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USING BENCHMARKING TO MINIMIZE COMMON DOE WASTE STREAMS Volume I. Methodology and Liquid Photographic Waste

Prepared for
**U.S. Department of Energy
Environmental Restoration and Waste Management
Office of Waste Management
Waste Minimization Division**

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Abstract

Finding innovative ways to reduce waste streams generated at Department of Energy (DOE) sites by 50% by the year 2000 is a challenge for DOE's waste minimization efforts. This report examines the usefulness of benchmarking as a waste minimization tool, specifically regarding common waste streams at DOE sites. A team of process experts from a variety of sites, a project leader, and benchmarking consultants completed the project with management support provided by the Waste Minimization Division EM-352. Using a 12-step benchmarking process, the team examined current waste minimization processes for liquid photographic waste used at their sites and used telephone and written questionnaires to find "best-in-class" industry partners willing to share information about their best waste minimization techniques and technologies through a site visit. Eastman Kodak Co., and Johnson Space Center/National Aeronautics and Space Administration (NASA) agreed to be partners. The site visits yielded strategies for source reduction, recycle/recovery of components, regeneration/reuse of solutions, and treatment of residuals, as well as best management practices. An additional benefit of the work was the opportunity for DOE process experts to network and exchange ideas with their peers at similar sites.

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- Johnson Space Center/NASA, Houston, TX; Rick Slater, Photography Technologist

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- Teresa Torres

Executive Summary

The Mission	Finding innovative ways to reduce waste streams generated at DOE sites by 50% by the year 2000 is a challenge for DOE's waste minimization efforts.
Project Focus	Sponsored by the DOE's Waste Minimization Division EM-352, this project focused on identifying common waste streams throughout DOE, examining waste minimization technologies that have been used successfully by companies or organizations other than DOE, and providing this information to affected sites within DOE. Benchmarking was the methodology for analyzing the internal processes and seeking industry partners that have successfully improved their waste minimization processes.
Report Purpose	<p>This report</p> <ol style="list-style-type: none">1. serves as a blueprint for any organization or team that wants to perform its own benchmarking study to minimize waste, and2. describes the results of the team that worked on finding the best waste minimization practices for liquid photographic waste.
Benchmarking Definition	<p>Benchmarking is the continuous process of improving products, services, and practices by identifying and understanding the current process, exchanging information with recognized leaders in the field, and implementing meaningful improvements.</p> <p>Benchmarking is used by a variety of companies and organizations as a quality improvement tool. For this project, the group used the following 12-step benchmarking process:</p> <ol style="list-style-type: none">1. Identify process to be benchmarked2. Establish management commitment3. Identify and establish benchmarking team4. Define and understand the process to be benchmarked5. Identify metrics6. Evaluate current performance7. Identify potential benchmarking partners8. Collect process data from potential partners9. Analyze potential partners' data and choose partners10. Conduct site visits11. Communicate results12. Continue to conduct benchmarking of process
Benchmarking Team	The benchmarking team consisted of a project leader, process experts with daily working knowledge of the subject process, and consultants that provided benchmarking expertise.

Continued on the next page...

Executive Summary

Benchmarking Team, continued

The team evaluated the current internal processes for liquid photographic waste, created a process flow chart, and defined process metrics. The team then used telephone surveys and written questionnaires to help find industry partners with a similar working environment that had addressed the problems that the team was investigating. The team found two partners: Eastman Kodak Co., and Johnson Space Center/National Aeronautics and Space Administration (NASA).

Site Visit Results

The partners agreed to allow three members of the benchmarking team to visit their sites and learn about their waste minimization practices. The key minimization options fell into the following categories:

1. **Source reduction**—Source reduction is the preferred method of waste minimization, incorporating the following strategies: using correct chemicals; using squeegees to minimize chemical carry-over between baths; determining correct replenishment rates; using floating lids on chemical containers to reduce evaporation, oxidation, and contamination; and using plumbingless minilabs.
2. **Recycle/recovery of components**—Recycling and recovering components such as silver may be accomplished through metallic replacement (chemical replacement cartridge), electrolytic recovery, precipitation, reverse osmosis, ion exchange, and evaporation.
3. **Regeneration/reuse of solutions**—Good waste minimization results also can be achieved through the regeneration and reuse of solutions such as bleaches, fixing baths, wash waters, developers and stabilizers, and stop baths.
4. **Treatment of residuals**—Although treatment of residuals is not considered a true waste minimization technique, Kodak is currently researching a variety of techniques besides high temperature incineration.

Also, both partners offered suggestions for best management practices that covered system design, water control, and process and monitoring considerations.

Additional Benefit

The project had an unexpected side benefit—DOE personnel from across the country were able to network and exchange ideas with their peers at similar sites.

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Acronyms

BCS	Boeing Computer Systems
BMP	Best Management Practices
CRC	chemical replacement cartridge
COO	Conduct of Operations
D&D	Decommissioning and Decontamination
DOE	U.S. Department of Energy
EDTA	ethylenediaminetetraacetic acid
ES&H	Environmental Safety and Health
FY	Fiscal year
GPP	Guides to Pollution Prevention
HAZWRAP	Hazardous Waste Remedial Actions Program
M&O	Management and Operation
MMES	Martin Marietta Energy Systems
NASA	National Aeronautics and Space Administration
OP	Operating Procedure
PCB	Polychlorinated Biphenyl
PHA	Preliminary Hazard Assessment
PP	Pollution Prevention
REECO	Reynolds Electrical and Engineering Company
RSL	Remote Sensing Laboratory
SLP	Sandia Laboratory Policies
SNL/CA	Sandia National Laboratories, California
SNL/NM	Sandia National Laboratories, New Mexico
SOP	Standard Operating Procedures
VMF	Vehicle Maintenance Fleet
WMCPU	Waste Minimization Crosscut Plan Update
WMin	Waste Minimization
WMIS	Waste Management Information System
WS	Waste Stream
WWTP	Waste Water Treatment Plant

1.0 Introduction

1.1 Background

Executive Order	On August 3, 1993, President Clinton issued Executive Order 12856 "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements," which requires federal agencies to develop voluntary goals to reduce their total releases of toxic pollutants by 50% by December 31, 1999. To meet the demands of the Executive Order and related environmental regulations, the U.S. Department of Energy (DOE) created the 1993 Waste Minimization Crosscut Plan. This plan establishes a DOE-wide goal to reduce all newly generated DOE waste streams as well as pollutants by 50% in annual incremental reductions of 10% per year beginning in fiscal year 1995. (WMCPU, 1993)
DOE Waste Minimization Mission	The Crosscut Plan states that DOE's waste minimization (WMin) mission is "To reduce DOE multimedia wastes and pollutants by implementing cost-effective waste minimization technologies, practices, and policies, with partners in government and industry while conducting the Department's operations in a regulatory compliant and environmentally sound manner."
DOE Objective	This benchmarking project helps to accomplish one of the major DOE Crosscut Plan Strategic Objectives, which is "to identify and develop technology and exchange information." By learning from "best in class" partners, the DOE can enhance the effectiveness of WMin efforts by exchanging applicable technologies and information with those who are already successful.
Sponsor	The sponsor of this project is the DOE Waste Minimization Division, EM-352. The division's mission is to plan, coordinate, and develop a DOE-wide Waste Minimization and Pollution Prevention Program that results in a decrease in the amount of waste produced by the DOE.
Benchmarking Approach	<p>Benchmarking was chosen as the project approach because it</p> <ul style="list-style-type: none"> • has proven capabilities as a quality improvement tool, • provides flexibility, • may be applied to many different processes, and • increases ties with U.S. industry. <p>For a complete definition of benchmarking and an explanation of the process, refer to Section 2.</p>

Section 1—Introduction

1.2 Purpose

Purpose

The purpose of the project was to examine the common waste streams throughout the DOE and determine ways to minimize these waste streams. This report is part of the DOE-wide effort to prevent pollution and minimize common waste streams. The DOE waste minimization effort strives to reduce sources of waste and to recycle wastes and pollutants. Pollution prevention is defined by the DOE as source reduction activities that prevent waste generation and contaminant releases.

This purpose of this report is to

1. provide a blueprint for any organization or team that wants to perform their own benchmarking study to minimize waste, and
2. describe the results of the team that worked on finding the best waste minimization practices for liquid photographic waste.

