Opportunity Assessments

**a Training and
Resource Guide**

Pollution Prevention Opportunity Assessments

A Training and Resource Guide

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ABBREVIATIONS AND ACRONYMS

CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorofluorocarbons
CWA	Clean Water Act
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
LLMW	Low Level Mixed Waste
LLW	Low Level Waste
MTRU	Mixed Transuranic Waste
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
P2	Pollution Prevention
P2OA	Pollution Prevention Opportunity Assessment
PCB	Polychlorinated Biphenyl
RCRA	Resource Conservation and Recovery Act of 1976
RL	U.S. Department of Energy, Richland Operations Office
ROI	Return on Investment
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEPA	State Environmental Policy Act
TRI	Toxic Chemical Release Inventory
TRU	Transuranic Waste
TSCA	Toxic Substances Control Act
TSD	Treatment Storage and Disposal (Facilities)
UST	Underground Storage Tanks

..... INTRODUCTION

Purpose of Training & Guidance Document

The intention of the "Pollution Prevention Opportunity Assessment Training and Resource Guide" is to help Hanford waste generators identify ways to reduce waste through the Pollution Prevention Opportunity Assessment (P2OA) process. This document presents pollution prevention tools and provides a step-by-step approach for conducting assessments.

Training

The training contains four modules:

- **Pollution Prevention Training** – Introductory information about pollution prevention including the elements, the benefits, the drivers, examples of pollution prevention, and DOE Pollution Prevention goals.
- **Pollution Prevention Opportunity Assessment Training** – Examines the assessment process and approach for conducting assessments.
- **Sample Assessment** – A walk through of an actual assessment to demonstrate how to complete the P2OA worksheets.
- **Practice Assessment** – Workshop participants will complete an assessment on one of their own waste streams or conduct a case study assessment.

Guidance

Guidance is a resource section designed to complement the training. It describes how to identify, assess, and implement opportunities for preventing pollution and to stimulate the ongoing search for such opportunities. The guidance contains special circumstances for conducting a P2OA such as non-routine waste streams.

Appendices

Appendices consist of materials that will support the pollution prevention effort: waste handling costs, sources of additional information, and a glossary.

Background...

Pollution Prevention

Evolution of Pollution Control

The past 30 years have revealed the error of past actions and overall ignorance of the effects of those actions on the environment. As public awareness of environmental problems grew, Congress enacted legislation to address the pollution apparent in the environmental "media" of air, water, and land, as well as in the workplace and marketplace. The result was a fragmented, often bewildering array of statutes influencing environmental improvement, including the following:

- Clean Air Act (CAA)
- Comprehensive Environmental Response, Compensation and Recovery Act (CERCLA)
- Clean Water Act (CWA)
- Federal Hazardous Substances Act (FHSA)
- Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
- Hazardous Material Transportation Act (HMTA)
- Occupational Safety and Health Act (OSHA)
- Resource Conservation and Recovery Act (RCRA)
- Safe Drinking Water Act (SDWA)
- Toxic Substances Control Act (TSCA)

The Congressional response to pollution had two main paths. The first was to control pollution. The regulated community relied heavily on capture, treatment, and disposal to manage wastes, emissions, or effluents after they had been generated. Second, legislation was media-specific in its approach, with regulations governing pollution in air segregated from regulations governing pollution of water, which are separate from those regulating solid and hazardous waste, and so on. Other facets of cradle-to-grave materials legislation included: product performance requirements, labeling requirements, bans and phase-outs of materials or products, public distribution of data gathered, and more.

Drawbacks of Pollution Control

Media Transfers

Classic examples illustrate how transfers between environmental media happen with pollution control technologies. Smokestack scrubbers remove and collect potentially toxic particulates to bring air emissions within regulatory standards, but the collected toxins must then be disposed of as hazardous wastes. This hazardous waste may leach from the disposal facility into ground or surface water, evaporate into the air, or remain in the ground or surface water.

Some booths for applying paints are equipped with water curtains, which capture solids and some solvents in overspray from paint guns. The water screen reduces the number of spent air filters generated as hazardous waste as well as lowering solid and solvent emissions. However, the wastewater then requires treatment or recovery of metals and solvents. Treatment techniques are not 100% successful, which means that some hazardous wastes will be discharged from the facility.

In response to media-specific regulation, pollution control addresses air pollutants, water discharges, and management of solid and hazardous wastes separately. As in the examples above, this results in a shift of pollutants and risks from one environmental medium to another. True multimedia source reduction will eliminate cross-media transfers or at the very least, substitute a less harmful, more controllable emission (for example, trading VOC emissions for water discharge from an aqueous cleaning systems).

Risks of Exposure

Another drawback of treating or disposing of pollutants is that waste is dealt with toxics after they have been used or generated, leaving everyone vulnerable. Workers are susceptible to accidents and often unknown long-term exposure risks. Communities and surrounding facilities may incur risks from long-term exposure to uncontrolled releases to air, surface water, and ground water. Others in the path-of-supply routes or waste streams may also suffer if transportation accidents result in spills, or if waste treatment or containment facilities fail.

Control after generation may increase the potential for future liability under any or all of the regulations should activities result in any public or environmental harm.

Short-Term Solution

Controlling pollution after it has been generated, perhaps technically "easier" than process modification, is a short-term solution to a long-term problem. But the long-term costs of emission control, maintenance of equipment, down time, waste disposal, water effluent fees, air pollutant fees, potential liability for failures of treatment, and disposal are high and likely to go higher. Hazardous raw material inputs are similarly expensive, and indeed, future regulations may phase out their use entirely. From an accounting standpoint, applying a control fix after the production process also tends to make costs of environmental protection harder to internalize as a true cost of production.

These factors make control more of a short-term approach, since a one-time capital investment in control equipment does little to control long-term costs and does not address the cause of those long-term costs. Process modification eventually may be necessary anyway, if the regulatory landscape changes.

Pollution Prevention

None of the pollution control options of treatment or disposal address long-term environmental problems, and the limits of their capacity will be reached as emission and waste generation rates increase with economic activity. For these reasons, environmental agencies and others are attempting to promote the use of pollution prevention (P2) through regulatory programs in order to enhance environmental protection.

Going to the Source

Pollution prevention can extend environmental protection beyond what is possible with end-of-the-pipe, after-the-process pollution control. Essentially, all non-product outputs (by-products, emissions, or wastes) can be reduced by addressing wastes "up-the-pipe" to their source. This approach offers greater, long-term protection of all environmental media and can address the short comings of pollution control-media transfers.

Pollution prevention is an ongoing reexamination of how materials are used or non-product outputs are generated. Understanding why, where, and how materials are used allows evaluation of opportunities for substitution or reduction of use. This represents a change in how we have approached materials use and production in the past, and results from increased awareness of their total economic and environmental cost. Pollution prevention has potential for more efficient and cost-effective use of resources within the U.S. Department of Energy (DOE).

INTRODUCTION

Prevention Hierarchy

Pollution prevention can be thought of as a hierarchy of activities (source reduction first, followed by recycling/reuse, segregation, and treatment) that is constantly applied to materials use or generation of potentially hazardous emissions and wastes. The intent in applying this hierarchy is always to start at the top, looking first for opportunities for prevention with the greatest potential impact on pollution. Pollution prevention is best achieved through reducing or eliminating non-product output or materials use at the source, by:

- Changing products
- Substituting less hazardous materials
- Using more efficient processes or equipment
- Preventing inefficiencies due to lack of maintenance or poor housekeeping

Other Options

Recycling (collecting and transporting materials for reprocessing) is a waste-management option second only to source reduction. Recycling processes themselves have residual wastes that require disposal, and there are dangers associated with the transport and handling of materials being recycled. Since recycling requires waste as a raw material, it sometimes can reduce incentives for source reduction of waste.

Once we get in the habit of looking first to pollution prevention options, then pollution control technologies and procedures, incineration, and disposal clearly become less preferable options.

P2 also a Sound Business Practice

If product and process modifications at the top of the source reduction hierarchy are not feasible, other options may have more immediate potential. Modification of process and procedures, such as improved scheduling of production, improved housekeeping, attention to maintenance, employee training, on and off-site recycling, can all take place at a relatively low cost as part of a reorientation toward environmental awareness and stewardship. New products and processes can have this stewardship built in, right from the design stage.

The notion of environmental stewardship may not serve as a driver that leads to the greatest environmental protection. Rather, analysis of practices and application of sound business practice leading to organizational and process optimization may serve a greater end. For example, contractors stand to derive both tangible and intangible benefits from implementing pollution prevention, including the following:

- Avoided costs for transportation, treatment and disposal
- Reduced or avoided costs of compliance (fees, fines)
- Profit from sale of byproducts to others as raw materials
- Savings on amount and costs of raw materials through closed-loop recycling
- Reduced or avoided costs of litigation
- Reduced or avoided insurance costs
- Less down time due to occupational health problems
- Avoided costs of addressing problems later, at inflated prices
- Avoided costs of accidents and spills
- Costs reduction for materials
- Avoided costs of administration and management

These are just some of the savings attainable. It is worth noting that many of these may never show up directly as hard dollars saved, and could be difficult to track. But they should at least be assigned a value and taken into account when making decisions on implementing pollution prevention options.

The...

DOE Waste Minimization Mission

The Department's pollution prevention mission is to minimize the generation and release of pollutants to the environment by implementing cost-effective pollution prevention technologies, practices, and policies with partners in government and industry. The Department will simultaneously conduct its operations in such a way as to minimize impact on the environment, improve the safety of operations and energy efficiency, and promote the sustainable use of natural resources.

-defined by the Pollution Prevention Program Plan, 1996

What is P2?

Definition of Pollution Prevention

"Any practice which reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment or disposal."

-defined by the Pollution Prevention Act of 1990

A Pollution Prevention (P2) program can be defined as an organized, comprehensive, and continual effort to achieve three goals:

- Reduce hazardous, radioactive, mixed, and non-regulated wastes
- Conserve resources such as energy and water
- Prevent or minimize pollutant releases to all environmental media from all operations and site cleanup activities.

The concepts of a Pollution Prevention Program are shown graphically in Figure 1.

Figure 1: Graphical Presentation of Pollution Prevention Concepts

Historically waste has been viewed at the end-of-the-pipe. The Pollution Prevention Act of 1990 shifted the focus upstream to source reduction.

A hierarchical approach to environmental management is applied to all types of waste, i.e., some kinds of waste management are better than others. The program priorities in descending order are:

Source reduction

Recycling

Waste treatment

Waste segregation

Environmentally safe disposal

Introduction ("Why Do It?")

The purpose of this document is to provide help to you, Hanford waste generators, in finding ways to reduce waste through Pollution Prevention Opportunity Assessments (P2OAs). It is based on guidance from other sites, and serves to complement the Hanford-specific training on P2OAs.

The chapters of this document include help on how to choose major waste generating activities, how to conduct a P2OA, how to get results, and how to show progress. There is also a chapter on special situations and problems your facility may encounter. This first chapter tells you why you should consider conducting P2OAs and why they may be required.

DOE Pollution Prevention Goals

Goal	Baseline Year	By End of 1999
Toxic Chemical Release Inventory Reduction	1993	50%
Hazardous Reduction	1993	50%
Radioactive Reduction	1993	50%
Low-Level Mixed Waste Reduction	1993	50%
Sanitary Waste Reduction	1993	33%
Recycling	N/A	33%
In addition, increase affirmative procurement of EPA-designated recycled products to 100%		

*Waste to Disposal Without
Pollution Prevention*

Waste
Generating
Activity

Disposal

Source Reduction

- Product Substitution
- Good Housekeeping
- Process-Modification/Optimization
- Improved Equipment Design
- Procedure-Related Changes

Source Reduction is the elimination of waste before it is even generated.

