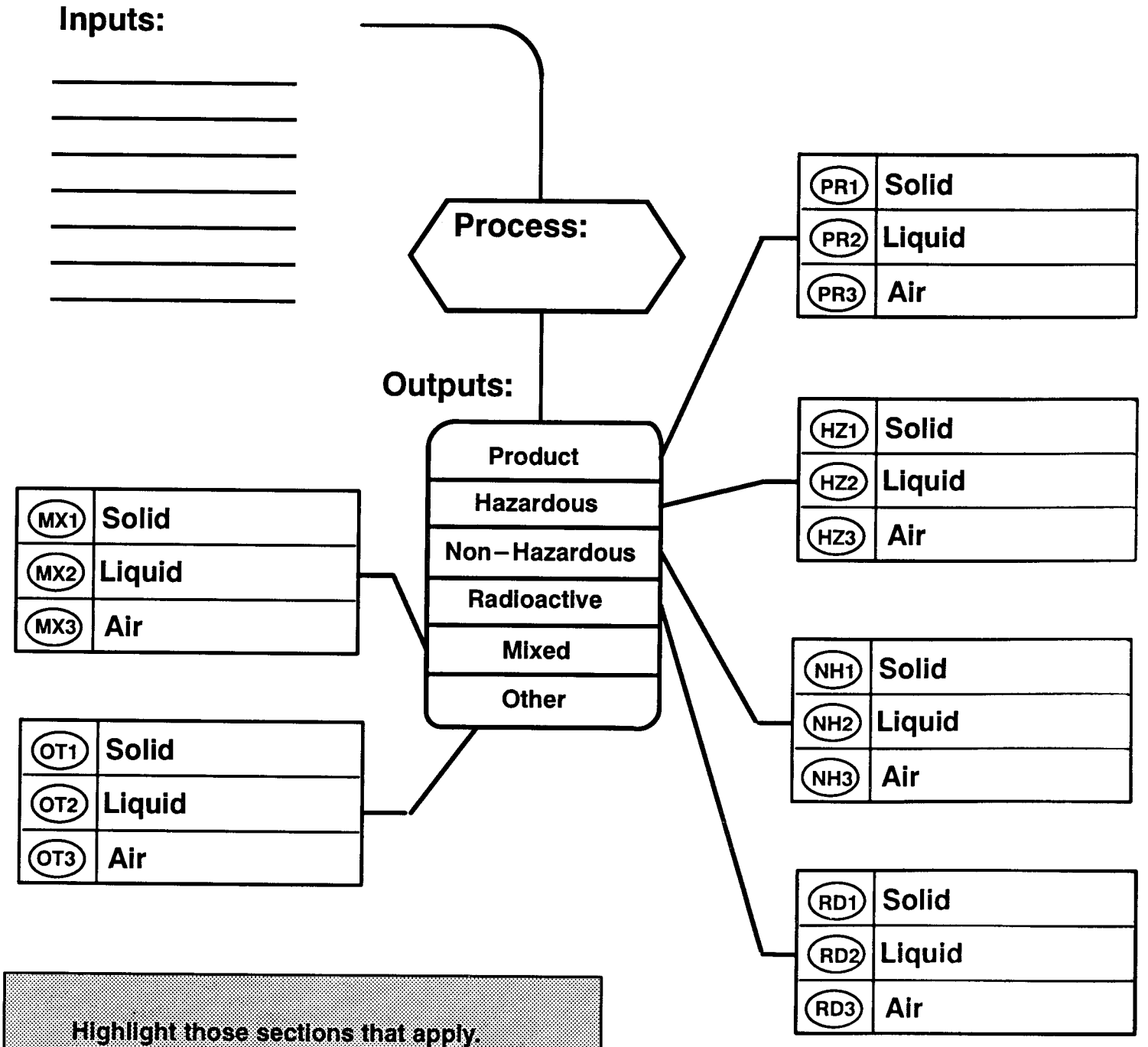
Worksheet 3
Style 2
Level III

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.