Project Focus

The project focused on identifying common waste streams throughout the DOE, identifying waste minimization technologies that have been successfully applied to these waste streams, and providing this information to the DOE. Benchmarking provided the methodology for analyzing the internal processes and seeking industry partners that have successfully improved their own waste minimization efforts.

1.3 Report Structure

This document is Volume I in a planned series of waste minimization benchmarking project reports. Volume I includes the background, full project scope, details, and results of the liquid photographic waste case study. A second waste stream, waste motor oil, is included in the project. During the benchmarking process, the waste motor oil team was unable to locate an industry partner that was doing a better job of waste minimization than DOE (at the time of publication). The group decided to perform an internal, DOE-based benchmark. The results of the waste motor oil group will be published in another volume. Volumes will be added as other waste streams are studied.

The following table describes the report structure:

Report Section	Description
1	Identifies purpose, project background, and intent.
2	Describes Sandia's generic 12-step benchmarking methodology, which can be adapted by any organization that wants to apply benchmarking to process improvement.
3	Describes how the project was conducted, using the 12 steps of the benchmarking methodology as a framework. Details from the liquid photographic waste team are included. Waste minimization practices, techniques, and recommendations are included in Section 3.11.
4	Describes the lessons learned that might be helpful to other organizations that use this benchmarking methodology.
Appendices	Provide a list of common DOE waste streams, brief training guides on questionnaire development and site visit techniques, questionnaires used in the project, and a list of resources for more information.

2.0 Benchmarking Methodology

Introduction This section describes the generic process of benchmarking, as defined by Sandia's Process Improvement/Benchmarking Team.

Benchmarking Definition Benchmarking is the continuous process of improving products, services, and practices by

- identifying and understanding customer requirements and process performance,
- exchanging information with recognized leaders (internal and external to the organization),
- implementing meaningful improvements, and
- recalibrating the process by assessing the progress and monitoring the trends and results.

Author Robert Camp has defined benchmarking as "the search for industry 'best practices' that lead to superior performance." (Camp, 1989)

Benchmarking Steps The following is a flow chart of the 12-step benchmarking methodology (Figure 2-1) used at Sandia.

Figure 2-1. 12-Step Benchmarking Methodology

2.1 Defining the Benchmarking Process

Benchmarking Process

The following table shows the steps that comprise the benchmarking process. Steps 1 through 6 reflect internal process improvement. Steps 7 through 12 reflect external activities.

Step	Activity
1	<p>Identify Process to be Benchmarked</p> <p>The process selected must be narrow enough in scope that it is manageable. The process must be important to the work or business function and be customer-focused because a substantial amount of resources (i.e., people, time, and funds) will be required to conduct the benchmark. The result must improve the process and add value.</p>
2	<p>Establish Management Commitment</p> <p>Management is defined as the person(s) who has the authority to allocate resources (people, time, and funds) and who is ultimately responsible for the outcome of the benchmarking activity.</p> <p>Management</p> <ul style="list-style-type: none"> • has the responsibility to make the effort to understand the fundamentals of benchmarking and to demonstrate its willingness to implement the results. • needs to support the team and its recommendations with resources, encouragement, and commitment. • has the right to expect frequent updates from the benchmarking team (e.g., verbal reports, meeting minutes, reports, periodic presentations).
3	<p>Identify and Establish Benchmarking Team</p> <p>The benchmarking team members include</p> <ul style="list-style-type: none"> • process experts who have extensive knowledge of the process through their daily jobs; these are the people impacted by any changes. • resource personnel such as facilitators, trainers, quality or benchmarking consultants, information specialists, technical writers, and statisticians. • a project leader who guides the benchmarking process. <p>The team may need training in benchmarking techniques, including process definition, the benchmarking process, quality tools, questionnaire design, and interviewing techniques. The team members must understand their roles and responsibilities and commit to a common team purpose or goal. The members must attend and participate in all meetings and complete assignments.</p> <p><i>continued on the next page...</i></p>

Section 2—Benchmarking Methodology

Step	Activity
4	<p>Define and Understand the Process to be Benchmarked</p> <p>The team defines the process through an understanding of important process elements: inputs, outputs, suppliers, and customers. The customer drives the business, and therefore the team needs to understand the customers' wants, needs, and expectations. The team's final output for this step includes a process flow chart depicting the work flow and the relationships between people and organizations. The output from this step will lay the foundation for the remainder of the benchmarking activity.</p>
5	<p>Identify Metrics</p> <p>The metrics must be meaningful to the process. Example metrics include customer requirements, cost, cycle time, and quality. Metrics, when possible, should be consistent with established standards (i.e., industrial, national, international). The process metrics will aid in evaluating and assessing the current process. Strength and weakness trends developed from the metrics can identify areas for improvement and provide guidance and direction for selecting improvements to be implemented. Effective metrics will provide guidance for developing survey tools for benchmarking partners.</p>
6	<p>Evaluate Current Performance</p> <p>The metrics help to identify the process areas to be improved and the nature of the improvements. The team may need to develop a decision matrix for ranking the improvements. A cost/benefit or return-on-investment analysis may be required to evaluate whether the benchmarking process should be continued. If the recommendation for implementation of the appropriate process improvements is made, it will be necessary to monitor the trends and results.</p>
7	<p>Identify Potential Benchmarking Partners</p> <p>Based on the metrics collected from the internal process, the team needs to identify and establish criteria for "best in class" partner selection criteria. The team can identify potential partners through numerous resources: library search and contacts with external organizations, knowledgeable individuals, suppliers, and customers. The team needs to identify a sufficient pool of partners to determine the final few they will visit.</p> <p><i>continued on the next page...</i></p>

Step	Activity
8	<p>Collect Process Data from Potential Partners</p> <p>The team develops surveys to obtain preliminary information from potential partners. Surveys may consist of questionnaires, telephone interviews, or face-to-face interviews. (Normally, site interviews are reserved for Step 10.) The survey questions are based on the process metrics and criteria established for selecting partners. Up-front planning on how to analyze the quantitative and qualitative data is essential for developing good surveys.</p>
9	<p>Analyze Potential Partners' Data and Choose Partners</p> <p>The preliminary data is used to select partners for site visits and interviews. The project leader compares the data gathered from the potential partners to the metrics and criteria set by the team. The final partner(s) must have a process that is applicable to various DOE sites. The project leader should make direct comparisons of the data, process parameters, and constraints. The team will analyze the data and determine how to weight and rank criteria in order to select the final partners.</p>
10	<p>Conduct Site Visits</p> <p>To gain the maximum benefit from partner site visits, careful and thorough preparation is essential. Preparation includes, but is not limited to, determining appropriate interviewees, assigning team interviewing roles, developing a list of questions and a meeting agenda, and determining how to handle the interview data.</p> <p>The site visit is an opportunity for two-way communication between the benchmarking team and each partner. During the site visit, the team will conduct an in-depth interview. It is essential that the team develop an effective interview guide for each partner before the site visits. After all partners' information is collected, the quantitative and qualitative data are analyzed. A decision matrix may be used to identify and select the partners' practices to be incorporated.</p>
11	<p>Communicate Results</p> <p>The team reports results to upper management and all involved parties and develops an action plan that describes the team's recommendations, methods for implementation, and implementation costs and schedule. The findings need to be adaptable to the process and the organization's culture and constraints. The improvements will need to be monitored and evaluated.</p> <p><i>continued on the next page...</i></p>

Section 2—Benchmarking Methodology

Step	Activity
12	Continue to Conduct Benchmarking of Process The best process today may not be the best process tomorrow. Depending on the level of change in the process, customer requirements, competition, technological advances, and changing business practices, it is important to revisit the process, or specific aspects of the process, periodically.

Reference

Section 2 is an adaptation of Section 2 of the report, *Benchmarking the Property Inventory Process at Sandia National Laboratories*, SAND92-2565. It describes the generic process of benchmarking, as defined by Sandia's Process Improvement/Benchmarking Department.

3.0 Conducting the Project

Adaptation of Benchmarking Methodology

The 12 steps of the benchmarking methodology listed in Section 2 provide the framework for this section.

Benchmarking is a flexible process that lets each team adapt the standard procedure to the unique needs of the project. Because of cost and schedule constraints, the benchmarking process was streamlined and condensed for this project.

The following describes how the project leader and the liquid photographic waste team adapted the benchmarking process to the needs of this project.