What is note-worthy about the following examples is that each attacked the waste stream at its source.

Product Substitution

Methanol Use Eliminated

Ethanol was substituted for methanol to clean experimental equipment. The used cleaning rags are now disposed of as low level waste instead of mixed low level waste.

Good Housekeeping

Hanford Waste Products Benefit School District

One of the techniques that is encouraged to be used to achieve source reduction is good housekeeping. Good housekeeping helps prevent spills, avoid duplicate purchases, improves safety and enhances work conditions.

Another advantage is better inventory control. By performing and maintaining good housekeeping, you're able to identify products before they expire and could have been disposed of as waste.

Process Modification/ Optimization

Closed Loop Cooling System On-Line at WESF

A closed loop cooling system was brought on line for the capsule storage pool cells at the Waste Encapsulation Storage Facility (WESF). This new system replaces the old single-pass cooling system which discharged effluent at approximately 80 liters per second (1300 gallons per minute). In addition, WESF can now discharge its cooling water to the 200 Area Treated Effluent Disposal Facility rather than B Pond. Completion of this project significantly reduces the quantity of process waste water that is discharged to the environment.

.....TRAINING

Improved Equipment Design

Sodium Minimization for 241-AN-107 Low Hydroxide Remediation

An on-line corrosion monitoring probe was installed in Double Shell Tank 241-AN-107 to monitor the required endpoint for corrosion inhibitor (sodium hydroxide). The probe monitors the sodium hydroxide addition to determine when corrosion is at acceptable levels and ensures the chemistry is correct.

The tanks store radioactive waste from 50 years of plutonium production. Corroding tank walls can leak radioactive contaminants to the soil and groundwater. It is essential to monitor the corrosion conditions of the tank walls and the addition to determine tank integrity and ensure safe waste storage until retrieval and final waste disposal can be accomplished. The installation of the corrosion probe alleviated the continual sampling.

The use of the corrosion probe during inhibitor addition reduced tank additions by 113 cubic meters (30,000 gallons) over five years, or 23 cubic meters annually. This also resulted in elimination of sodium addition of 51 metric tons. The elimination of 51 metric tons will reduce low level waste glass vitrification production by 204 metric tons.

Procedure Changes

Iodine-129 Sampling Requirements Reduced

TWRS employees worked with the Effluent Monitoring Program to reduce the number of Iodine-129 sampling performed on four ventilation stacks based on an iodine emissions study. Effluent Monitoring granted approval to reduce sampling from weekly to quarterly.

Recycling is the use, reuse, or reclamation of a material.

Recycling

- Material Recovery/Reclamation
- Closed-Loop Systems
- Raw Materials/Waste Exchanges

Material Recovery/Reclamation

Mercury Reclamation at 222-S Laboratory

The 222-S personnel implemented a filtration and distillation process that recycles mercury for reuse. Mercury is decanted, run through a pinhole into a damp filter and trapped on the filter. The mercury is then distilled for final purification using an Eberbach™ automatic mercury still.

Closed-Loop System

Hydrogen Feed, Recovery, and Recycle

A compressor, tankage, and manifold system was installed in the Chemical Engineering Laboratory to allow use of low-pressure cylinders to feed high-pressure chemical reactors. A hydrogen recovery and reuse system was added to minimize venting of unused gas.

Raw Materials/Material Exchanges

Educational Development Gift Program

When employees upgrade computers on the Hanford Site, their old equipment is evaluated for redeployment back on site or placed in the Department of Energy's Educational Development Gift Program. The Program, designed to help students improve their math and educational skills, has benefited schools in Washington, Oregon, Idaho, and Montana.

Soil Washing Tent Redeployed

A 33-foot-wide, 68-foot-long tent was moved from the 100D Area to the LERF to cover the 291 load-in facility where tanker trucks are emptied. The tent had previously been used for soil washing operations.

Waste Treatment

Waste treatment includes technological processes which reduce the quantity, toxicity, or mobility of waste after it is already created.

Waste
Generating
Activity

Disposal

- Distillation
- Stabilization
- Neutralization
- Incineration
- Evaporation

Stabilization

Waste Neutralization and Disposal

Following waste sampling activities, liquid waste was neutralized and disposed of as low level waste at the 200 Area Liquid Effluent Facility. This neutralization process saved repackaging the waste into lab pack form which would have created twice the volume. It also saved storage costs at the Central Waste Complex.

Compaction

Facilities Compact Wastes

The generation of low level waste continues to increase with work being performed at different facilities. Waste is sent for compaction to an offsite vendor. This reduces the volume sent for disposal.

Before compaction: 34 inches

After compaction: 3 inches

Waste Segregation

Survey

Portable Radiological Detection Instruments for Surveying Contaminated Materials

Procurement of Eberline E-600 Survey Meters will allow Radiation Technicians to survey for both alpha and beta with a greater sensitivity using a 100 square centimeter probe. The accuracy of these meters will allow the release of more materials for reuse or recycling and result in a source reduction of low level waste.

Sorting

Segregation of Waste

T Plant has segregated mixed low level waste containers, allowing a large portion of the contents to be disposed of as low level waste.

Separation Process Implemented

A new process for disposal of oil and water condensate from the blowdown of air compressors has been implemented. The liquid waste is characteristically less than 5% oil, however, regulatory requirements require liquids to be absorbed with two times the absorbent material. The new "separation process" for oil and water condensate eliminates the disposal of containers and absorbent material.

Pollution Prevention Program

A comprehensive pollution prevention program addresses all types of waste including energy and water.

Waste to Disposal After Pollution Prevention

Pollution Prevention saves the high cost of disposal.

EPA Hierarchy of a Pollution Prevention Program

The DOE has adopted the EPA Hierarchy as the preferred approach when conducting Assessments.

Barriers and Incentives to Pollution Prevention

Anticipate obstacles and plan to overcome them.

[illegible]

Benefits of Pollution Prevention

The benefits of pollution prevention include advantages to employees, the environment, and Hanford contractors. From a worker's safety point of view, P2 reduces personal exposure to chemicals and radioactivity, reduces the potential for serious accidents and spills, and reduces regulatory workload. As Low As Reasonably Achievable (ALARA) and safety programs actively support pollution prevention efforts.

The environmental benefits arise from the reduction of releases to the ground, water and air, and from conservation of resources such as raw materials energy, and water. This protects both wildlife and the people of the area who all use the natural resources in order to live.

Finally, contractors benefit from the reduction in compliance and reporting costs, improved efficiency of operations, improved public relations, and reduction of long term civil and criminal liability. P2 and P2OAs also foster a positive working relationship with regulators and with the community, as they are seen as positive technical and procedural activities.

Thus, P2 ensures worker safety, reduces damage to the environment, and saves money!

Regulatory/Reporting Requirements

Many regulatory and DOE requirements exist for pollution prevention. Several RCRA codes, and DOE Order 5400.1, require a Pollution Prevention/Waste Minimization Program Plan in place at each site.

This interpretation, which has been accepted by the State of Washington, is upheld by RCRA in the *Implementation Guidance for DOE Order 5400.1*, which specifies that "the basic elements of an effective waste minimization program" include "periodic waste minimization assessments/audits." The order defines these assessments as "a continuing effort," not a "one time endeavor."

A guiding document from DOE, the 1996 *Pollution Prevention Program Plan*, offers some focus. This document strongly emphasizes cost effectiveness and rapid return on investment from the opportunities found with P2OAs. The *Plan* focuses on all wastes types, as well as conservation of water and energy, as aspects of pollution prevention.

Safety and ALARA can also be direct benefits of pollution prevention.

See Appendix D
for a complete
listing of P2
drivers.

P2 Drivers

There are forty-four DOE and RCRA legally binding P2 drivers; statutory/regulatory and Order requirements including:

- The Pollution Prevention Act of 1990
- RCRA
- CERCLA
- DOE Orders

Definition of a P2OA

A P2OA thoroughly examines work activities and identifies opportunities to minimize the generation of waste and reduce costs.

A systematic way of finding methods to reduce waste is through a Pollution Prevention Opportunity Assessment, or a P2OA. A P2OA is conducted by a select team that identifies and prioritizes waste streams, examines the processes that cause the generation of the waste, and discovers ways to reduce this waste. Most P2 programs begin with management commitment as well as the identification and prioritization of waste streams on which to focus. Conducting a P2OA consists of selecting a team, gathering information about the waste generating activity, brainstorming pollution prevention opportunities, researching those opportunities, and making recommendations.

A good P2 program should also have a method to move from the P2OA process to implementation of P2 opportunities. P2OAs are considered the standard DOE method to identify and rank pollution prevention opportunities. They are used and recommended by the Environmental Protection Agency (EPA), the Department of Energy (DOE), private industry, and other state and federal regulatory agencies.

Benefits of a P2OA

- ▶ **1** Identifies pollution prevention opportunities
- ▶ **2** Creates a baseline to monitor pollution prevention progress
- ▶ **3** Serves as a continuous process improvement tool
- ▶ **4** Provides economic evaluation information

Regulatory/DOE Drivers for Conducting a P2OA

- RCRA 40 CFR 264.73 certification and program in place
- Pollution Prevention Act of 1990
- 1996 DOE Pollution Prevention Program Plan

Hanford's P2OA Approach

- Facility Specific Assessments
- Sitewide Strategic Assessments
- Community Assessments

Figure 3, below, shows the steps for implementing P2 opportunities and reducing waste.

Sitewide Strategic P2OAs are conducted to reduce the largest waste generating sources common to multiple contractors or largest generator.

Figure 3: Pollution Prevention Process

P2OA Procedure

- 1 ... Identify priority waste/chemical streams
- 2 ... Select activities for further study
- 3 ... Organize P2OA team
- 4 ... Conduct facility walk through, flow diagram
- 5 ... Describe activity and conduct material balance
- 6 ... Brainstorm P2 opportunities
- 7 ... Conduct a cost benefit analysis
- 8 ... Implement the recommended opportunities

1 Identify Priority Waste/Chemical Streams

How to Prioritize Your Waste Streams & Activities

Before conducting P2OAs, first you must decide which waste streams to analyze. Since the number of waste streams at Hanford or any one of its facilities could number in the tens of thousands, it is important to group them together by common content or source and to prioritize them according to importance. This section describes where at Hanford to obtain information about waste streams, how to prioritize and how to set reasonable goals in terms of the number of P2OAs to be done annually. The steps are also listed in Figure 4.

Review the waste stream and activity priorities on an annual basis. This way,

- ▼ Obtain a list of major chemical, radioactive and other material inputs
- ▼ Get waste stream information
- ▼ Determine volume and cost of each waste stream
- ▼ Choose other important criteria
- ▼ Rank waste streams
- ▼ List main contributing activities
- ▼ Set goals
- ▼ Conduct P2OAs

Figure 4: Preparing for P2OAs

Review existing information resources.

information from the previous calendar or fiscal year can be used. Additionally, this will correspond with the annual reporting requirements.

Information Required & Sources

First, develop a material procurement list that identifies the hazardous products and chemicals purchased and used in your facility. These will be the large quantities hazardous materials entering or stored for facility operations. Additionally, try to identify other sources of materials (hazardous, radioactive, non-regulated) entering the facility that end up creating or being handled as waste.

Your final input list should include, for example:

- Purchased materials of any significant quantity
- All purchased hazardous chemicals or materials
- Environmental samples received from onsite and offsite customers
- Material brought in by subcontractors or other persons
- Waste from customers to be treated, handled or disposed of by your facility
- Legacy waste

This list must be general and should include any large material inputs or products of significant quantity used in that become waste. Modifying some of the activities generating these input streams may be out of your control, while others may be possible—do not worry about that right now, those will be identified when doing a P2OA.