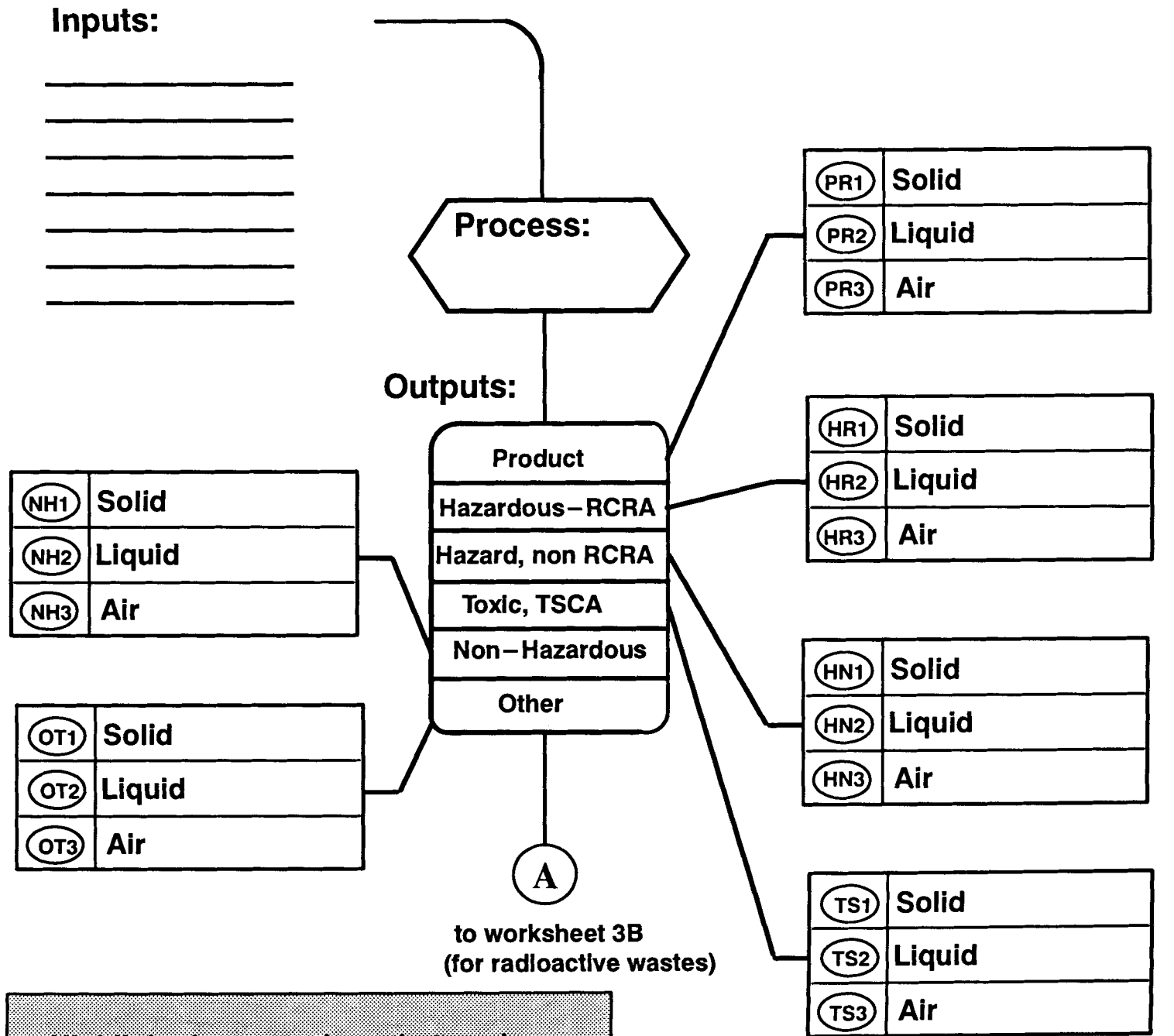
Worksheet 3A
Style 3
Level III

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.

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.