3.1 Step 1: Identify Process to be Benchmarked

Identification of Common Waste Streams

Initial activities centered on collecting information on as many DOE waste streams as possible. As a starting point, the Waste Management Information System (WMIS) database provided by the Hazardous Waste Remedial Actions Program (HAZWRAP) was used. Through a subjective analysis of DOE waste streams, 38 common DOE waste streams were identified. (See Appendix A.) Of these 38, two waste streams were chosen for this project. This section describes the selection process.

Decision Process Description

The following table describes the process used to select the two waste streams for this project.

Step	Action
1	<p>Collect Waste Stream Data</p> <p>Collect information about waste streams generated in the DOE complex. The following information sources were used:</p> <ul style="list-style-type: none"> • Waste Management Information System (WMIS) data base, Oak Ridge, TN • Annual waste reduction reports sent to DOE headquarters • DOE process expert's opinions • Queries made to waste minimization site coordinators through this project, including a written survey
2	<p>Compile Comprehensive List</p> <p>Compile information collected in Step 1 and categorize by waste type as follows:</p> <ul style="list-style-type: none"> • Hazardous • Radioactive (low-level and high-level) • Transuranic • Mixed • Sanitary
3	<p>Evaluate Waste Stream by Function or Volume</p> <p>For each waste stream on the comprehensive list, ask the following questions:</p> <ul style="list-style-type: none"> • Is the waste stream infrastructure-related? For example, does it result from facility operations, such as motor pool, photography, printing, or office work? • Does the waste stream apply to most DOE sites? (Based on process knowledge.) • Does the waste stream create a large volume of waste? The waste stream may not be extremely hazardous, but it may be expensive to process because of the large volume of waste generated. (Large volume is a subjective judgment.) <p style="text-align: right;"><i>continued on the next page...</i></p>

Step	Action
4	<p>Distill a Short List of Waste Streams</p> <p>Select only the waste streams that had affirmative answers in Step 3. (See Appendix A.)</p>
5	<p>Choose Waste Streams for Study</p> <p>Two waste streams, liquid photographic waste and waste motor oil, were chosen for the following reasons:</p> <ul style="list-style-type: none"> • Manageable process to define and understand • Good chance of success • Process experts were easily found and readily available in the DOE complex • Vehicle fleet maintenance working group already existed. The Fleet and Plant Operations and Maintenance group was created by the Waste Minimization Contractor Coordination Group.

OUTCOME OF BENCHMARKING STEP 1:

Processes chosen for benchmarking:

- Liquid photographic waste
- Waste motor oil

NOTE:

Because the waste motor oil team was unable to find, at the time of publication, an industry partner that practiced better waste minimization techniques than were currently in use by some DOE sites, the team decided to perform an internal benchmark that would provide a profile of the best DOE efforts. Therefore, information on the waste motor oil team will be detailed in another volume.

3.2 Step 2: Establish Management Commitment

Strong DOE Commitment

Because of DOE's emphasis on minimizing waste, management commitment was a positive element in this project. Management at all levels provided support, funding, resources, and suggestions. The DOE sponsor for this project is the Waste Minimization Division, EM-352. The project also had the support of the individual team members' management.

All Levels

Management commitment was provided at many levels for this project, including the following:

- Headquarters provided support through project funding and guidance.
 - The Albuquerque Field Office provided support through the WMin coordinator.
 - Site management provided support by allowing the process experts the time to participate.
 - Sandia management provided support through benchmarking expertise and trainers.
-

OUTCOME OF BENCHMARKING STEP 2:

DOE management committed resources at local, regional, and national levels.

3.3

Step 3: Identify and Establish Benchmarking Team

Team Members

A benchmarking team usually consists of a project leader, process experts, management, and support personnel. Not all team members are required to participate at all times. Some team members may perform more than one role, as needed, for the team at large and smaller subteams.

Finding Team Members

The project leader used the following sources to find benchmarking team members:

- Networking
- Contacts within the DOE
- Proceedings from waste minimization conferences
- Discussions with site waste minimization coordinators

NOTE: The team should be as small as possible while including all of the required roles. A good rule of thumb is 4-6 process experts.

Roles and Responsibilities

The following table outlines suggested roles and responsibilities.

Role	Responsibilities
Project Leader Plan, organize, assign tasks, and oversee the benchmarking project.	<ul style="list-style-type: none"> • Identify the waste stream to be benchmarked • Identify process experts and assemble the team • Manage the project • Arrange for benchmarking training • Report project progress to DOE management and team members • Negotiate commitments with benchmark partners • Coordinate tasks • Attend all workshops and site visits • Oversee report preparation
Process Experts Provide professional expertise on the target process.	<ul style="list-style-type: none"> • Participate in workshops • Define the current process • Identify best management practices • Identify metrics and criteria for determining crucial factors for questionnaires and interview questions for site visits • Implement new ideas learned from other team members • Contact potential partners • Perform site visits to learn new processes • Write short progress reports of activities • Implement new ideas learned from site visits

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Section 3—Conducting the Project

Roles and Responsibilities, Continued

Role	Responsibilities
DOE Management Provide support and resources.	<ul style="list-style-type: none">• Set policy• Provide support and personnel, time, and funds
Trainers/Facilitators Teach participants benchmarking techniques and lead workshops and work sessions to accomplish goals.	<ul style="list-style-type: none">• Train team members in:<ul style="list-style-type: none">- benchmarking philosophy and methods- process definition and flowcharting- developing questionnaires for telephone contacts and written responses- developing interview questions- proper procedures for site visits• Consult on sensitivity issues• Facilitate working sessions to keep the team on track and lead discussions
Information Specialist Aid the search for potential benchmarking partners.	<ul style="list-style-type: none">• Search a variety of data bases using key words to find potential industry partners for benchmarking• Create a packet of materials and potential leads to aid the process experts and project leader in their search
Writer/Recorder Document the benchmarking process.	<ul style="list-style-type: none">• Record information at the workshops and transcribe minutes• Write questionnaires, using questions developed by the process experts at the workshop• Provide writing support for project leader, as needed

Team Assignments

The team assignments are suggested, not mandatory. The team assignments listed in the table below were used for this project.

Team	Responsibilities	Members
Planning Team	<ul style="list-style-type: none"> • Sets the goals of the project • Creates task plans • Defines the cost, schedule, and budget 	<ul style="list-style-type: none"> • Project leader • Local DOE field office waste minimization coordinator • DOE Headquarters EM-352 Representative • Additional suggestions: Members of the planning team might include site waste minimization coordinators, process experts, and site management personnel.
Benchmarking Team	<ul style="list-style-type: none"> • Performs the work to accomplish the project's goals, including: <ul style="list-style-type: none"> - Defining the process and its metrics - Setting criteria for industry partners - Developing a questionnaire - Identifying industry partners - Conducting telephone surveys - Developing interview questions - Conducting on-site interviews - Writing progress and project reports - Providing a pool of personnel for the subteams 	<ul style="list-style-type: none"> • Project leader • Process experts (4-6 experts) • Benchmark consultants/facilitators for training and consultation • Support personnel (information specialist, technical writer, scribes to record minutes)
Interview Team	<ul style="list-style-type: none"> • Visits the industry partners, conducts interviews, and records responses <p>NOTE: It is recommended that team members are trained on benchmarking ethics and site visit techniques.</p>	<ul style="list-style-type: none"> • The Questioner—Has strong interviewing skills, elicits as much information as possible with broad category questions, always a process expert. • The Listener—Refers to a long list of detailed questions to make sure enough information is collected to satisfy all the questions, usually a process expert. • The Scribe/Facilitator—Takes detailed notes and monitors the agenda to keep the site visit on track, usually the project leader.

OUTCOME OF BENCHMARKING STEP 3:

Planning team, benchmarking team, and interview team successfully assembled.

3.4 Step 4: Define and Understand the Process to be Benchmarked

Process Foundation Step 4 is the most important step in the benchmarking process because it lays the foundation for all future activity. The team must define and understand the existing process before examining another's process. This step establishes the baseline from which to measure performance gaps.

Team Convenes The entire team gathered for the first time in Step 4. The project leader, benchmarking consultants, process experts, information specialist, and support staff attended a workshop, the first in a series of three.

Workshop Goals The goals of the first workshop were to

- Define and understand the process to be benchmarked.
- Create a flow chart of the generic process.
- Define the metrics of the process (Step 5).
- Define the criteria for choosing potential partners (Step 7).

The workshop also had important auxiliary goals, which were to:

- Coalesce the team into a cooperative, working unit.
- Train the team in benchmarking methodology.