Next, determine waste streams and quantities that exit your facility, including air emissions and water waste. This is done by looking at your material inputs and determining where those exit your facility. Possible sources for this information are the Solid Waste Information Tracking System (SWITS) database, satellite accumulation records, and waste manifests. It is also beneficial to categorize these wastes by hazardous, radioactive, mixed, and sanitary (nonregulated), as it helps focus on what wastes are generated at your facility. Group these waste streams into large but practical categories. Also, determine from your waste generation numbers where your largest waste type is, such as LLW or HAZ—you may want to address those streams in particular.

Choosing Criteria

The data collected in the above section can now be summarized and criteria for prioritizing waste streams chosen. First, list the waste stream data collected above on the "Waste Stream Information" worksheet (see Guidelines for *Waste Stream Information*, page 51). You may not want to list all the waste streams; one method is to choose the top three waste streams from each waste type. Or, you may want to focus entirely on a particular waste type (and its waste streams) that is a very difficult to manage.

From this list, determine the mass or volume of each waste stream and record that value on the worksheet. Mass/volume and cost are two criteria that should be used to prioritize waste streams. These two values should be multiplied to calculate a total cost for generating the total quantity of waste. The costs are on the back of the worksheet and are based on DOE approved life-cycle costs at Hanford.

PREPARE

You may want to use additional criteria to prioritize your waste. The "Other Concerns" column is where you would list any other important criteria other than non-quantifiable cost and volume. These should be very specific to your facility. Perhaps a waste stream is a particular ALARA or safety hazard due to the way it must be handled. Or, it is very toxic to humans or the environment. Or, it is a waste stream that is very high profile with the community. All non-quantifiable but important criteria should be listed in the last column of the "Waste Stream Information" worksheet, see practice Assessment Section page 49-63.

Using data recorded from the first worksheet, now prioritize these waste streams. Generally, the stream with the highest total cost will be the highest priority waste stream. You may rank them strictly on cost and quantity (using the highest total cost as the highest priority), but you may also want to move streams up the priority list depending on their toxicity or other less quantifiable criteria recorded in the Other Concerns column. Record the top waste streams in order on the Priority Streams and Activities worksheet.

Waste generation information can be obtained through:

- Solid Waste Information Tracking System (SWITS)
- Waste shipment manifests
- Emission inventories
- Forecast information
- Permits
- Facility/Contractor records and reports
- Pollution prevention representatives
- URL <http://apsq105.rl.gov/polprev/p20a/p20a.htm>

2 Select Activities for Further Study

Picking Activities

Once the top streams are listed, it is time to determine what activities create these waste streams (see Guidelines for *Priority Streams and Activities*, page 53). These activities will be the ones in which you will conduct P2OAs. To prevent becoming overwhelmed, only list the top one to three waste generating activities for each waste stream. These activities will come from general knowledge of your facility and can be very broad (such as, "painting" or "sampling analysis"). Several activities may generate one waste stream. Group these activities when you can, otherwise consider them separate P2OAs. Once you have listed your activities, begin conducting your P2OAs.

Remember, the key to selecting P2OA activities is to identify actions in your facility that generate the most expensive and largest amount of waste. Once these are determined, the P2OA will look at all the waste streams from these activities (even though one stream may be a priority over others).

Activities contributing to the identified waste streams can be identified through:

- Facility/Operations Personnel
- Hazardous Materials Coordinators
- Environmental Compliance Representatives/Officers
- Pollution Prevention representatives

3 Organize P2OA Team

Build a Team

The first step is building a team that will conduct each P2OA (see Guidelines for Worksheet 1, *Team and Activity Description*, page 55). The team usually includes a team leader who has technical and practical knowledge of the activity. This person is responsible for seeing that the P2OA worksheets are completed, opportunities are identified, and cost-effective opportunities are implemented.

In addition to the team leader, several other core members will assist in conducting the P2OA. These individuals can be people who know about the priority waste generating activity, or they can be unfamiliar to the specifics. Team members or information sources should be selected based on their process knowledge, purchasing and material inventory knowledge, regulatory experience, or P2OA expertise and interest. Teams may vary in size depending on the nature of the activity. Either way, the key is talking to the workers performing the activity and seeking out the technical information required from people in other specialized areas, such as safety, industrial hygiene, etc. who may not be part of the team.

Once a team has been organized, the P2OA leader can initiate the P2OA on the priority activity. The team members are recorded on Worksheet #1.

Learn about the Activity & Gather Information

The first step the team will want to take is to get a closer look at the activity they will be assessing. A tour of the area where the waste is generated is usually the most helpful. Talk with the workers performing the activity as they are the most knowledgeable about the waste stream. Ask how they think the waste could be reduced; often they will have thought of P2 initiatives that they have not been able to implement. Watch how the work is completed to see if there are inefficiencies.

Other sources of information can be the material used and waste generated, data collected previously, purchase requisitions, and examination of material and waste containers.

In order to record this information, a description of the activity is recorded on Worksheet #1. Then, Worksheet #2 can be used to map out the materials in and the wastes out of the activity. If this worksheet is too restrictive, feel free to complete one in a more free-form manner.

Team Members Can Include:

■ Craft personnel	■ Engineers
■ Waste generators	■ Scientists
■ Waste management specialists	■ Managers
■ Laboratory technicians	■ Chemist
■ Other line personnel	■ Operators
■ Radiological protection personnel	

4 Conduct Facility Walk Through, Flow Diagram

See Guidelines for Worksheet 2, *Activity Flow Diagram*, page 57.

- Schedule the walk through
- Monitor the activity at different times
- Interview
- Photograph or videotape activity
- Observe the "housekeeping" aspects
- Assess the organizational structure
- Assess administrative controls
- Draw a flow diagram

Photography Developing Activity

An activity flow diagram organizes data graphically.

5

Describe Activity and Conduct Material/Energy Balance

See Guidelines for Worksheet 2, *Activity Flow Diagram*, page 57.

Sources of Material/Energy Balance Information:

- Process knowledge
- Operating logs
- Purchasing records
- Emission inventories
- Material and chemical inventories
- Samples
- Laboratory notebooks

6

Brainstorm P2 Opportunities

Brainstorm

From a knowledge of the activity, the team can begin to seek out ideas to reduce waste (see Brainstorming Guidelines, page 59). Brainstorming as a group is the best method for obtaining ideas, with the group including the team and any others who are directly involved with the activity. Try not to be negative as you brainstorm; the ideas do not have to be specific at this point; as an example, an idea to reduce solvent waste could be "Look for ways to recycle/reuse solvent." A more detailed understanding of how to accomplish this comes during the next step. Figure 6 shows a tool that may help in brainstorming, by categorizing potential opportunities. Record all ideas in some form for documentation.

Good planning is essential for efficient site reviews.

Figure 6: Brainstorming Tool, Fishbone Diagram

Once a list of ideas is generated, the team can determine which ideas to pursue and assign those to interested team members.

Ask Yourself These Questions:

- Is this operation necessary?
- Why is the waste generated?
- Can energy usage be decreased?
- Why do we conduct the operation this way?
- Why must we use these chemicals?
- Is there more efficient equipment available?
- Are there any non-hazardous substitutions available?

7

Conduct a Cost Benefit Analysis

Identifying Funding Sources

In this section it is important to describe the methodology used to determine waste reduction, cost savings and implementation costs (see Guidelines for Worksheet 3, *Pollution Prevention Opportunity Description*, page 61). Elements to be considered include waste type e.g., LLW, MLLW, etc. and volume, specific estimated costs savings for one year after implementation is complete and calculate payback which is the number of years to recover the implementation costs. This can be achieved by dividing the implementation costs by the annual cost savings.

When calculating the annual cost savings it is important to identify the annual costs before and after then subtract the before and after cost to determine the net cost savings.

Cost to be considered when conducting a cost benefit analysis are listed on the next page:

Direct Costs:

- Capital Expenditures
 - Buildings
 - Equipment and installation
 - Utility connections
 - Project engineering
- Operation and Maintenance
- Expenses or Revenues
 - Raw materials
 - Labor
 - Waste disposal
 - Water and energy
 - Value of recovered material

Document cost calculations so that the full benefit of the pollution prevention program can be quantified.

Indirect Costs:

- Administrative Costs
- Regulatory Compliance Costs
 - Permitting
 - Recordkeeping and reporting
 - Monitoring
 - Manifesting

Liability Costs:

- Penalties
- Fines
- Personal Injury
- Natural Resources Damage

8

Implement the Recommended Opportunities

Less than a two year payback is reasonable for implementation. Funding can be sought through:

- Facility Programs
- DOE-RL High Return on Investment Project Proposals

Sources of Technical Assistance

- Trade associations
- Published literature
- Federal, state, and local environmental agencies
- Equipment vendors
- Other companies
- Pollution prevention representatives

Database P2OA Tracking System

Completed assessments are posted on the Hanford P2 Homepage

Internal Address: <http://apsql05.rl.gov.polprev/default.asp>

Tracking Techniques

The easiest way to track progress is to retain and file your P2OA forms. This can be done in hard copy, electronically, or both. With each set of P2OA forms, keep background research information and contacts. Also, keep track of any information and budget data on opportunities implemented. That way you can track the outcome of each P2OA.

A summary tracking report may also be useful to show the overall success of your P2OA program. This form will summarize the actual opportunities implemented. The main summary pieces of success data that you may want to track for each opportunity are:

- Opportunity implemented
- P2OA resulting in the opportunity
- Waste class(es) reduced
- Waste stream(s) reduced
- Volume/mass of waste(s) reduced
- Implementation cost
- Annual or one-time cost savings
- Payback period

All completed P2OAs are stored on the Hanford P2 Homepage at <http://apsql05.rl.gov.polprev/default.asp>. Once you have completed your assessment contact your Pollution Prevention representative to have it placed on the internet for use by others.

Getting Credit for Your Work—Who to Tell

The required reporting for each P2OA is basically the five worksheets (or another method of your choice) detailing the P2OA process. These can be submitted to your P2 representative as you conduct them, or on a quarterly or yearly basis. Additionally, a brief update on the number of P2OAs conducted and the status or progress of the P2 opportunities for each also should be submitted. The specifics for required reporting are detailed in the *Hanford Site Guide for Preparing and Maintaining Generator Group Pollution Prevention Program Documentation*, (DOE/RL-95-103 Rev. 2) available from your P2 representative.

Not only should accomplishments be recorded for reporting and regulatory reasons, successes should be communicated for the benefit of you and others. By telling people about the P2 you have achieved, you not only reveal yourself as an environmentally proactive group, but the technique or technology can be transferred to other facilities or sites that have similar problems. Some methods of achieving this are:

- Posting accomplishments on a facility bulletin board
- Submitting articles in a technical magazine, such as *Pollution Engineering* or *Pollution Prevention Review*
- Presenting at a technical conference, such as the DOE Pollution Prevention Conference or the Air and Waste Management Association Annual Conference.
- Submitting articles in a national newsletter, such as *Pollution Prevention Advisor*
- Submitting articles in the site newsletter, the *Hanford Reach*
- Providing an entry for the *Hanford Pollution Prevention Accomplishments Book*
- Applying for awards, such as the DOE Pollution Prevention Awards

Also remember to document any "failures." These could include ideas that were not approved or did not perform as expected. These may be used as lessons learned for the next time or for another facility. If the problem was solved via another means, that also should be recorded as a lesson learned for yourself and others.

Opportunity Implemented from a P20A

Isolate 151-S Diversion Box

Precipitation accumulates in 151-S Diversion Box located in Tank Farms. If the diversion box was not sealed to prevent precipitation accumulation, 151-S would have to be pumped and the liquid disposed of as contaminated radioactive mixed waste. Jumpers stored in 151-S are identified as ancillary equipment and will remain until the double shell tank closure. The structure was sealed with a foam preventing seepage until the structure is to be opened for retrieval of the jumpers.