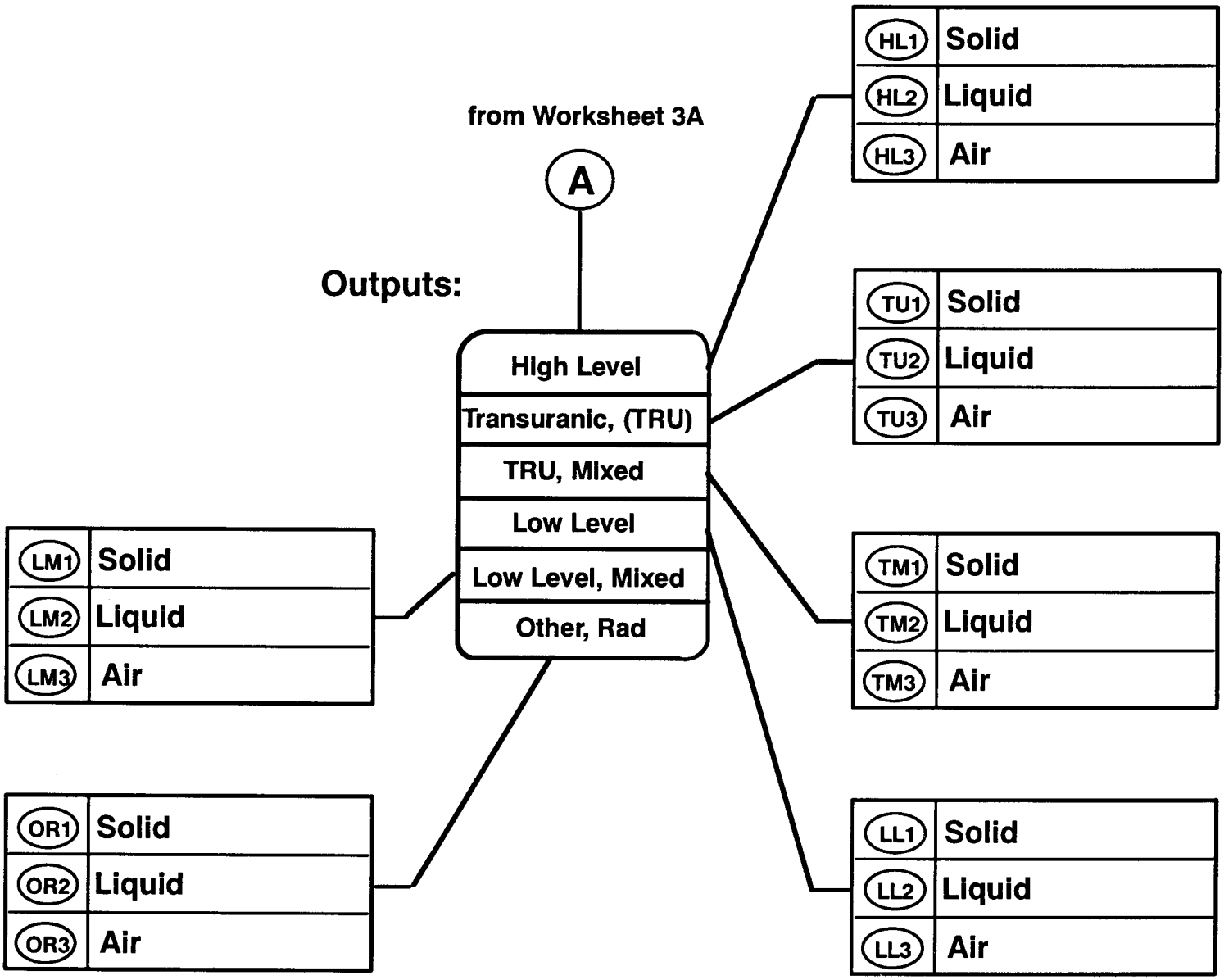
TSCA Waste - Individual chemical wastes (both liquid and solid), such as polychlorinated biphenyls (PCBs).

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	Total Output	OUTPUT QUANTITY (Units: _____)								
			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