Workshop Activities The two-day workshop was held to provide training and a work session for the entire benchmarking team.

The stage table below summarizes the workshop activities related to Step 4. A detailed description of the activities follows the stage table.

Stage	Activity
1	Workshop facilitators directed team-building exercises to help the team integrate into a cooperative, working unit.
2	Workshop facilitators trained the team in the benchmarking methodology so team members understand the group process, the task, the commitment, and the work involved to complete the project.
3	Team members developed a flow chart of the process to be benchmarked.

Stage 1 — Team Building

Team Building One of the first activities was a team-building exercise. The team was charged with defining:

1. Team name
2. Motto
3. Mission statement

The group exchanged ideas, brainstormed, and got to know one another through the group exercise.

The outcome of the tasks:

Team Name	The Foto Fixers
Motto	Less is Better
Mission Statement	The mission or goal of the Foto Fixers is to develop a hazardous liquid waste stream minimization methodology for photographic chemical processes. This methodology will address DOE and regulatory requirements, and will consider best management practices (BMPs) and new technologies.

Mission Statement Purpose

The mission statement helped the team establish common goals, narrow the focus, and define the group's mission. The mission statement provided a touchstone to prevent the group from straying off the track.

The mission statement also helped to keep the target small. If, for example, the liquid photographic waste group had decided to minimize ALL photographic process waste, such as ruined paper, used film, and so on, the target would have been too large, the waste minimization process would have become unmanageable, and the group would have lost focus.

Stage 2 — Train the Process Experts

The process experts were chosen for their knowledge of their fields and the tasks they perform in their daily jobs. However, they needed training in how the process of benchmarking works. The first workshop also provided training in the 12-step benchmarking process (refer to Section 2). The trainers and facilitators from the Process Improvement/Benchmarking Department at Sandia guided the workshop and provided training.

Also, the training facilitators made sure everyone was familiar with flow charting techniques and terminology before proceeding with the flow charting activities.

Stage 3 — Create a Flow Chart That Works for All Members

**Process
Flow Chart**

The process experts came from a variety of sites that had different procedures to accomplish the same task. Each site was unique, but the final product was the same. Regardless of the site, the team members produced photographic products for their customers.

**Process
Parameters**

All processes have the following common parameters:

- Inputs
- Suppliers
- Outputs
- Customers

The team used the parameters above to help them define a particular process that produces a liquid photographic waste stream. For each parameter, the team brainstormed for ideas. After making four lists, the group reviewed each listed component to see if it was directly related to the liquid photographic waste stream, or if it was tangential. The mission statement provided a reminder for keeping the group focused. The team members deleted some items and combined and revised others. The final lists are shown below.

Inputs

The inputs for the liquid photographic waste stream are

- Up front chemicals
 - Processing equipment
 - Film/paper
 - Filters
 - Exhausted chemicals
 - Process mistakes
 - Waste water treatment system
 - Staff knowledge/work/process implementation
 - Facility design
 - By-products of photography processes
 - By-products of treatment processes
 - Regulations/requirements
 - Procedures/processes
 - Work requests
 - Conduct of Operations (code of procedures) and Formality of Operations
-

Suppliers

The suppliers for the liquid photographic waste stream are

- Chemical suppliers
- Water works/utility company
- Photo paper and film
- Equipment manufacturers
- Customer's work requests
- Technical/instruction publications

Continued on the next page...

**Suppliers,
continued**

- Power company
- DOE
- Regulators
- Management/staff
- Maintenance service
- Facility service
- Waste organization

Customers

The customers of the liquid photographic waste stream are

- Internal management
- DOE
- Regulatory agencies
- The public
- Storage treatment and disposal facility
- Shippers
- Public treatment works

Outputs

The outputs of the liquid photographic waste stream are

- Effluent/waste water (treated vs. nontreated, hazardous vs. nonhazardous)
- Liquid waste (treated vs. nontreated, hazardous vs. nonhazardous)
- Being in compliance/passing audits (regulated/nonregulated)
- Self-assessments
- Testing process
- Reports
- Operational data base

Flow Chart

After the lists were finalized, the team created a flow chart (Figure 3-1) for the liquid photographic waste process.

OUTCOME OF BENCHMARKING STEP 4:

Photographic process inputs, outputs, customers, and suppliers were identified. A flow chart of the process was completed.

Figure 3-1. Photographic Waste Administrative Process

Figure 3-1. Photographic Waste Administrative Process, continued

3.5 Step 5: Identify Metrics

Definition	Metrics are the measures of the internal process. Metrics allow evaluation and assessment of existing performance and provide points of contrast after the lessons learned from the benchmarking activity have been applied.
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Purpose	Metrics help the team create questions for finding the right industry partner and form the foundation for questionnaire development and interview questions.
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Metrics	After the process flow chart was created (see Step 4), the facilitator led the team through a discussion of the metrics that applied to its process and defined a list of metrics.
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The group decided that the following metrics were relevant for finding potential industry partners:

- Total gallons of effluent discharged per year
- Gallons of photo chemicals used per year
- Ratio of materials used per product produced
- pH range of effluent (element tracking)
- Information on out-of-tolerance occurrences
- Concentrations of key components (analytical analysis)
- Preliminary Hazard Assessment (PHA) or risk assessment of work conditions
- Machine utilization/effluent not treated (balance work flow to machine utilization)
- Frequency of sampling
- Number of process technicians

NOTE: Not all of the metrics are easily obtainable measures within DOE.

OUTCOME OF BENCHMARKING STEP 5:

Metrics were defined that provide the measures of the internal process and identify the criteria for finding potential industry partners.

3.6

Step 6: Evaluate Current Performance

Modification of Step 6

This step was not explored in depth because of the diversity of the sites. However, each process expert was urged to use information from the workshop to apply to his or her own process.

Information Exchange

The team performed an informal evaluation of a site's performance by exchanging information and comparing activities and processes. Each process expert had the opportunity to discuss and explain his or her site process during the first workshop.

Value of Networking

Most of the participants said that this workshop was the first time they were able to meet with their peers. They learned new ideas from other sites' processes and felt the workshop had provided a networking opportunity. The process experts said that the variances in environmental laws and regulations that apply to the different sites was of great interest.

A photography technologist reported that the workshop had helped him because of the supportive network that the benchmarking process fosters. Improved work relationships resulted. He reported that when problems arise, they are not seen as crises, but manageable problems with attainable solutions.

OUTCOME OF BENCHMARKING STEP 6:

Individual team members shared information on his or her process with the other process experts and established network contacts for future problem solving.

3.7 Step 7: Identify Potential Benchmarking Partners

Search Parameters

The search parameters for identifying potential partners were based on the metrics and criteria established by the process experts at the process flow workshop.

Defining the criteria limited the search to partners that will fit the team's needs. The liquid photographic waste team needed to find a partner that had a variety of operations, such as black and white, color, and motion picture processing. A company that only did black and white processing would not fit the criteria because their operations would not be diverse enough to apply to a majority of DOE sites.

Criteria

The liquid photographic waste team defined the following criteria as being important for choosing an appropriate partner:

- Size of staff
 - Size of physical plant
 - Number of machines
 - Kind of business
 - Custom
 - Amateur
 - Aerial
 - X-ray
 - Motion picture
 - Other
 - Regulations
 - Federal
 - State
 - County
 - City
 - Other
-

Identification of Potential Partners

There are a variety of sources for identifying potential partners, including the following:

- Literature search by an information specialist
 - Process experts' suggestions
 - Contacts through customers or suppliers
 - Trade associations or publications
-

Literature Search

The technical library information specialist was able to start the search before the first workshop, based on the chosen waste stream and the project goals. The information specialist attended the first workshop to familiarize herself with the partner requirements. After the workshop, the metric and criteria lists were given to the information specialist to use as the basis for a literature search to find potential partners.

The literature search steps to identify potential industry partners are summarized below.

Step	Action
1	Search the appropriate data bases <ul style="list-style-type: none"> - using key words suggested by the criteria provided by the benchmarking team. - for companies that are patenting innovative techniques.
2	Review technical journals in the subject field.
3	Check reference sources for company information.
4	Verify company addresses and telephone numbers.
5	Identify possible contacts to whom benchmarking questionnaires can be sent.
6	Prepare a report, listing all companies and contacts.

The list of companies and contacts was provided to the group at the second workshop (see section 3.8).