Pollution Prevention Opportunities Exercise

Determine if the practices below represent pollution prevention. If the answer is yes, describe the pollution prevention technique in the space below. You may want to refer back to the source reduction, recycling, and treatment diagrams beginning on page 11.

1. **Burning up spent toluene in an incinerator to generate energy instead of sending it to a waste hauler?**

Pollution Prevention? Yes ☐ No ☐

Why?/Why Not?

2. **Replacing solvent cleaning agents with non-regulated detergent and water cleaning operations to avoid the use of hazardous solvents.**

Pollution Prevention? Yes ☐ No ☐

Why?/Why Not?

3. **Installation of a hard-piped vapor recovery system to capture and return vaporous emissions.**

Pollution Prevention? Yes ☐ No ☐

Why?/Why Not?

4. **Sending waste printing inks to a local commercial recycler.**

Pollution Prevention? Yes ☐ No ☐

Why?/Why Not?

5. **Replacing the nozzle of a high pressure paint applicator to better focus the paint spray stream.**

Pollution Prevention? Yes ☐ No ☐

Why?/Why Not?

6. **Drying and pressure filtration of a heavy metal waste sludge prior to disposal.**

Pollution Prevention? Yes ☐ No ☐

Why?/Why Not?

7. **Improving work practices to avoid spills of machine cutting fluids.**

Pollution Prevention? Yes ☐ No ☐

Why?/Why Not?

8. **Removing solvents from wastewater by means of an activated carbon adsorber then regenerating the carbon using another solvent.**

Pollution Prevention? Yes ☐ No ☐

Why?/Why Not?

Answers:

1. No - Media Transfer
2. Yes - Product Substitution
3. Yes - Closed Loop
4. Yes - Offsite Recycling
5. Yes - Equipment Modification
6. No - Does not decrease the number of heavy metals molecules in the sludge
7. Yes - Good housekeeping
8. No - Regenerating the carbon requires the use of another solvent or heating which transfers the waste to the atmosphere

.. **SAMPLE ASSESSMENT**

SAMPLE ASSESSMENT

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 1

Team and Activity Description

Date July 31, 1997

P2OA ID Code 97-LLW-1

Facility 222S

Activity Laboratory Analyses

Team Members (*Leader)	Telephone	MSIN
Peter Segall*	372-0469	H6-06
Ronald J. Boom	373-4456	T6-12
Jann M. Frye	376-8624	T6-30
Richard K. Fuller	373-1883	T6-50
Grant L. McCalment	373-0616	T6-20
Joel M. VanSant	373-3383	T6-20

Description of Activity to be Examined in this P2OA

The 222S Laboratory Complex, located in the 200 West Area, is currently the primary analytical chemistry laboratory. The primary mission of 222S Laboratory is to support all Hanford clean-up activities. Approximately 60-70% of the laboratory workload is in support of tank farms. Solid low-level waste is generated from laboratory analyses of tank waste samples. The remaining laboratory activities support analytical services for other activities such as the waste management processing plants, environmental sampling and similar activities across the site.

The 222S Laboratory generated 258 cubic meters of solid low-level waste (LLW) in calendar year (CY) 1996. Approximately 45 cubic meters of the solid LLW was generated from routine operations, laboratory analyses, with the remainder from construction/project activities. Sample analyses have been identified as the primary generator of solid LLW from routine operations within the laboratory. The activities, producing the majority of solid LLW waste are conducted in rooms 1B (Sample Preparation), 4A and 4B (Radioactive Chemistry), 4D (Chromatography) and 4J (Low Activity Radioactive Chemistry). It is estimated that sample analyses activities generate 20 cubic meters of solid LLW. Tracking of actual quantities from each room and hood was initiated in late March 1997 and the data to date doesn't accurately reflect full production capabilities at this time.

The solid LLW stream, being evaluated as part of this P2OA, is made up of plastics, paper/cardboard, glass, metals, styrofoam, diatomaceous earth (used as filler material), rubber and other miscellaneous materials. The laboratory work is conducted in hoods within each room with some solid waste generated from counter top activities. Solid LLW wastes generated are set aside and disposed of as compactible waste (i.e., paper, dry rags, gloves, clothing, and other dry, low density, compactible wastes) or non-compactible wastes (i.e., glass, empty plastic bottles, metal, hard plastic, rigid cardboard, etc). Contaminated empty non-hazardous glass and plastic vials, bottles, reading <100 m/hr at contact are crushed. Empty nonhazardous, nonsmeearable, glass and plastic bottles, and small pieces of wood are shredded.

Note: Compactible waste is sent to an off site contractor for compaction.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 2 **Activity Flow Diagram**

Chemical and Radioactive Inputs		Material Inputs		Energy Inputs	
Name	Quantity	Name	Quantity	Name	Quantity
N/A		Plastics (30%) - Liners/bags, syringes, vials, bottles, pipets, containers, etc.	6 m ³	N/A	
		Glass (25%) - pipets, bottles, pipet controller, vials, flasks, beakers, etc.	5 m ³		
		Rubber (2%) - gloves	0.4 m ³		
		Paper/cardboard- (25%) towels, chemwipes, filter- disks, pH indicator, envelopes, cardboard carriers, etc.	5 m ³		
		Metals (5%) stir bars, dishes, planchet, etc.	1 m ³		
		Diatomaceous - earth (10%)	2 m ³		
		Miscellaneous (3%) -	0.6 m ³		

ACTIVITY

Activity Time Period:
Annual

Outputs include: Solid (2) Liquid (l) Air (a)

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 2

Activity Flow Diagram (Continued)

Product or Result Output		Hazardous Waste Output		Non-Hazardous Waste Output	
Name	Quantity	Name	Quantity	Name	Quantity
N/A		N/A		N/A	
Radioactive Waste Output		Mixed Waste Output		Other	
Name	Quantity	Name	Quantity	Name	Quantity
Plastics (30%) - Liners/bags, syringes, vials, bottles, pipets, containers, etc.	6 m ³	N/A		N/A	
Glass (25%) - pipets, bottles, pipet controller, vials, flasks, beakers, etc.	5 m ³				
Rubber (2%) - gloves	0.4 m ³				
Paper/cardboard- (25%) towels, chemwipes, filter- disks, ph indicator, envelopes, cardboard carriers, etc.	5 m ³				
Metals (5%) stir bars, dishes, planchet, etc.	1 m ³				
Diatomaceous - earth (10%)	2 m ³				
Miscellaneous (3%) -	0.6 m ³				

Total Input Volume 20 m³ ~ Total Output Volume 20 m³

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 3
Pollution Prevention Opportunity Description

Date July 31, 1997	P20A ID Code 97-LLW-1	Facility 222S
Activity Laboratory Analyses		
P20 No. 1	P20 Title Re-Use Plastic Waste Disposal Containers	

Current Practice

Waste within laboratory hoods is collected in approved waste containers. Most of the solid low-level non-compactible hood waste is collected in a 165 ounce, 7 3/4" diameter, 7" high hard plastic containers. After the container is appropriately labeled low-level waste (LLW) and identified by the room number, a polyethylene liner is placed into the container. The top of the liner is folded over the container lip and the liner is pressed towards the sides and bottom. The container is placed into the hood for waste collection.

When the container is full or ready for removal from the hood, the liner is horse tailed and taped. The lid is taped or secured onto the container. The container is double bagged, the bags are horsetailed and taped and the waste transferred to the 90 day accumulation area.

A review of the March-April 1997 waste log-in sheet data for non-compactible LLW generated from hood activities revealed that one hundred (100) 165 ounce hard plastic containers ($v = \pi r^2 H = 3.14 \times (3.9375)^2 \times 7 = 340 \text{ in}^3 (0.006 \text{ m}^3)$) are utilized per month totaling 1200 hard plastic containers per year. Based on Generator services process knowledge, a maximum of 25 plastic containers can be placed into a 55 gallon drum. This equals 48 non-compactible low-level hood waste drums generated per year (approximately 12 m^3) of LLW.

Recommended Action

It is recommended that the hard plastic containers utilized for disposal of low-level non-compactible hood waste be reused rather than disposed of as LLW. It is conservatively estimated that the plastic container could be used, on an average, 5 times rather than immediately discarded as solid waste. It is estimated that elimination of disposing of the non-compactible plastic containers will allow for a 50% increase in the quantity of non-compactible LLW waste placed in a 55 gallon drum.

The same hard plastic containers are utilized for disposal of MLLW non-compactible hood waste. It is also recommended that the hard plastic containers be reused rather than disposed of as MLLW (It is estimated 1000 hard plastic 165 ounce plastic containers are used annually). It is conservatively estimated that the plastic container could be reused, on an average, 4 times rather than immediately discarding as solid waste. It is also estimated that elimination of disposing of the non-compactible plastic containers will allow for a 50% increase in the quantity of non-compactible MLLW placed in a 55 gallon drum.

Implementation of this recommendation will require Hanford Analytical Services Laboratory, Operating Procedure, "Segregate and Manage Solid Laboratory Wastes" (LO-100-151, dated 6/27/97) to be revised to reflect the reuse of the plastic containers for non-compactible low-level and mixed low-level hood waste. In addition, based on the process knowledge of the brainstorming team, for improved puncture protection, it is recommended that a 0.010 nylon reinforced plastic liner be placed inside the plastic container rather than using the current liner.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 3

Pollution Prevention Opportunity Description (Continued)

Calculation of Waste Reduction and/or Energy Savings

LLW - It is estimated that implementation of the recommendation to re-use hard plastic containers will result in a reduction in LLW generation annually of approximately 4 m^3 . It is also estimated that revising the procedure to re-use the plastic containers will result in an estimated increase of non-compactible LLW placed in a 55 gallon drum by fifty percent (50%). However, since it is estimated the hard plastic container will be disposed of every fifth use, the number of drums eliminated annually will be reduced from 48 to 29 (a reduction of 19). An annual reduction in non-compactible LLW of 4 m^3 will result (10 m^3 to 6 m^3).

MLLW - It is estimated that implementation of this recommendation will result in a reduction of MLLW generation annually of approximately 3 m^3 annually. It is also estimated that revising the procedure to re-use the plastic containers will result in an estimated increase in non-compactible MLLW place in a 55 gallon drum by fifty percent (50%). However, since it is estimated the hard plastic containers will be disposed of every fourth use, the number of drums eliminated annually will be from 40 to 25 (a reduction of 15). An annual reduction in MLLW of 3 m^3 will result (8 m^3 to 3 m^3).

LLW Generation Reduction

Decrease in Waste Drums Utilized

Current Non-Compactible Hood LLW Generated* = $48 \text{ (55 gallon drums)} \times 0.2082 = 10 \text{ m}^3$

*Based on an average of 25 plastic containers placed in a drum.

Revised Non-Compactible Hood LLW Generated** = $29 \text{ (55 gallon drums)} \times 0.2082 = 6.04 \text{ m}^3$

**Based on 38 waste bags placed in a drum

Total LLW Reduced = $10 \text{ m}^3 - 6.04 \text{ m}^3 = 3.96 \text{ m}^3$

MLLW Generation Reduction

Decrease in Waste Drums Utilized

Current Hood MLLW Generated* = $40 \text{ (55 gallon drums)} \times 0.2082 = 8.3 \text{ m}^3$

*Based on an average of 25 plastic containers placed in a drum.