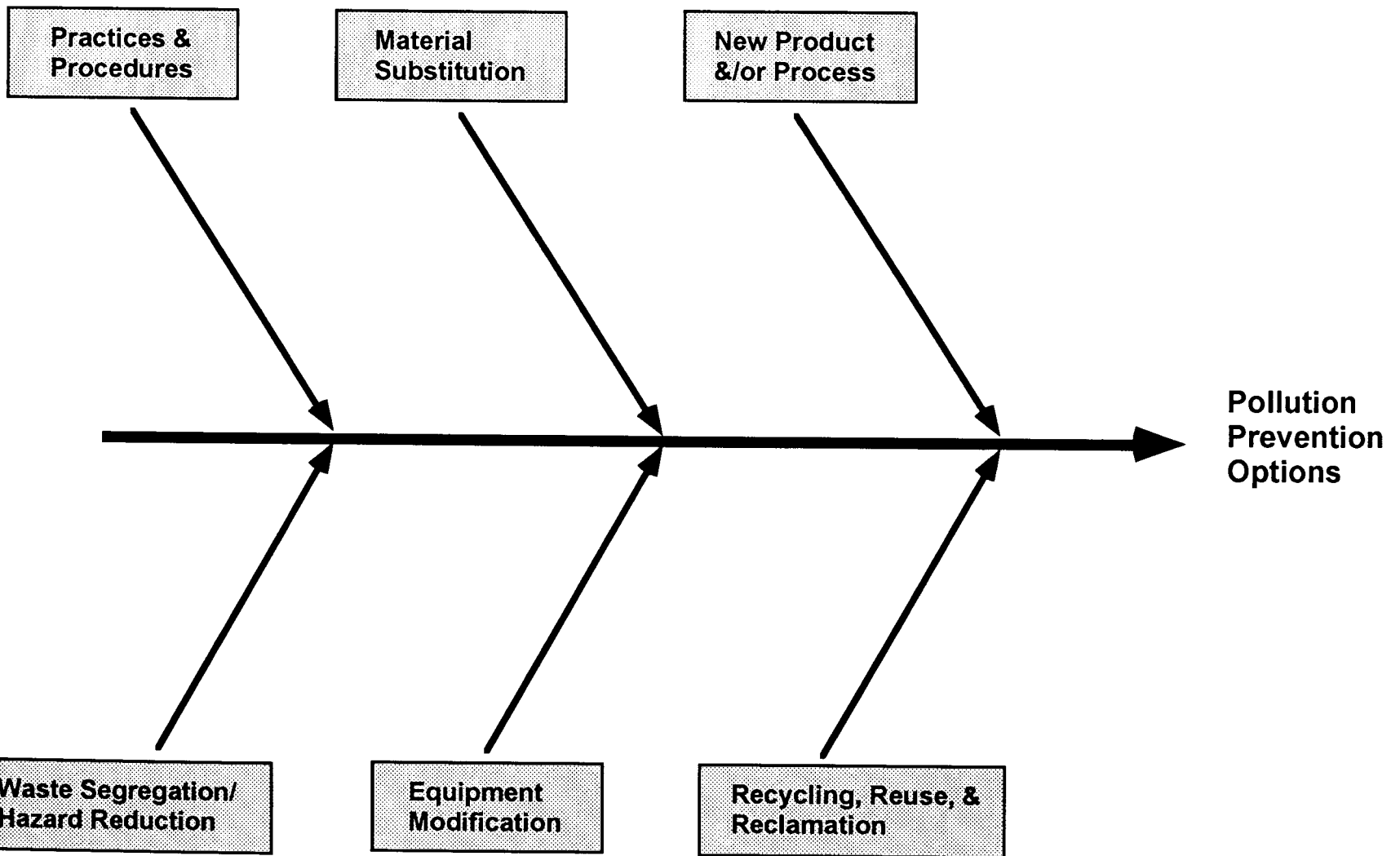
Level III

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

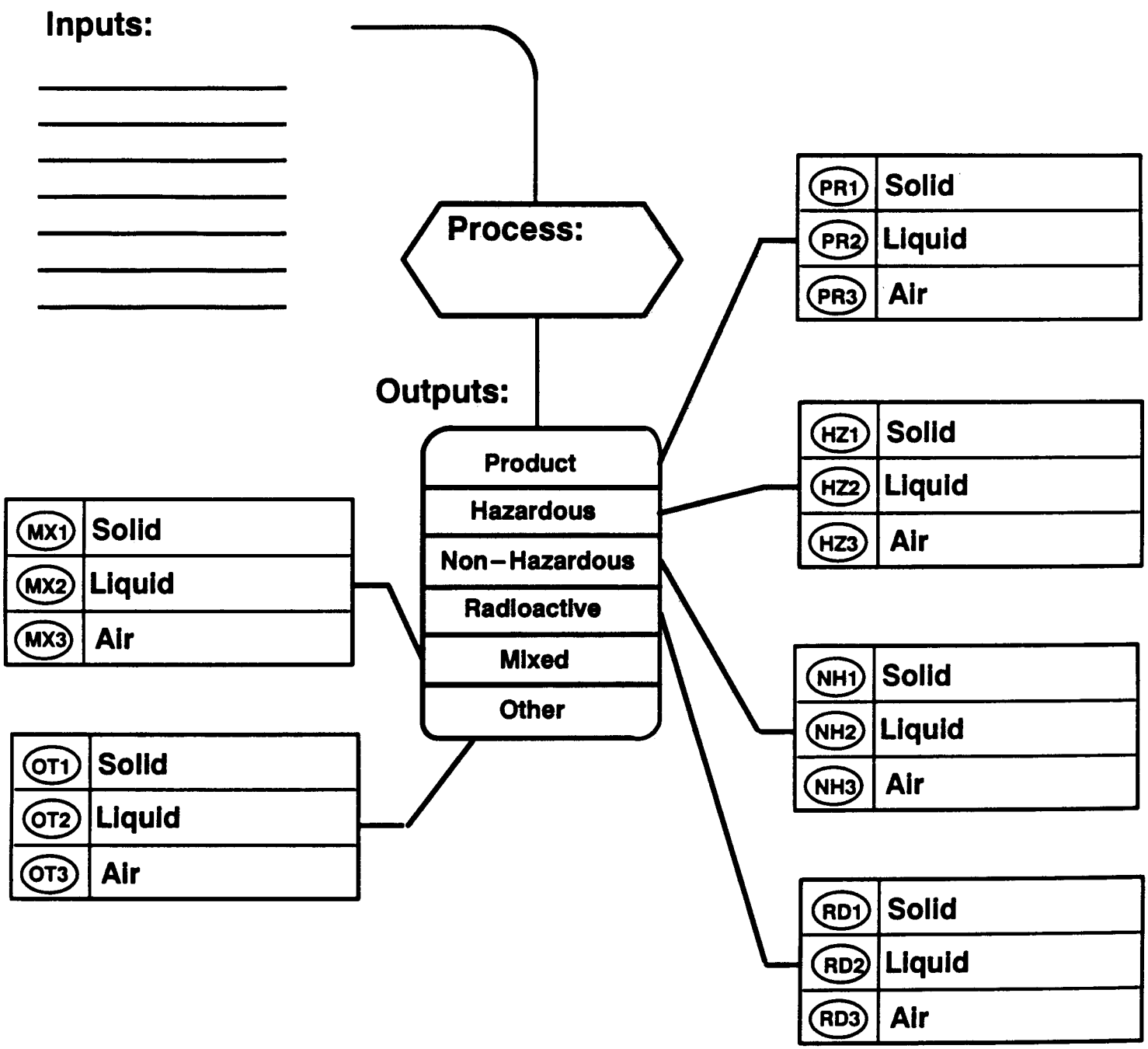
Level I

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. __: _____

Type (*)	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty

Option No. __: _____

Type (*)	Consider?	Feasibility	Estimated Cost	Estimated Savings	Anticipated Reduction Qty

Option No. __: _____

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)

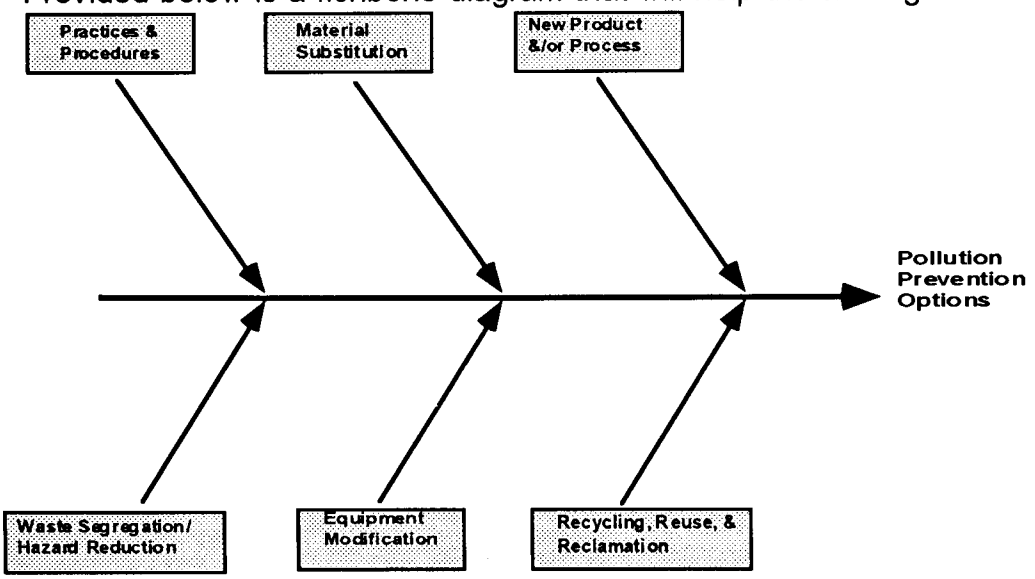
6. **Estimated Cost**: Estimate an implementation cost.

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: _____

Conclusions: _____

Recommendations: _____

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 H

REFERENCES

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9. M.I. Baker and F.E. Kosinski, Process Waste Assessments for Waste Minimization Planning, U.S. Department of Energy, Oak Ridge Y-12 Plant, Y/DZ-532 (November 21, 1989).

10. E.A. Kjeldgaard, J.H. Saloio, and G.B. Varnado, *Development and Test Case Application of a Waste Minimization Project Evaluation Method*, U.S. Department of Energy, Sandia National Laboratories, SAND90-1178 (August 1990).

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13. U.S. Department of Energy/Defense Program's, Office of Production Facilities (DP-64), *Prioritization of Pollution Prevention Options Using Value Engineering*, December 1993.