Process Experts' Suggestions

In this case, the best source for partners was the knowledge available from the process experts. Their networking contacts were valuable in supplying information that was not available through published sources. Creative brainstorming at the second workshop yielded good suggestions for potential partners, including the two final partners, NASA and Kodak.

Results

The literature search and process expert networking initially identified 24 companies for the liquid photographic waste team.

13 **OUTCOME OF BENCHMARKING STEP 7:**
A list of potential partners was finalized.

3.8 Step 8: Collect Process Data from Potential Partners

Data Collection Methods	The main tools for gathering initial process data from potential partners is a questionnaire, either verbal or written. Both types were used for this project.
Questionnaire Development Training	<p>The benchmarking team reconvened for the second workshop to learn questionnaire development techniques and to define the questions it wanted to pose to potential partners.</p> <p>Refer to Appendix B for an abbreviated training guide on questionnaire development techniques. Refer to Appendix C for the final telephone and written questionnaires used in this project.</p>
Telephone Questionnaire Purpose	The telephone questionnaire was not meant to be an exhaustive survey, but a brief inquiry to determine whether the company would be interested in participating and whether the company was suitable for benchmarking. The telephone questionnaire provided a filter, focusing on major processes rather than details of the company's operations.
Written Questionnaire Purpose	<p>The purpose of the written questionnaire was to collect the needed information to choose the best partner.</p> <p>The written questionnaire incorporated most of the metrics defined in the first major workshop on process definition. The written questionnaire was sent only to the companies contacted by telephone that met the criteria, that expressed an interest in participating, and that would possibly provide innovative techniques in waste minimization.</p>

Questionnaire Process

The following table describes the process for developing and using both the telephone and written questionnaires:

Step	Team Member	Action
1	Process Experts	<ul style="list-style-type: none"> • Use the metrics to develop rough questions • Using process knowledge, make sure the questions will help identify good partners and are not just "nice to know" information
2	Project Leader and Technical Writer	<ul style="list-style-type: none"> • Use the rough questions developed at the workshop to create the telephone questionnaire and the written questionnaire
3	Project Leader	<ul style="list-style-type: none"> • Divide the names and telephone numbers of potential partners among the process experts (2 or 3 per process expert) • Fax the final version of the telephone questionnaire to the process experts • Send a rough draft of the written questionnaire to the process experts for comment
4	Process Expert	<ul style="list-style-type: none"> • Call the companies and conduct the telephone questionnaire • Report the results to the project leader • Review the written questionnaire and send the suggestions to the project leader
5	Project Leader	<ul style="list-style-type: none"> • Evaluate results of telephone questionnaire and compare company information to original criteria • Select companies for written inquiry
6	Project Leader, Technical Writer	<ul style="list-style-type: none"> • Write final draft of written questionnaire • Write cover letter
7	Project Leader	<ul style="list-style-type: none"> • Send written questionnaire to the industry partners that match the criteria and are willing to participate

Results

Of the 24 initial contacts made by the liquid photographic waste team, 11 companies

- had processes that were appropriate for comparison to the DOE's process defined by the process experts and
- were willing to participate.

Written questionnaires were sent to these companies. Of the 11 written questionnaires sent, 7 were returned. (This return rate of 64% exceeds the average return rate of 30-60% for prescreened written questionnaires.)

OUTCOME OF BENCHMARKING STEP 8:

- 1) Telephone questionnaire "qualified" 11 potential partners
- 2) Written questionnaire follow-up provided 7 responses used for further analysis.

3.9 Step 9: Analyze Potential Partners' Data and Choose Partners

The answers to the written questionnaires provided the data for analysis and for selection of a benchmarking partner. (The written questionnaire is shown in Appendix C.) The table below shows the criteria used to select partners.

Criteria	Explanation
Size of Staff	The team was looking for a laboratory that had a medium-to-large size staff (six or more laboratory workers, excluding photographers). The size of the staff indicated that enough photography products were processed to make WMin efforts worthwhile and cost-effective.
Diversity of Operations	Laboratories with diverse operations would mirror DOE facilities. For example, a one-hour photo shop that does only color print processing did not have the desired diversity.
Waste Minimization Efforts	The team looked for companies with strong management and worker support for waste minimization through good training, thorough written procedures, and a commitment to waste minimization.
Best Management Practices	Companies were evaluated on how many of the Best Management Practices listed on the questionnaire were already in use at their site.
Willingness to Share	The team was looking for companies that were willing to have on-site visitors and who were willing to let the team publish the results without restricting the report's audience. NOTE: In many benchmarking projects, the company names are not used because of confidentiality issues. Because this project applies to many DOE sites, the group needed to work with partners that were willing to have published results.

Out of the seven potential partners that returned the questionnaire, three companies met the requirements stated above. The project leader called the three finalists and discussed their waste minimization efforts and successes. The two that had the most active waste minimization programs were chosen.

- OUTCOME OF BENCHMARKING STEP 9:**
Partners selected for on-site benchmarking:
- Eastman Kodak Co.
 - Johnson Space Center/NASA

3.10 Step 10: Conduct Site Visits

Overview

The industry site visit is the final tool to help the team gather information on how to improve each DOE site's waste minimization process.

Site Visit Training

The interview team, a subset of the benchmarking team, convened for a third workshop to learn interview techniques, rules of conduct, and agenda development skills.

Refer to Appendix D for an abbreviated training guide on on-site interviewing techniques. Refer to Appendix E for the final interview question set used in this project.

Site Visit Process

The following table shows the site visit process.

Step	Action	Team Member
1	<ul style="list-style-type: none">Contact the chosen partners and make arrangements for the site visit through a telephone call and a formal letter.Contact the companies not selected and thank them for their time and tell them the publication date of the final report.	Project Leader
2	<ul style="list-style-type: none">Train the team in interviewing skills, site visit standards, etiquette, benchmarking ethics, and handling sensitive information.	Benchmarking Facilitators
3	<ul style="list-style-type: none">Create the agenda for the site visit.	Interview Team, Project Leader
4	<ul style="list-style-type: none">Develop interview questions. (A helpful source was the <u>Guides to Pollution Prevention, The Photoprocessing Industry</u>, published by the EPA.)	Interview Team (Process Experts, Project Leader)
5	<ul style="list-style-type: none">Send the agenda, interview questions, any information requested by the partners, and auxiliary documentation (such as benchmarking information) to the partners.	Project Leader
6	<ul style="list-style-type: none">Visit the site, using the interview questions to keep the visit focused.	Interview Team
7	<ul style="list-style-type: none">Analyze the information and report on what is useful to the team.	Interview Team

3.10.1 Eastman Kodak Site Visit

The first site visit was performed at the Eastman Kodak Company headquarters in Rochester, New York.

Rather than follow the prepared agenda and question list, Kodak conducted a series of presentations by staff members, including a comprehensive tour of Kodak's research and development laboratories. Kodak has extensive experience in hosting visitors interested in waste minimization, so the group followed the program offered by Kodak. The team recorded answers to their specific questions as they were covered during Kodak's presentation.

The process experts received a wealth of information, verbally and in written documents. Some time was spent discussing up-coming waste minimization technologies, some of which were presented in the first quarter of 1994 at the National Association of Photographic Manufacturers Association convention.

Summary of Kodak Visit

The visit to Kodak covered the following topics:

- Overview of Kodak health, safety, and environment programs
- Introduction to Customer Imaging Environment Support Services
- Overview of Environmental Sciences Section
- Tour of the following processing areas:
 - Motion picture
 - E-6, a color reversal process
 - Aerial
 - C-41, a color negative process
 - RA-4, a printing process
- Strategies for environmental compliance
- Tour of Environmental Sciences Section Laboratories
- Wrap up, questions, comments

3.10.2 Johnson Space Center/NASA Site Visit

The second site visit was performed at the Johnson Space Center/NASA site in Houston, Texas.

This visit paralleled the team's expectations for a site visit because the scripted interview was followed. However, not all NASA personnel were available, due to other commitments. The main contact person was able to answer all of the team's questions because he had been instrumental in many of the changes made in NASA's waste minimization efforts over the past few years.

Summary of NASA Visit

The visit to NASA followed this agenda:

- Interview NASA contact
 - Tour photography operations
 - Discuss quality control issues with a photographic chemist to finish answering interview questions
 - Wrap up, questions, comments
-

Section 3—Conducting the Project

13 OUTCOME OF BENCHMARKING STEP 10:

The interview team completed site visits at

- Eastman Kodak Co.
- Johnson Space Center/NASA

3.11

Step 11: Communicate Results**Overview**

This section briefly summarizes the site visits and what was learned from the partners. The section discusses waste streams generated by photoprocessors and the four key minimization options. Finally, this section provides a list of Best Management Practices (BMP) learned from the two industrial partners.