Revised Hood MLLW Generated** = $25 \text{ (55 gallon drums)} \times 0.2082 = 5.2 \text{ m}^3$

**Based on 38 waste bags placed in a drum.

Total MLLW Reduced = $8.3 \text{ m}^3 - 5.2 \text{ m}^3 = 3 \text{ m}^3$

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 3

**Pollution Prevention Opportunity Description
(Continued)**

Calculation of Net Annual Cost Savings

Waste Disposal Savings

Life Cycle Cost of 1 m³ of LLW = \$1,900***

***Reference: "Hanford Return-On-Investment Guide", DOE/RL-97-12, dated January 1997

Cost savings for reducing 4 m³ of LLW = 4 x \$1,900 = \$7,600

Life Cycle Cost of 1 m³ of MLLW = \$13,800***

Cost savings for reducing 3 m³ of MLLW = 3 x \$13,800 = \$414,000

Total Cost Savings for Waste Reduction = \$49,000

Material Savings

165 Ounce Plastic Containers (10 per case) = \$11.30****

****Telecon P. Segall/P. Hansen (222S) dated 7/15/97

Plastic container savings = 171 (Cases) x \$11.30 = \$1,932

Material Costs

0.010 Nylon Reinforced Disposal Bag (Estimated Cost \$2.50)

Annual usage - 2,200

Disposal bag cost = 2,200 x \$2.50 = \$5,500

Total Annual Savings = \$7,600 + 41,400 + 1,932 - 5,500 = \$45,432

Calculation of Implementation Cost and Payback

Implementation Cost

Revise Hanford Operating Procedure, "Segregate and Manage Solid Laboratory Wastes",
L0-100-151, Rev. C-0, dated 06/27/97.

Procedure Revision - 33 pages x \$15.25 = \$503

(Basis of Estimate Analytical Services \$15.25 per page for a procedure revision)

Engineering \$236

(Basis of Estimate - 4 hours @ \$59/hr)

Total Implementation Cost - \$739

Payback = Implementation Cost/Total Annual Savings = \$739/\$45,432 = .016 years

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 3

Pollution Prevention Opportunity Description (Continued)

Date July 31, 1997	P20AID Code 97-LLW-1	Facility 222S
Activity Laboratory Analyses		
P20 No. 2	P20 Title	Reduce Unnecessary Materials Brought into Radiation Zones/Laboratory Rooms

Current Practice

Paper, cardboard, plastic wrap, packaging, styrofoam, styrofoam peanuts, cardboard carriers, etc. makeup approximately 25% (5 m³) of the LLW generated within the laboratory rooms performing analyses. Although a sign outside the Surface Contamination Area (SCA) addresses "WMin LLW Radioactive Waste Reduction" by emphasizing the minimization of entry into the SCA with unnecessary materials, these materials continue to be carried into the radiation zone.

Efforts are made to minimize paper, cardboard and other unnecessary materials being transferred into the radiation zone at the supply room access window. Glassware and other materials are removed from cardboard boxes, packaging, etc. and placed into clear plastic bags for transporting into the radiation zone. However, this activity is dependent upon one person's initiative, is not consistently implemented, and only applies to materials from the supply room. No specific procedure requirements limit entry of unnecessary materials into the radiation zone as it is considered an individual's responsibility.

Recommended Action

To provide more emphasis on the minimization of bringing unnecessary materials into the radiation zone and laboratory rooms, it is recommended that the following be implemented:

1. Laboratory Analytical Procedures be revised to add a precaution to the Safety Section as follows:

PRECAUTION

Personnel performing or assisting analytical analysis activities should ensure that unnecessary materials such as plastic wrap, packaging materials, cardboard, cardboard boxes, styrofoam, etc. are not brought into the laboratory rooms or radiation zone. Unnecessary materials result in the generation of radioactive waste.

2. The issuing of an Operations Standing Order addressing waste minimization and the minimizing of bringing unnecessary materials into radiation zones and laboratory rooms.
3. Utilize the electric signs located at the entrance to 222S and the Radioactive Material Area (RMA) for dressout to address waste minimization and the bringing of unnecessary materials into radioactive areas and laboratory rooms.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 3

**Pollution Prevention Opportunity Description
(Continued)**

Calculation of Waste Reduction and/or Energy Savings

The implementation of the recommendations discussed above will result in a reduction of unnecessary materials being brought into radioactive zones/laboratory rooms. This will result in an estimated 20% annual reduction (1 m³) in the LLW generated from the unnecessary paper, cardboard, plastic wrap, packaging, styrofoam, styrofoam peanuts, etc. brought into radioactive areas and laboratory rooms.

LLW Waste Reduction

Annual Waste Generation (paper, cardboard, styrofoam, etc.) = 5 m³

Estimated LLW Reduction = 5 m³ x .20 = 1 m³

Calculation of Annual Cost Savings

LLW Disposal Savings - LLW

Life Cycle Cost of 1 m³ = \$1,900*

*Reference: "Hanford Return-On-Investment Guide", DOE/RL-97-12, Dated January 1997

Annual cost savings for reducing 1 m³ = 1 x \$1,900 = \$1,900

Calculation of Implementation Cost and Payback

Implementation Cost

There is no cost involved in implementing the recommendations discussed above. The changes to the Laboratory Analytical Procedures can be issued as part of the annual review changes or with another proposed revision which is to be issued prior to the annual review.

Payback

The payback is immediate.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 3

Pollution Prevention Opportunity Description (Continued)

Date July 31, 1997	P2OA ID Code 97-LLW-1	Facility 222S
Activity Laboratory Analyses		
P2O No. 3	P2O Title Re-use of Glassware	

Current Practice

The 222S Laboratory currently runs several analytical methods (wet chemistry) in which the glassware used during analysis is disposed of as LLW. The empty and dry glassware containers are segregated and crushed for disposal. It is estimated that the laboratory analyses annually generates 20 m³ of LLW. Of this volume, 5 m³ of this waste is discarded glassware.

The laboratory has purchased, through July of FY 1997, \$48,616 of glassware in FY 1997 to support 21.6 Analytical Equivalent Units (AEU's) of laboratory analysis work to date. This prorates to a FY 1997 cost of \$58,316. The FY 1998 forecast for the 222S Laboratory is estimated at the same level of work.

Recommended Action

It is recommended that the 222S Laboratory clean the glassware utilized in laboratory analysis activities and re-use it rather than disposing of it as LLW. The 222S Laboratory has a ultrasonic cleaner (Volumetric Flask Cleaning System-CAT 15-336-27) in storage that could be installed in Room 2B and be utilized as a Glass Cleaning Station. It is conservatively estimated that installation of and use of the ultrasonic cleaner will reduce the glassware disposed of as LLW by approximately 75% (3.75 m³) per year. This assumes that there will have to be re-purchase of glassware to support routine breakage as well as re-purchase of small vials and pipettes which are not capable of being cleaned effectively.

Prior to implementation of this recommendation, a test program is required to ensure that the glassware ultrasonically cleaned is as clean as new glassware thus avoiding the potential of sample contamination. This test program will consist of establishing clean glassware standards for new glassware and comparing the results against glassware that will be analyzed against standards representing acid and fusion analysis performed in the laboratory, cleaned and reused multiple times.

Implementation of this recommendation will require a revision to Hanford Analytical Services Laboratory Procedure, "Segregate and Manage Solid Laboratory Wastes" (LO-100-151, dated 6/27/97) to reflect ultrasonic cleaning of glassware after use as well as crushing for disposal. It will also require operator training and a procedure developed for operating the ultrasonic cleaner.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 3

**Pollution Prevention Opportunity Description
(Continued)**

Calculation of Waste Reduction and/or Energy Savings

It is estimated that implementation of this recommendation to re-use glassware will result in an annual reduction of 3.75 m³ of LLW.

Annual LLW glassware generation = 5 m³

Estimated glassware reduction (75% reuse/repurchase) = .75 x 5 m³ = 3.75 m³

Calculation of Net Annual Cost Savings

Waste Disposal Savings - LLW

Life Cycle Cost of 1 m³ = \$1,900*

*Reference: "Hanford Return-On-Investment Guide", DOE/RL-97-12, dated January 1997

Cost savings for reducing 3.75 m³ = 3.75 x \$1,900 = \$7,125

Material Savings

Glassware - FY 1997 (through July) Expenditures = \$48,616

FY 1997 (August + September (estimated)) = \$9,700

Total = \$58,316

Glassware replacement cost = .25 x \$58,316 = \$14,579

Annual Cost Savings = \$7,125 + (\$58,316 - \$14,579) = \$7,125 = \$43,737

Calculation of Implementation Cost and Payback

Implementation Cost

Ultrasonic Cleaner for Glass Station - \$2,260**

**Volumetric Flask Cleaning System CAT 15-336-27 Purchased and in storage

Installation of Ultrasonic Cleaner

(Cost estimate based on installation of ultrasonic cleaner in room 1F-Reference Work Package 2S-96-02008/W)

Materials - \$300 (shop stock)

Work Package Preparation - 8 hours @ \$59/hour (fully burdened) = \$472

Labor - 24 hours @ \$50/hour (fully burdened) = \$1,200

Total - \$1,972

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 3

Pollution Prevention Opportunity Description (Continued)

Revise Hanford Operating Procedure, "Segregate and Manage Solid Laboratory Wastes",
LO-100-51, Rev. C-0, dated June 27, 1997 - 33 pages x \$15.25 per page = \$503

Prepare Procedure for Operating Ultrasonic Cleaner - 40 hours @ \$59 = \$2,560

Operator Training - 2 hours @ \$50/hour (fully burdened) = \$100

Test Program

Preparation of test plan, test program, data analysis, and final report -

Estimated Cost \$35,000

Total Implementation Cost = \$2,260 + \$1,972 + \$503 + \$2,560 + \$100 + \$35,000 = \$42,395

Payback

= Implementation Cost/Total Annual Savings

= \$42,396/\$43,737 = .97 years

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 4

Pollution Prevention Opportunities Summary

Date July 31, 1997

P2OA ID Code 97-LLW-1

Facility 222S

Activity Laboratory Analyses

P2O No.	P2O Title	Waste Class Reduced	Annual Waste Reduction or Energy Savings	Estimated Annual Savings	Estimated Implementation Cost	Payback (years)
1	Re-Use Plastic Waste Disposal Containers	LLW/ MLLW	LLW - 4 m ³ MLLW - 3 m ³	\$45,432	\$739	0.016
2	Reduce Unnecessary Materials Brought into Radiation Zones/ Laboratory Rooms	LLW	1 m ³	\$1,900	\$0	Immediate
3	Re-Use Glassware	LLW	3.75 m ³	\$43,737	\$42,395	0.97

Notes and Other Benefits

Brainstorming Ideas

The ideas listed below were identified during the brainstorming session conducted with the team members in addition to the ideas evaluated. Each item was prioritized and the top 3 items were chosen to be evaluated.

Ideas to be Evaluated at a Later Point in Time

1. Automatic Material Survey Station - note - requires alpha detection capability Repackaging Hood Waste.
2. Repackaging Hood Waste More Efficiently - note - considered in evaluation of re-use of hard plastic containers. Further detailed evaluation required.
3. Ultrasonic cleaning- glassware, crucibles, etc. note - partially considered in reuse of glassware evaluation.
4. Advanced Improved Technology for Analyses.
5. Utilization of New Equipment for Analysis.
6. Procurement of Latest Equipment-Autosampler-Reduce sample size and generation of waste.
7. Reduction in Sample Size.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 5

Final Summary

Date July 31, 1997

P20A ID Code 97-LLW-1

Facility 222S

Activity Laboratory Analyses

Proposed Opportunities and Discussion

Three opportunities were analyzed for implementation. Each opportunity evaluated is a stand alone item and can be implemented with no impact on the other. Implementation of Opportunity #1, "Re-use Plastic Waste Disposal Containers", will result in a reduction in both LLW (4 m³) and MLLW (3 m³). Combining the savings and implementation costs resulted in a payback of less than a month. Opportunity #2, "Reduce Unnecessary materials Brought into Radiation Zones/Laboratory Rooms" and Opportunity #3, "Re-use Glassware", will result in an estimated annual waste reduction of approximately 5 m³ of LLW. The evaluation of reuse of glass, requires the conducting of a test program to verify that cleaning of glassware. It is expected the test program will be highly successful.