One major recommendation from the DOE process experts to photo labs is to stay in touch with their chemical manufacturers, touching base every few months to tap the wealth of process and chemical information that manufacturers have and are willing to share.

Much of the information in this section is not new, but served as reminders of what the process experts already knew. Part of the benchmarking methodology is to constantly re-evaluate the target process to see if any changes can be incorporated that will improve the process.

Normally, Step 11 of the benchmarking methodology includes implementing improvements and monitoring the results. Because this project deals with a consensus (i.e., generic) process, and a variety of sites, actual implementation was not possible. The purpose of this section is to provide results and offer options so individual sites may create their own implementation plans. The tables are comprised of information supplied by Kodak and EPA's Guides to Pollution Prevention, the Photoprocessing Industry.

NOTE: Refer to Appendix F for a list of resources and contacts for expert help in waste minimization in photography.

Key minimization options discussed were

1. Source Reduction
2. Recycle/Recovery of Components
3. Regeneration/Reuse of Solutions
4. Treatment of Residuals

Kodak Site Visit

Kodak stressed their commitment to helping customers solve technical, management, and transportation problems with photographic waste effluents. They demonstrated advancements that customers could use to measure and treat waste streams. Upcoming waste minimization technologies were presented.

Johnson Space Center/NASA Site Visit

Johnson Space Center/NASA is developing a comprehensive program to ensure all environmental discharges are in compliance. A systematic waste reduction program will be in place to ensure that these reductions are being implemented in the most cost-effective manner.

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Waste Streams Wastes generated by photoprocessors are primarily aqueous effluents. These may be categorized as: process bath wastes, color developer wastes, and bleach/fix/bleach-fix wastes (Freeman, 1990).

The following table lists the common solutions that comprise the effluents, their constituents, and the environmental concerns they cause. (GPP, 1991)

Solution	Constituents	Environmental Concern
Prehardeners, hardeners, and prebaths	Organic chemicals Chromium compounds	Oxygen demand Toxic metals
Developers	Organic chemicals	Oxygen demand
Stop baths	Organic chemicals	Oxygen demand
Ferricyanide bleaches	Ferricyanide	Toxic chemical
Dichromate bleaches	Organic chemicals Chromium compounds	Oxygen demand Toxic metals
Clearing baths	Organic chemicals	Oxygen demand
Fixing Baths	Organic chemicals Silver Thiocyanate Ammonium Compounds Sulfur compounds	Oxygen demand Toxic metals Toxic chemicals Ammonia Possible hydrogen sulfide (H ₂ S) generation
Neutralizers	Organic chemicals	Oxygen demand
Stabilizers	Phosphate	Bio-nutrients
Sound-track fixer or redeveloper	Organic chemical Ammonium compounds	Oxygen demand Ammonia
Monobaths	Organic chemicals	Oxygen demand
In addition, photoprocessing solutions may be acidic or alkaline.		

3.11.1. Source Reduction

Source reduction is the preferred method of waste minimization but must be used in combination with other methods to ensure the most effective strategy.

The following table lists source reduction methods.

Method	Description	Comments
Using Correct Chemicals	<p>Choose chemicals that</p> <ul style="list-style-type: none"> • produce the lowest waste <ul style="list-style-type: none"> - can be treated by a waste treatment facility - have low replenishment rates • use the same manufacturer's chemicals within a single process. Mixing different brands within a single process may produce nontreatable matrices or void existing treatment technologies. 	<p>The chemicals that are best for a lab will depend on factors such as</p> <ul style="list-style-type: none"> • Effluent regulations in the area and chemical limits that affect the laboratory. • Utilization of the film and paper processor. • Level of equipment, chemical, and maintenance costs that the laboratory can justify. • Commitment to reduce effluent discharges. • Space limitations. • Other needs unique to each laboratory.
Squeegees	<p>Squeegees provide a simple and effective way to reduce carry-over of processing solutions and wash waters. Properly installed, they can reduce solution or wash-water carryout by 75 percent or more.</p> <p>The following steps will result in dramatically improved squeegee function:</p> <ul style="list-style-type: none"> • change often • use correct squeegee material for right solution • wash squeegee every 15 minutes • wipe squeegee frequently during process 	<ul style="list-style-type: none"> • Install squeegees following all washes and processing solutions in continuous processing machines. (Squeegees are not recommended in some locations because the carryover adds needed dilution to the next solution.) It is also not practical or possible to use them on processors such as rack-and-tank, basket, or drum processors. • Check the specifications for the process for recommended placement of squeegees. <p><i>continued on the next page...</i></p>

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Method	Description	Comments
Replenishment Rates	<p>Replenishment rates are determined by factors such as</p> <ul style="list-style-type: none"> • the type and amount of the photographic material being processed, • the exposure level of the material, • processor speed, • solution carry-in and carry-out, • concentrations of the reaction and decomposition products, and • process control. <p>Usually the recommended replenishment rates exceed the amount needed to maintain the solution level, resulting in an overflow that is either discharged to the drain or collected for treatment and possible reuse.</p>	<p>Check for the following:</p> <ul style="list-style-type: none"> • The correct replenishment rates are being used. • The correct process specifications are being used. • The replenisher-delivery systems are operating properly.
Floating Lids	<p>Using floating lids on solution-storage containers can</p> <ul style="list-style-type: none"> • double the useful storage life of solutions by reducing oxidation and evaporation. • reduce contamination from dust and dirt. 	<ul style="list-style-type: none"> • Mix only the amount of solution that can be used during its useful storage life to minimize solution loss from oxidation and evaporation.
Plumbingless Minilabs	<p>Plumbingless minilabs use a proprietary chemical stabilizer in place of wash water. While conventional minilabs discharge 20 to 25 gallons of effluent per roll of film processed, plumbingless minilabs discharge less than 0.1 gallon of effluent per roll.</p>	<p>Although the volume of effluent is greatly reduced, the concentrations of contaminants are much higher than for the conventional minilabs. Wherever there are concentration limits on sewer discharges, potential users should review this point with local authorities if silver can be recovered from this effluent using either the metallic replacement or electrolytic processes described in the next table.</p>

3.11.2 Recycle/Recover Components

As much as 80 percent of the total silver processed for black-and-white positives and almost 100 percent of the silver processed in color work will end up in the fixer or bleach-fix solution. Silver is also present in the rinse water following the fixer or bleach-fix due to carry-over. The amount of silver in rinse water is a small fraction of that in the fixer or bleach-fix solutions, but can be economically recovered when high volumes of rinse water are used. A variety of equipment types and sizes are available for silver recovery.

The table below discusses silver recovery methods.

Comparison of Silver Recovery Methods			Applicable Production Volume		
Method	Advantages	Disadvantages	Low	Medium	High
Metallic Replacement (Chemical Replacement Cartridge (CRC))	<ul style="list-style-type: none"> • Low investment • Low operating cost • Simplest operation 	<ul style="list-style-type: none"> • pH sensitive • High iron content of effluent • Silver recovered as sludge • High silver concentration in effluent unless two units are in series • Overall high cost due to frequent changing of cartridges 	X	X	
Electrolytic Recovery	<ul style="list-style-type: none"> • Recovers silver as pure metal • High silver recovery rate • Most economical 	<ul style="list-style-type: none"> • Potential for sulfide formation • High silver concentration in effluent • pH sensitive 	X	X	X
Precipitation	<ul style="list-style-type: none"> • Can attain 0.1 milligrams of silver per liter (mg Ag/L) • Moderate investment • Relatively simple technology 	<ul style="list-style-type: none"> • Complex operation • Silver recovered as sludge • Treated solution cannot be reused • Potential H₂S release for sodium sulfide system • Must know silver concentration for proper dosage • Can be very time-consuming • Phase separation stage is critical 	X	X	

Continued on the next page....

Comparison of Silver Recovery Methods			Applicable Production Volume		
Method	Advantages	Disadvantages	Low	Medium	High
Reverse Osmosis	<ul style="list-style-type: none"> Also recovers other chemicals Purified water is recyclable 	<ul style="list-style-type: none"> Concentrate requires further processing High investment High operating cost Distillates may need further treatment Need to control biogrowth 	X		
Ion Exchange	<ul style="list-style-type: none"> Can attain 0.1-2.0 mg Ag/L Good for very low Ag limits 	<ul style="list-style-type: none"> Only for dilute effluent Complex operation High investment Distillates may need further treatment Need to control biogrowth High replacement cost for resins 		X	X
Evaporation	<ul style="list-style-type: none"> Minimum aqueous effluent Water conservation 	<ul style="list-style-type: none"> High energy requirement Silver recovered as a sludge Organic contaminant buildup Potential air emissions High initial cost Distillates may need further treatment Need to control biogrowth 	X		

3.11.3 Regenerate/Reuse Components

The following table lists available treatments for the regeneration and reuse of chemistry and wash waters, ranked in order of the ease and effectiveness for waste volume reduction.

Treatment	Description	Production Volume Required For Method to be Effective			Comments
		Low	Medium	High	
1. Bleaches	Many bleaches are recovered and reused. Recovery of EDTA (ethylenediaminetetraacetic acid) type bleaches is very common and regeneration and reuse is done easily. Ferricyanide bleaches have been recovered and reused for years. Some bleaches are designed for low replenishment rates.	X	X	X	Requires more labor, less waste recovery potential than fixing bath treatment
2. Fixing Baths	With in-line desilvering, it is possible to reduce replenishment rates by 50-75%. Recent work has proven batch desilvering of overflow with reuse is feasible.	X	X	X	Simple to install, economical; impacts silver concentration and subsequent wash water
3. Wash Waters	Spent rinse water can be treated to restore purity and recycled for rinsing. A small portion of incoming clean water is added to the recycled water stream and an equivalent overflow goes to the sewer drain after the fixer wash. A single recycling system can serve several photoprocessor units.	X	X	X	Simple to install, low to moderate cost
4. Developers	Most commonly used technique is ion exchange. Electrodialysis is used in Japan and not commonly in the United States. Some developers are formulated to be reused directly. Some formulations are designed for a very low replenishment rate.			X	Complex, high technical skills required, expensive
5. Stabilizers	Recent experimentation has shown it may be possible to reduce replenishment rates if stabilizers are recirculated through resins or activated carbon			X	Easy, low cost, low maintenance
6. Stop Baths	For the most part, stop baths are not reused. In some cases, formulas have been modified for very low replenishment rates. pH control can minimize usage.			X	

3.11.4 Treatment of Residuals

Treatment is not a true waste minimization technique. It must be done when the production of waste is unavoidable. The goal of treatment is to convert the effluent to a form that can be discharged legally to a sewer system.

For facilities that cannot discharge to a Waste Water Treatment Plant (WWTP), volume reduction for vacuum evaporation or distillation can minimize amounts to be hauled offsite. Also, high temperature incineration is the only final treatment currently recommended by Kodak. Most users would have to contract services for any of the treatments listed below. All would be costly. Good practices would reinforce the practicality of minimizing waste at the beginning of each process.

The following treatment technologies are some of the technologies under investigation by Kodak:

Treatment	Description	Comments
1. Chemical Oxidation	<ul style="list-style-type: none"> Various oxidants including hydrogen peroxide, hypochlorite, ozone, and combinations of oxidants with and without catalysts 	<ul style="list-style-type: none"> Limited success on photo solutions
2. Electrolytic Oxidation	<ul style="list-style-type: none"> Various electrode combinations commercially available 	<ul style="list-style-type: none"> Not ready for application to photoprocessing
3. High Pressure, High Temperature Techniques	<ul style="list-style-type: none"> Wet air oxidation Supercritical water oxidation 	<ul style="list-style-type: none"> Experimental Not an on-site treatment process
4. Biological	<ul style="list-style-type: none"> Recommended treatment when photo solutions are 10% or less of total input to WWTP; partial treatment is advised when photo solutions are 100% of input to WWTP 	<ul style="list-style-type: none"> Promising
5. Powdered Activated Carbon Treatment	<ul style="list-style-type: none"> Specialized biological treatment system 	<ul style="list-style-type: none"> Experimental
6. High Temperature Incineration	<ul style="list-style-type: none"> Recommended treatment for photo solutions and evaporator residues; must be over 1500°F 	<ul style="list-style-type: none"> Only final treatment recommended by Kodak

3.11.5 Best Management Practices

The following lists best management practices (BMPs) that were learned from the site visits that are most applicable to DOE site processes. The lists are compilations from both sites.

System Design	• Conduct a thorough systems analysis. Look at how business is being done today, not how it was done when the facility was designed or built.• Know your regulatory discharge or sewer codes.• Cut down the number of systems in use; trim the laboratory profile.• Have up-to-date and clearly written procedures available.• Size equipment and capacities to actual needs.• Purchase low-maintenance equipment, even if the initial cost is higher.• Work closely with vendors to ensure proper use/application of products.• Stay in touch with manufacturers and attend trade shows.• Make sure your test labs are accredited by your state.• Keep abreast of new technology.
Water Control	• Perform a systems assessment before changing the water volume to ensure the product quality stays high.• Perform regular water use audits.• Use water savers. Wash water savers can reduce water usage by 25-65%.• Control inventories of processing chemicals so they are used before their expiration dates.• Conserve wash water and energy by equipping machine with solenoids to turn off water.
Processing Considerations	• Process in batches for better labor allocation and less processor waste.• Make up processing solutions only in quantities needed to meet realistic processing volumes.• Improve quality control for all processes to prevent unnecessary discharges.• Use floating lids or balls on all solution tanks to prevent loss through oxidation or evaporation.• Properly separate film types early in the process to avoid processing mistakes.• Install sticky pads at the entrance to lab facilities to reduce the dust in solutions and on film and prints. The pads should be changed often.• Use air or vacuum squeegees if feasible.• Do not mix different brands of chemicals.
Monitoring Considerations	• Calibrate flow meters (at least annually).• Monitor replenishment rates.• Monitor silver in effluent throughout the waste stream.
-

Section 3—Conducting the Project

■ OUTCOME OF BENCHMARKING STEP 11:

Source reduction, recycle/recovery, regeneration/reuse, treatment techniques, and best management practices were documented for possible improvement to minimize waste at DOE photography labs.

3.12 Step 12: Continue to Conduct Benchmarking of Process

Normally, benchmarking is an ongoing process. The best waste minimization technology today may be outmoded and outclassed by new developments. This step is not currently being pursued because of cost and schedule constraints, but would be necessary for actual process improvements.

4.0 Conclusions and Recommendations

Results and Recommendations

Because results and recommendations are an integral part of the benchmarking effort, they are included in the main body of the report. See Section 3.11 for the results of the benchmarking project for liquid photographic waste and recommendations for best management practices.

Learning Process

The benchmarking process is also a learning process. As the project progresses, the most important quality for a team to have is the ability to be flexible, to shift gears, and to handle the unexpected, particularly during site visits. This section is written for benchmarking project leaders or team members to help them anticipate and hopefully avoid pitfalls.

4.1 Lessons Learned by the Project Leader

Planning

The following provides suggestions for planning activities:

- Keep complete and organized files of all correspondence and documentation.
 - Keep the correspondence with partners and potential partners in a separate file for easy access.
 - Plan the workshops carefully. Verify the logistics prior to the start of the meeting to avoid delays or inconveniences during the meeting.
 - Have a laptop computer at the workshops to record the activities directly.
 - Be flexible. The project leader needs to be willing to adapt if the team comes to a dead end in any part of the benchmark process.
 - Communicate regularly with sponsors.
-

Modifying the Methodology

A full benchmark is a long and rigorous process; the team had to modify the benchmark process to accommodate the needs of the customer, DOE management. Several steps of the benchmark process can be successfully modified but none can be eliminated. Implementation, which is a major part of traditional benchmarking, could not be done with this project because the team used a consensus process rather than a specific process. The process information was gathered from a variety of sites so there was no way to write an implementation plan that would apply to more than one site.

Interactions with Team Members

The following provides suggestions for managing team dynamics:

- Have a written "contract" with the benchmark consultant clearly stating requirements, expectations, schedule, and costs. This "contract" or agreement may be dynamic in the beginning.
- Spend the necessary time finding the "right" team members rather than finding the "easy-to-get" team members. Working with highly qualified process experts with extensive experience in waste minimization added to the project's success.

Continued on the next page...