Recommendations and Schedule for Implementation

Because of the FY 1998 site goal to reduce generation of MLLW from routine operations to less than 248.5 m³, implementation of processes that reduce the generation of MLLW from routine operations should be given the highest priority. It is recommended that Opportunity #1, "Re-use of Plastic Waste Disposal Container", be implemented as soon as possible. It is also recommended that Opportunity #2, "Reduce Unnecessary Materials Brought into Radiation Zones/Laboratory Rooms", and Opportunity #3, "Re-use of Glassware" be implemented in the near term to support achieving the waste reduction goals.

.. PRACTICE ASSESSMENT

Industrial Process Exercise

Cleaning and Degreasing

Al's Aircraft Repair provides complete aircraft repair for several commuter airlines operating out of a midwest airport. These services include paint stripping and repainting, structural and mechanical inspections, repair and overhaul of engines and other mechanical equipment, and general aircraft maintenance. The company is only 5 years old and employs approximately 50 people including FAA certified inspectors. The company operates 8 hours per day and 7 days per week. However, the weekend crew consists of only 8 people from the general maintenance group who can handle emergency repair jobs.

The company's costs for hazardous waste disposal have risen steadily. As a result, the company conducted a review of their hazardous waste manifests which indicated the following operations as the major generators of hazardous wastes that were shipped off-site for disposal:

- The aircraft stripping operation consists of an initial strip process where methylene chloride is sprayed on the plane, left on the plane for 1 hour to react with the paint, and removed from the plane with squeegees. The strip process is followed by a rinse process where the plane is rinsed with water to remove any remaining paint and methylene chloride. The strip process generates 20 55-gallon drums per month of a mixture of waste methylene chloride and paint. In addition, the rinsing process generates 40 55-gallon drums per month of a dilute methylene chloride/water mixture. The company is investigating the use of a system which uses a mixture of sodium hydroxide and water to replace the methylene chloride for aircraft stripping. The company supplying the system has determined that both the mixture of paint, sodium hydroxide, and water from the squeegee operation and the mixture of paint, trace amounts of sodium hydroxide, and water from the rinsing operation are not hazardous per RCRA regulations. This analysis was made with samples of the paint currently used by Al's. Al's is planning to discharge the waste to the local POTW.
- The aircraft painting operation applies a solvent based paint to the planes using spray guns. Al's currently paints with 25 different colors of paint. The operation produces 20 55-gallons per month of mixture of waste paint and paint thinner from cleaning the paint guns. The company is reviewing a proposal for a replacement line of water-based paints. The dried waste paint has been determined to be non-hazardous, and the company is considering the discharge of waste paint and the water for cleaning the paint guns to the POTW.
- The repair and overhaul operation shop currently uses 4 mineral spirits for degreasing engine and other soiled parts. These washers are placed on top of 55-gallon mineral spirits drums that are replaced every 4 weeks. The company is investigating the purchase of an aqueous system which uses a terpene blend for cleaning. The supplier claims that the waste material can be discharged to the POTW.

The facility has retained you as part of a waste reduction team to address the three problems, analyze all aspects of the changes proposed, and make recommendations to management.

Guidelines for Waste Stream Information

This worksheet helps a P2 team prioritize waste streams and document summary information. Using the waste projections:

- Identify the three largest streams for each waste class. Record the waste class, the waste stream name, and the projected waste volume on the worksheet. Important sanitary waste streams can also be identified on this worksheet, if these are a priority or can easily be reduced.
- Using the tables below, identify the cost per mass/volume (disposal cost) for each waste stream and record it in the Cost Per Mass/Volume column.

**Table 1:
Sum of Avoidable Costs by Waste Type**

Waste Type	Average Life Cycle Disposal Costs
Low Level	<ul style="list-style-type: none"> Non-Compacted Waste - \$2,000/m³ Compacted Waste - \$4,400/m³
Mixed Low Level	<ul style="list-style-type: none"> Without Treatment - \$9,050/m³ Thermal Treatment - \$15,650/m³ Non-Thermal Treatment with Debris and without Debris - \$14,650/m³
Hazardous	<ul style="list-style-type: none"> \$11,700/metric ton
TRU	<ul style="list-style-type: none"> TRU Retrieved from Burial Ground to WRAP to WIPP - \$57,300/m³ TRU Waste Retrieved from Storage to WRAP to WIPP - \$57,100/m³ TRU Waste from Generator Direct to WIPP - \$47,300/m³
Solid Sanitary	<ul style="list-style-type: none"> Compactable Waste - \$132/metric ton Non-Compactable Waste - \$132/metric ton plus \$200 labor per shipment
Liquid Waste	<ul style="list-style-type: none"> 200 Area ETF - \$0.25/gallon* 200 Area TEDF - \$0.01/gallon 300 Area TEDF - \$0.03/gallon Double Shell Tank Costs - \$17.37/gallon**

If it is necessary to determine standard utility cost for, natural gas, electrical, steam, fuel oil and/or process water contact the appropriate utility organization.

*Secondary solid radioactive CERCLA waste shipped to EDOF for burial costs by ETF = \$500m³

**Includes costs for transfer, storage, and insurance at the 242-A Evaporator.

- Multiply the projected waste quantity of each waste stream by the mass/volume cost of the waste and enter the amount in the Total Cost column.
- Identify any other factors* to be considered with the individual waste streams and record a key word for this factor in the Other Concerns column. P2 teams will have to determine the weight given these other factors. The Other Concerns column is designed to provide flexibility for teams to attend to specific management or environmental priorities.

* Toxicity, regulatory, safety, ALARA, etc.

[illegible]

Guidelines for Priority Streams and Activities

With the waste streams identified, the P2 team is ready to prioritize the streams and major activities generating them.

- Prioritize waste streams identified on the Waste Stream Information Worksheet by highest total cost, accounting for other appropriate prioritizing factors.*
- Identify the major activities generating each of these waste streams. While the form allows identification of the top three waste stream producing activities, more or less activities can be identified as appropriate. It would also be appropriate to list on this worksheet activities that could easily be changed to achieve waste reduction, e.g., "low hanging fruit."

This step will involve contacting key individuals in the facility. Important individuals to begin with would be the hazardous materials coordinator and the Environmental Compliance Officer/Representative.
- Determine the approximate percentage of waste each activity contributes to the total waste stream. Enter this amount in the % column.

* Toxicity, regulatory, safety, ALARA, etc.

Priority Waste Streams/Chemicals and Activities

[illegible]

Guidelines for Worksheet 1

This worksheet provides the scope and identification of the pollution prevention opportunity assessment (P2OA) team. For the P2OA 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 assembles the team to perform the assessment. Team members may include engineers, waste generators, waste management specialists, scientists, operators, laboratory technicians, and other line personnel. Additional resources may be utilized to provide information not available within the team, including interviews with line personnel, procurement and health and safety, as well as research of technical publications/case studies. The size of the team may be large for complicated operations, but should be kept to a minimum to maintain focus.

- **Date:** List the initiation date for this P2OA.
- **P2OA ID Code:** List the P2OA ID Code selected by the team or facility. This should be a unique identifier.
- **Facility:** List the facility in which this P2OA is being examined.
- **Activity:** List the activity contributing to the waste stream.
- **Team Members, Title, Phone, MSIN:** To facilitate team meetings and for future reference, this information should be completed when the P2OA team is formed.
- **Activity Description:** This section should list the main activities contributing to the waste stream that are to be examined in this P2OA. Remember that this waste stream can be examined again in a future P2OA with a different activity focus, so limit the activities to be examined in a single P2OA to no more than three. If activities are very diverse, complete separate worksheets for each. A description of each activity should be listed, including pollution prevention activities already in place. Be sure to include the purpose or goal of the activity, schedule or frequency of activity, materials used, steps taken to complete the activity, and all wastes generated by each step. Items such as equipment, controls, operators, and operator training (qualification or certification) may also be included.

WORKSHEET 1

[illegible][illegible]

Guidelines for Worksheet 2

This worksheet provides a method to document the activity flow diagram for the assessment. The flow diagram should identify all inputs (materials/resources) 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 and is meant to be a guideline. If desired or if the activity is very complex, a more detailed diagram may be completed to identify all waste streams, especially for complex, multi-step processes. Several forms can be completed if several activities contribute to the waste stream of interest.

Please note that, although the focus may be on one priority waste stream, an analysis should be conducted on all material inputs and outputs. This is because the reduction of one waste may affect others in the activity (and you want to take credit for those too!). Additionally, while looking at an activity, it is cost and time effective to look at all waste streams and materials for possible reduction opportunities. You may also wish to document the process as a flowchart so that you can easily see the flow of materials in and out.

- **Date, P2OA ID Code, Facility, Activity:** List the date this sheet is completed, the unique P2OA ID code, facility, and the examined activity for this P2OA from Worksheet 1.
- **Activity:** Fill in the Activity Name box with the activity being examined.
- **Activity Time Period:** List the time period for the activity being examined, such as, the complete clean-up, one analysis, yearly, etc.
- **Inputs:** List the input materials on the lines provided, including hazardous materials, non-hazardous materials, and energy sources. Don't forget to include resource inputs such as water, cleanup supplies, reusable supplies, anything that ends up as a waste, is used and cleaned, or is used up during the activity.
- **Outputs:** Outputs include solid, liquid, and air. Fill in the outputs, both useful items and wastes, in the boxes. Include all manifested and non-manifested wastes, plus air emissions, if any.
- **Material Balance:** A rough material balance can be conducted (making sure the inputs equal the outputs), to determine if most of the input and output materials have been captured. Energy inputs will not be included in the material balance.

PRACTICE ASSESSMENT

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 2 Activity Flow Diagram

Date _____ P2OA ID Code _____ Facility _____
Activity _____

INPUTS

Chemical and Radioactive Inputs	
Name	Quantity

Material Inputs	
Name	Quantity

Energy Inputs	
Name	Quantity

ACTIVITY

Activity Time Period: _____

OUTPUTS

Product or Result Output	
Name	Quantity

Hazardous Waste Output	
Name	Quantity

Non-Hazardous Waste Output	
Name	Quantity

Radioactive Waste Output	
Name	Quantity

Mixed Waste Output	
Name	Quantity

Other	
Name	Quantity

Total Input ~ Total Output? _____ Qty. In ~ _____ Qty. Out

Brainstorming Guidelines

Before these summary sheets can be completed, the team should hold a brainstorming session to develop Pollution Prevention Opportunities (P2Os). Brainstorming sessions are effective ways for individuals to generate options and should occur in an environment that encourages creativity and independent thinking. A knowledge of the activity is essential before the brainstorming session.

Brainstorming for: Pollution Prevention Opportunities

Practices & Procedures

Material Substitution

Equipment Modification

Waste Segregation

Recycling, Reuse & Reclamation

Other

Pollution Prevention Opportunities

Guidelines for Worksheet 3

Promising P2Os from the brainstorming session should then be researched by individual team members. Consideration of the Pollution Prevention Hierarchy (source reduction, recycling, treatment, and disposal) should be made. This is in order to determine specifics related to the P2Os, and may involve calls to vendors or procurement, discussions with engineers, talking to line personnel and others. Considerable calculations and notes will most likely be taken on other sheets during the process. When complete, each idea's information can then be recorded on this summary sheet, which serves as a method to record and evaluate the options that have been identified.

- **Date, P2OA ID Code, Facility, Activity:** List the date this sheet is completed, the unique P2OA ID code, facility, and the examined activity for this P2OA from Worksheet 1.
- **P2O No. and P2O Title:** A number should be assigned to each P2O from the complete brainstorm list and written here. The title should be descriptive of the recommendation, starting with an action verb (e.g., replace, modify, install, insulate, develop, reduce, retrofit, educate).
- **Current Practice:** Briefly describe the current practice as it relates to this opportunity, so that the action described next can be fully understood.
- **Proposed Alternative:** Describe what the change will be and how it will reduce waste or save energy.
- **Calculation of Waste Reduction and/or Energy Savings:** Briefly describe the methodology used to determine waste and energy reductions. Cite references. List calculations as necessary to provide specific numbers. Be specific as to what the waste reduced consists of and what waste type is reduced (LLW, Mixed, Haz). The avoidable Solid Waste Management costs are provided on Appendix E. It provides average life cycle disposal cost.
- **Calculation of Annual Cost Savings:** Briefly describe the methodology used to determine cost savings. Cite references. List calculations as necessary to provide specific numbers. State the specific estimated cost savings for one year after implementation is complete.
- **Calculation of Implementation Cost & Payback:** Briefly describe the methodology used to determine implementation costs. Cite references. List calculations as necessary to provide specific values. Calculated payback as: implementation cost divided by annual cost savings.

PRACTICE ASSESSMENT

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT

WORKSHEET 3

Pollution Prevention Opportunity Description

Date _____ P20A ID Code _____ Facility _____
Activity _____
P2O No. _____ P2O Title _____

Current Practice

Proposed Alternative

Calculation of Waste Reduction and/or Energy Savings

Calculation of Net Annual Cost Savings

Annual Costs Before:

Annual Costs After:

Annual Costs Before - Annual Costs After = Net Annual Cost Savings

Calculation of Implementation Cost and Payback

Implementation Cost ÷ Annual Cost Savings = Payback

Guidelines for Worksheet 4

This worksheet is meant as a simple way to compare the P2Os with each other after the research and feasibility analysis has been completed. They can be listed according to the P2 hierarchy (source reduction first, followed by recycling/reuse, and treatment). They can also be listed according to the shortest payback, either within each hierarchy level or overall.

- **Date, P2OA ID Code, Facility, Activity:** List the date this sheet is completed, the unique P2OA ID code, facility, and the examined activity for this P2OA from Worksheet 1.
- **P2O No., Title, Waste Class, Reduction, Savings, Implementation, and Payback:** These values can all be entered directly from the sections in Worksheets 3. If a savings or an implementation cost is very small, write "negligible." Just because an idea is not cost-effective or a large waste reducer, does not mean it should not be listed – it may be simple "low-hanging fruit" that can be accomplished giving instant success or good public relations. Some ideas may ease compliance with regulations, or resolve a safety concern and thus should be considered also.
- **Other Brainstorm Ideas Not Researched:** This section includes the list of all brainstorm ideas not considered for a full cost-benefit analysis. Also list reasons for not selecting an idea for a P2O.

Pollution Prevention Opportunities Summary

[illegible]

Reason Not Researched:

[illegible]

Guidelines for Worksheet 5

This sheet provides a brief summary about the whole assessment. Its purpose is to document how this assessment was performed, the conclusions reached by the team, and the recommendations for further actions. For a more complex assessment, a longer, more formal executive summary may need to be written out for presentation to management.

- ***Date, P2OA ID Code, Facility, Activity:*** List the date this sheet is completed, the unique P2OA ID code, facility, and the examined activity for this P2OA from Worksheet 1.
- ***Proposed Opportunities and Discussion:*** Briefly describe the main opportunities examined, including the waste streams or input material to be minimized, benefits achieved, and any positive or negative aspects to the opportunities.
- ***Recommendations & Schedule for Implementation:*** Briefly describe any actions that should or will be taken in respect to this assessment. Provide a recommendation for date of implementation.

Final Summary

Proposed Opportunities and Discussion

Recommendations and Schedule for Implementation

.....APPENDICES

Appendix A

Pollution Prevention Goals

The Secretary of Energy
Washington, DC 20585

May 3, 1996

MEMORANDUM FOR HEADS OF DEPARTMENTAL ELEMENTS

FROM:

HAZEL R. O'LEARY

SUBJECT:

Departmental Pollution Prevention Goals

The Department of Energy pollution prevention strategy is to reduce the generation of all waste streams and thus minimize the impact of departmental operations on the environment. Preventing pollution also reduces risks to the health and safety of workers and the general public and saves scarce budget dollars. To demonstrate the Department's commitment to pollution prevention, we have set the following goals to be achieved by December 31, 1999, using calendar year 1993 as a baseline year.

For Routine Operations:

- Reduce by 50 percent the generation of radioactive waste.
- Reduce by 50 percent the generation of low-level mixed waste.
- Reduce by 50 percent the generation of hazardous waste.
- Reduce by 33 percent the generation of sanitary waste.
- Reduce by 50 percent total releases and off-site transfers for treatment and disposal of toxic chemicals.

For All Operations, Including Cleanup/Stabilization Activities:

- Recycle 33 percent of sanitary waste.

For Affirmative Procurement:

- Increase procurement of Environmental Protection Agency-designated, recycled products to 100 percent, except where they are not commercially available competitively at a reasonable price or do not meet performance standards.

Operations Offices will direct sites under their purview to set site-specific goals to assist in achieving the departmental goals. Progress toward meeting the departmental goals will be reported annually to me. It is the responsibility of each Federal and contractor manager to work diligently to meet these goals; to aggressively seek ways to reduce the amount of pollutants generated within the workplace; and to conserve, reuse, and recycle resources.

Appendix B

Glossary

Affirmative Procurement Program A program that ensures that items composed of recovered materials will be purchased to the maximum extent practicable, consistent with Federal law and procurement regulations (RCRA, Section 6002).

Byproduct Under the Resource Conservation and Recovery Act, a byproduct is a material that is not one of the primary products of a production process and is not solely or separately produced by the production process. Examples are process residues such as slags or distillation column bottoms. The term does not include a co-product that is produced for the general public's use that is ordinarily used in the form in which it is produced by the process.

Cleanup/Stabilization Waste Cleanup/stabilization encompasses a complex range of activities including environmental restoration of contaminated media (soil, groundwater, surface water, sediments, etc.); stabilization of nuclear and nonnuclear (chemical) materials; and deactivation and decommissioning (including decontamination) of facilities.

Cleanup/stabilization waste consists of one-time operations waste produced from environmental restoration program activities, including primary and secondary wastes associated with retrieval and remediation operations, "legacy wastes," and wastes from decontamination and decommissioning/transition operations. It also includes all TSCA regulated wastes, such as polychlorinated biphenyl-contaminated fluids and/or equipment.

Decommissioning Actions taken to reduce the potential health and safety impacts of contaminated DOE facilities, including activities to remove a facility from operation, followed by decontamination, entombment, dismantlement, or conversion to another use.

Disposal Emplacement of waste in a manner designed to isolate it from the biosphere, with no intention of retrieval for the foreseeable future, and that requires deliberate action to regain access to the waste.

Environmental Restoration Cleanup and restoration of sites contaminated with radioactive and/or hazardous substances during past production, accidental releases, or disposal activities.

Examples of process waste water include cooling water from air compressor systems, air conditioners, and heating systems; boiler or cooling tower blowdown; ion-exchange regeneration waste water; and laboratory operations waste water. It does NOT include non-process waste waters such as storm water, well purge water, irrigation drainage, fire-fighting and hydrant flushings, lawn watering, pavement wash waters, vehicle waste water, etc.

Generator Group As defined by the responsible contractor, any discrete activity, project, or facility whose act or process produces waste.

Hazardous Substance Any hazardous substance listed as a hazardous substance in the Emergency Planning and Community Right-to-Know Act and any further updates, and all ozone depleting compounds as defined by the Montreal Protocol of October 1987 and any further updates of the protocol.

Hazardous Waste Solid wastes that exhibit any of the characteristics of hazardous waste identified in 40 CFR 261, Subpart C (e.g., ignitable, corrosive, reactive, acutely hazardous or acutely toxic), or that are listed in 40 CFR 261, Subpart D, "List of Hazardous Waste." Also includes dangerous waste as defined in WAC 173-303.

High-Level Waste (HLW) Irradiated reactor fuel, liquid wastes resulting from the operations 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.

Life Cycle The stages of a product's, process's, or package's life, beginning with raw material acquisition, continuing through processing, materials manufacture, product fabrication, and use, and concluding with any variety of waste management options, including recycling.

Low-Level Waste (LLW) Radioactive waste not classified as HLW, transuranic (TRU) waste, spent nuclear fuel, or by-product material (specified as uranium or thorium tailings and waste in accordance with DOE Order 5820.2A).

Mixed Waste Waste that contains both radioactive (as defined by the Atomic Energy Act of 1954) and hazardous (as defined by RCRA, Toxic Substances Control Act of 1976 [TSCA], and/or state regulations) components.

Nonroutine Activities One-time operations waste produced from environmental restoration program activities, including primary and secondary wastes associated with retrieval and remediation operations; 'legacy wastes'; and decontamination and decommissioning/transition operations. It also includes all TSCA-regulated wastes, such as polychlorinated biphenyl-contaminated fluids and/or equipment. By definition, these activities are not considered to be periodic and/or ongoing, because the waste is a direct result of past operations and activities, rather than a current process. However, newly generated wastes that are produced during these 'one-time operations' are considered to be a secondary waste stream, and should be separately accounted for whenever possible. This secondary (newly generated) waste usually results from common activities such as handling, sampling, treatment, repackaging, shipping, etc.

Pollution Control Measures that are applied after waste and pollutants are generated, such as: off-site recycling, waste treatment, concentrating hazardous or toxic constituents to reduce volume, diluting constituents to reduce hazard or toxicity, or transferring hazardous or toxic constituents from one environmental medium to another.

Pollution Prevention The use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes practices that reduce the use of hazardous and nonhazardous materials, energy, water, or other resources as well as those that protect natural resources through conservation or more efficient use.

Pollution Prevention Act of 1990 Established source reduction as the strategy of first choice for waste management.

Pollution Prevention Opportunity Assessment (P2OA) Evaluation and appraisal of a process, activity, or operation as a way to identify potential waste minimization opportunities.

Process Waste Water Any water produced during manufacturing or processing operations that comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product. This determination is independent of the level and/or nature of the contaminants. Additionally, process waste waters are liquid wastes, which are directly piped to a permitted (onsite) waste treatment facility where treatment may consist of neutralization, evaporation, or placement in a settling or percolation pond, etc. This term does not include the liquid discharges to publicly owned treatment works, which are governed by U.S. Environmental Protection Agency- or state-issued national pollutant discharge elimination system permits, or local pretreatment standards.

RCRA-Regulated Waste Solid waste, not specifically excluded from regulations under 40 CFR 261.4, "Identification and Listing of Hazardous Waste," or delisted by petition, that is either a listed hazardous waste (40 CFR 261.30 to 261.33) or exhibits the characteristics of a hazardous waste (40 CFR 261.20 to 261.24).

Recycling Recycling techniques are characterized as use, reuse, and reclamation techniques (resource recovery). Use or reuse involves the return of a potential waste material either to the originating process as a substitute for an input material or to another process as an input material. Reclamation is the recovery of a useful or valuable material from a waste stream. Recycling allows potential waste materials to be put to a beneficial use instead of going to treatment, storage, or disposal.

Routine Activities Normal operations waste produced from any type of production operation, analytical and/or research and development (R&D) laboratory operations; treatment, storage, disposal operations, 'work-for-others,' or any other periodic and recurring work that is considered ongoing in nature. 'Normal operations' refers to the type of ongoing process (i.e., production, R&D, etc.), not the specific activity that produced the waste. Periodic laboratory or facility cleanouts and spill cleanups that occur as a result of these processes are also considered normal operations.

Sanitary Waste Wastes, such as garbage, that are generated by normal housekeeping activities and are not hazardous or radioactive.

Segregation The practice of separating or isolating contaminated materials from non-contaminated materials, or the separation/isolation of one waste type from another in an attempt to minimize the amount of the more noxious (and costly) material for disposal.

Source Reduction The elimination or reduction of waste generation at the source. Source reduction activities and techniques include substitution of less hazardous materials, process optimization or modification, technology changes and administrative changes (inventory control), and housekeeping practices (waste segregation). Source reduction results in reducing or eliminating potential waste material exiting from a process.

Spent Nuclear Fuel Fuel that has been withdrawn from a nuclear reactor following irradiation, but that has not been reprocessed to remove its constituent elements.

State Regulated Waste Any other hazardous waste not specifically regulated under RCRA, which may be regulated by State or local authorities, such as used oil.

State-Only Regulated Waste Any other hazardous waste not specifically regulated under TSCA or RCRA, such as used oil, which may be regulated by a state or local authority.

Transuranic Waste Waste that is contaminated with alpha-emitting radionuclides with an atomic number >92 (heavier than uranium), half lives >20 years, and concentrations >100 nCi/g of waste.

Treatment Technological processes that reduce the quantity, toxicity, or mobility of waste. Examples include, but are not limited to, incineration, vitrification, neutralization, chemical extraction, physical separation, and solidification/stabilization technologies.

TSCA-Regulated Waste Hazardous chemical wastes, both liquid and solid, containing more than 50 p/m of polychlorinated biphenyls.

Waste Minimization Elimination or minimization of the generation of waste before treatment, storage, or disposal. Waste minimization is any source reduction or recycling activity that results in (1) reduction of total quantity of waste, (2) reduction of toxicity of waste, or (3) both, as long as that reduction is consistent with the general goal of minimizing present and future threats to human health and the environment.

Waste Reduction Reduction of the total amount of waste that is generated and disposed of by U.S. Department of Energy operations through waste minimization and treatment activities.

Appendix C

Pollution Prevention Regulatory Drivers

Function	Driver	Effect
Federal Procurement Guidelines	Resource Conservation and Recovery Act (RCRA) 40 CFR 247	Encourages procurement of recovered materials by the Federal Government
Generator Manifest Certification	RCRA 3002(b), 3005(h), 40 CFR 262, 264-265	Requires generator to certify that a hazardous waste minimization program is in place
Generator Biennial Report Certification	RCRA 40 CFR 262, 264-265	Requires generator to put in place a hazardous waste minimization program
Part B Permit Conditions	RCRA	Requires generator to put in place a hazardous waste minimization program
Liability Insurance Requirements	RCRA	Generator and facility owners and operators reduce liability by reducing waste
Land-Disposal Restrictions	RCRA	Increases the cost of waste management
Exclusion to the Toxicity Characteristic	RCRA	Minimizes chlorofluorocarbon (CFC) venting and encourages recycling
Waiver of Sovereign Immunity under RCRA	Federal Facilities Compliance Act (FFCA)	Government is subject to all RCRA requirements with a 3 year delayed effective date for mixed waste storage
Mixed Waste Minimization Reporting	FFCA	National inventory of all mixed waste including description of waste minimization actions
Toxic Release Inventory Reporting	Emergency Planning and Community Right-to-Know Act (EPCRA)	Establish reporting requirements for the use, storage, and on-site and off-site transfers of hazardous and toxic chemicals
National Policy	Pollution Prevention Act (PPA)	Declared pollution prevention as the first choice in environmental management
Toxic Release Inventory Reporting	PPA	Expands EPCRA 313 reporting requirements to include source reduction and recycling information
Increased Reporting Requirements	PPA	Increases public access to information, stimulating citizen enforcement and holds industry to stricter standards

Function	Driver	Effect
CERCLA Financial Liability	Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	Generators reduce future liability by reducing waste
National Ambient Air Quality Standards	Clean Air Act (CAA)	Promotes cutting emissions of six hazardous air pollutants
New Source Performance Standards	CAA	New plants must conform to strict emission requirements
Phased-In Requirements	CAA	Firms must meet new, more restrictive air emission standards
Early Reductions Program	CAA	Compliance extensions for voluntary early reductions of hazardous air pollutants
Maximum Achievable Control Technology (MACT)	CAA	Directs EPA to consider pollution prevention technologies when selecting MACT
Clean Fuel Fleet Program	CAA	Requirement to meet clean-fuel fleet vehicle emissions standards
Protection of Stratospheric Ozone	CAA	Phase-out of CFCs, halons, and carbon tetrachloride by 2000; limit on emissions of ozone-depleting substances during the servicing, use and disposal of equipment containing those substances
Minimization Certification	Clean Water Act (CWA)	Requires a plan for industrial firms to diminish the volume and toxicity of their hazardous discharges
Significant New Use Notification	Toxic Substance Control Act (TSCA)	Makes firms legally responsible to EPA for voluntary waste minimization commitment
Bans on Chemical Substances	TSCA	Eliminates feedstocks responsible for certain waste streams
Handling and Transportation Requirements	Hazardous Materials Transportation Act (HMTA)	Safety requirements raise costs of transporting waste
Handling Requirements	Occupational Safety & Health Act (OSHA)	Safety requirements raise costs of transporting waste

APPENDICES

Function	Driver	Effect
Environmental Taxes	Revenue Reconciliation Act (RRA)	Taxes on ozone-depleting chemicals
Research and Development Tax Credits	Tax Reform Act (TRA)	Provides for a tax credit for increasing investment in research and development of processes and products that reduce waste
Storm water Pollution Prevention Plan	CWA	Requires that industrial storm water discharge facilities have an on-site pollution prevention plan
General Environmental Protection Program	DOE 5400.1	Requires P2/WMin Plans, Annual Waste Reduction Reports, and a Pollution Prevention Awareness Program
Radioactive Waste Management	5820.2A	Requires Waste Management Plans including actions to minimize radioactive waste generation. Requires each DOE LLW generator preparing a design for a new process or process change to incorporate principles into the design that will minimize the generation of LLW
Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements	Executive Order (EO) 12856 (August 3, 1993)	Requires development of a pollution prevention strategy and agency development of a 50 percent reduction goal in toxic chemicals releases by the end of 1999
Federal Acquisition, Recycling, and Waste Prevention	EO 12873 (October 21, 1993)	Promotes reductions in waste generation through recycling and the use of recycled and energy efficient materials
Procurement Requirements and Policies for Ozone-Depleting Substances	EO 12843 (April 21, 1993)	Requires that Federal agencies minimize and allow for phaseout of Class I and II ozone-depleting substances
Federal Use of Alternative Fueled Vehicles	EO 12844 (April 21, 1993)	Stimulates the availability, acquisition, and use of alternatively-fueled vehicles for Federal agencies
Requiring Agencies to Purchase Energy Efficient Computer Equipment	EO 12845 (April 21, 1993)	Requires that all acquisitions of microcomputers meet "EPA Energy Star" requirements for energy efficiency

Function	Driver	Effect
Radiation Protection Programs	10 CFR 835	Requires the establishment of goals and performance indicators for the minimization of radioactive waste. It also requires a waste minimization program that will reduce the generation of radioactive waste and spread of contamination from Contamination, High Contamination or Airborne Radioactivity Areas
Energy Efficiency and Water conservation at federal facilities	EO 12902 (March 8, 1994)	Requires to reduce energy and water consumption from FY 1995-2005 according to established baselines
Dangerous Waste Regulations	WAC 173-303	Requires generator certification that a waste minimization program is in place for hazardous waste
National Policy	Energy Policy Act	Promotes energy conservation and efficiency and promote renewable energy
Directs specific percentage waste reduction by waste type	Letter from Secretary O'Leary dated May 3, 1996	Requires site-specific pollution prevention goals be established and progress be tracked
Radiological Performance Goals	Hanford Site Radiological Control Manual, HSRCM-1, Rev. 2, Part 3, Art. 131	Suggests establishing goals for minimizing the generation of radioactive waste
Waste Minimization Program for Radiological Control	Hanford Site Radiological Control Manual, HSRCM-1, Rev. 2, Part 4, Articles 441, 442, and 443, and Part 5, Article 451	Describes radioactive waste minimization program detailing required elements including development of waste minimization goals. Waste types include solid and liquid LLW and MLLW
Principal Guidance to fully implement Pollution Prevention Program	DOE 1996 <i>Pollution Prevention Program Plan</i> (DOE, 1996a)	Provides contractors with specific steps to meet DOE's pollution prevention commitments

Appendix D

Figure 1: Related Waste Conversions

Drums - Volume Based on External Dimensions

8 Gallon Drum	= 0.04 Cubic Meters**
16 Gallon Drum	= 0.08 Cubic Meters**
30 Gallon Drum	= 0.1136 Cubic Meters**
55 Gallon Drum	= 0.26 Cubic Meters**
85 Gallon Drum	= 0.38 Cubic Meters**

Boxes - Volume Based on External Dimensions

2' X 2' X 6' Box	= 0.74 Cubic Meters**
4' X 4' X 4' Box	= 2.92 Cubic Meters**
4' X 4' X 8' Box	= 4.08 Cubic Meters**

** The outside dimensions of the container determine the cost for handling and burial. These conversions should be used in determining avoidable costs rather than the internal capacity of the container. ("Hanford's Commonly Used Containers: Treatment, Storage, and Disposal Volumes" (WHC-SD-WM-CSD-005, Revision 0, Dated September 1996).

Waste Handling and Treatment Personnel Costs

If it is necessary to determine personnel costs for individuals who handle and ship waste or perform other activities addressed in the annual costs and savings, hourly labor rates for bargaining unit, exempt and non-exempt personnel should be obtained from the appropriate contractor project or financial analyst.

Table 1:
Sum of Avoidable Costs by Waste Type

Waste Type	Average Life Cycle Disposal Costs
Low Level	<ul style="list-style-type: none"> • Non-Compacted Waste - \$2,000/m³ • Compacted Waste - \$4,400/m³
Mixed Low Level	<ul style="list-style-type: none"> • Without Treatment - \$9,050/m³ • Thermal Treatment - \$15,650/m³ • Non-Thermal Treatment with Debris and without Debris - \$14,650/m³
Hazardous	• \$11,700/metric ton
TRU	<ul style="list-style-type: none"> • TRU Retrieved from Burial Ground to WRAP to WIPP - \$57,300/m³ • TRU Waste Retrieved from Storage to WRAP to WIPP - \$57,100/m³ • TRU Waste from Generator Direct to WIPP - \$47,300/m³
Solid Sanitary	<ul style="list-style-type: none"> • Compactible Waste - \$132/metric ton • Non-Compactible Waste - \$132/metric ton plus \$200 labor per shipment
Liquid Waste	<ul style="list-style-type: none"> • 200 Area ETF - \$0.25/gallon* • 200 Area TEDF - \$0.01/gallon • 300 Area TEDF - \$0.03/gallon • Double Shell Tank Costs - \$17.37/gallon**

*Secondary solid radioactive CERCLA waste shipped to ERDF for burial costs by ETF = \$550/m³

**Includes costs for transfer, storage, and treatment at the 242-A Evaporator.

Standard Utility Costs:

If it is necessary to determine standard utility cost for, natural gas, electrical, steam, fuel oil and or process water contact the appropriate utility organization.

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