Interactions with Team Members, Continued	<ul style="list-style-type: none"> • Give process experts plenty of time to discuss their processes with their peers at the workshops. • Make sure the workshop scribes understand clearly the purpose of the workshop. • Involve the technical writer from the beginning of the project. • Have strong facilitators at the workshops to keep the teams focused. • Be willing to be the "bad guy" if necessary and tell the team members clearly and early if they are not meeting expectations.
Training	<p>Training is an essential step.</p> <p>Offer "just in time" training staggered throughout the project so the skills are fresh in the minds of the participants.</p>
Analysis	<ul style="list-style-type: none"> • Have process experts write the draft of the results section for the final report. So much information is collected that only the process experts can decide what is most important and what is the most useful level of detail.
Site Visits	<ul style="list-style-type: none"> • Try to space interviews at least a week apart to allow time to digest and analyze the data from each visit. • Make the note-taking guides identical for all team members and number the questions clearly. • Bring a laptop computer on the site visits so the project leader can begin the report during the debriefing session with other team members.

4.2 Lessons Learned from the Process Experts

Greatest Benefit	<p>The process experts felt that the greatest benefit of the benchmarking process was the opportunity to network with their peers and share process and operations information.</p>
Greatest Value	<p>Process experts reported the following as the greatest value of the workshop to the DOE complex:</p> <p>"I feel our time will be multiplied many times over by the sharing of experiences and successes with each other. This can generate a very valuable product/tool."</p> <p>"Peers can discuss the various aspects of their operations and make common sense input to DOE through this workshop. Properly done, this should foster less, but improved oversight."</p> <p>"I have worked for the DOE complex in photography for 21 years. This is the first experience for me to have any formal contact with any other DOE photo labs. I now have contacts and personal relationships with three other DOE labs which I can use to improve our daily conduct of operations and to help me cope with whatever new environmental regulations may be coming my way."</p>

Section 4—Conclusions and Recommendations

Biggest Problems

The biggest problems encountered by the process experts included:

- Logistics: getting to scheduled meetings
 - Conflicting priorities with other work
-

4.3 Lessons Learned from the Benchmarking Consultant

- The process sponsor/owner needs to be clearly defined.
 - The project leader and benchmarking consultant need mutually agreed upon goals and objectives.
 - An agenda and ground rules need to be set and adhered to at workshops.
 - The facilitator needs to be trained in process definition and benchmarking methodology.
-

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Appendix A

Common DOE Waste Streams

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A.1 38 DOE-Wide Common Waste Streams

Waste stream information was obtained from:

- the Waste Minimization Information System (WMIS) data base
- annual waste reduction reports sent to DOE headquarters
- DOE process experts' opinions
- queries made to waste minimization site coordinators through this project, including a written survey

NOTE: These waste streams were selected from information contained in WMIS. A subjective analysis of the data base was made to choose waste streams common throughout the DOE complex.

Waste Stream Category	DOE Waste Stream																						
Common Sanitary Waste Streams	Construction debris Food waste Office paper Office waste (except white paper) Packaging waste Waste oil sludge Waste water sludge																						
Common Hazardous Waste Streams	<table> <tr> <td>1,1,1 - Trichloroethane</td><td>Paint solvent</td></tr> <tr> <td>Aerosol cans</td><td>Paint waste</td></tr> <tr> <td>Batteries</td><td>Paper gloves, rags, etc.</td></tr> <tr> <td>Cyanide solution</td><td>PCB waste - liquid</td></tr> <tr> <td>Degreasing solvent</td><td>PCB waste - solid</td></tr> <tr> <td>Fluorescent light tubes</td><td>Photographic chemicals</td></tr> <tr> <td>Freon TF</td><td>Plating shop waste</td></tr> <tr> <td>Gasoline/diesel</td><td>Toner solution</td></tr> <tr> <td>Hydrofluoric acid</td><td>Waste oil - auto</td></tr> <tr> <td>Hydrogen peroxide</td><td>Waste oil - machine</td></tr> <tr> <td>Lead-contaminated solids</td><td></td></tr> </table>	1,1,1 - Trichloroethane	Paint solvent	Aerosol cans	Paint waste	Batteries	Paper gloves, rags, etc.	Cyanide solution	PCB waste - liquid	Degreasing solvent	PCB waste - solid	Fluorescent light tubes	Photographic chemicals	Freon TF	Plating shop waste	Gasoline/diesel	Toner solution	Hydrofluoric acid	Waste oil - auto	Hydrogen peroxide	Waste oil - machine	Lead-contaminated solids	
1,1,1 - Trichloroethane	Paint solvent																						
Aerosol cans	Paint waste																						
Batteries	Paper gloves, rags, etc.																						
Cyanide solution	PCB waste - liquid																						
Degreasing solvent	PCB waste - solid																						
Fluorescent light tubes	Photographic chemicals																						
Freon TF	Plating shop waste																						
Gasoline/diesel	Toner solution																						
Hydrofluoric acid	Waste oil - auto																						
Hydrogen peroxide	Waste oil - machine																						
Lead-contaminated solids																							
Common Low-level Radioactive Waste Mixed Streams	Contaminated filters and prefilters Contaminated lead Contaminated protective clothing Contaminated soil Contaminated solvents Scintillation fluid and vials																						
Common Low-level Waste Streams	Contaminated gloves Contaminated metal Decommissioning & decontamination debris Radioactive oil																						

Appendix A - Common DOE Waste Streams

A.2 Eight Common Waste Streams

Of the 38 common waste streams in Section A.1, eight were chosen as potential waste streams for prototyping the waste benchmarking process.

	Waste Stream	Rationale for Selection
1	White office paper	<ul style="list-style-type: none">• All sites• Waste minimization technologies/techniques in place• Major landfill problem
2	Packaging waste	<ul style="list-style-type: none">• All sites• Waste minimization technologies/techniques in place• Major landfill problem
3	Waste oil	<ul style="list-style-type: none">• Most sites• Disposal problems• Waste minimization technologies/techniques in place• Major environmental impact
4	Photographic waste	<ul style="list-style-type: none">• Most sites
5	Paint waste	<ul style="list-style-type: none">• Most sites
6	Aerosol cans	<ul style="list-style-type: none">• Most sites• CFC problem• Disposal problems
7	1,1,1-Trichloroethane	<ul style="list-style-type: none">• Many sites• High toxicity
8	Contaminated lead	<ul style="list-style-type: none">• Many sites• Major mixed waste disposal problems

Appendix B

Questionnaire Development— A Training Guide

PREFACE: The following abbreviated training guide is a condensation of the information presented by Teresa Torres of the Process Improvement/Benchmarking Department of Sandia National Laboratories.

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Questionnaire Development Training Guide

Overview	This guide presents an introduction on how to develop good questionnaires, including design, format, and content. Refer to Appendix C for the questionnaires developed by the liquid photographic waste team. At the end of this appendix is a summary of the questionnaire development process.
Definition of a Questionnaire	A questionnaire is a set of questions used for obtaining and measuring factual information (statistically useful) or attitudes (qualitative information).
Design Considerations	<p>A well-designed questionnaire is</p> <ul style="list-style-type: none"> • Reliable: It will consistently convey the same meaning to the entire targeted audience. • Valid: It provides for obtaining accurate, relevant data, is easy for the user to complete, and provides information for decision-making.
Foundation Points	<p>Every questionnaire must have a solid foundation that includes the following:</p> <ul style="list-style-type: none"> • Objective: The writer(s) should be able to state a clear objective in one sentence. • The Big Question: What is the one most important question? <p>Before you begin, define the questionnaire objective. The objective does not belong in the questionnaire itself, but supplies the basis for all of the questions. If you cannot state a clear objective, the questionnaire will not elicit the information you need.</p> <p><u>Clear Objective:</u> To find a partner that has an effective waste-minimization program that has cost-effective treatment techniques, technologies, and procedures that can be applied to DOE photography laboratories.</p> <p><u>Unclear Objective:</u> To find a good waste minimization program.</p>
Questionnaire Content	The questions are based on the metrics and criteria defined during the process definition stage (Step 4).
Type of Questionnaires	<p>During the course of benchmarking, you will design two questionnaires.</p> <ol style="list-style-type: none"> 1. A telephone questionnaire 2. A written questionnaire

Telephone Questionnaire

Benefits and Uses

The process experts use the telephone questionnaire to guide them during the telephone conversation with a potential partner. The telephone questionnaire

- provides the initial contact with potential partners.
- establishes rapport with the company contact.
- initiates contact with the person who can approve the request for a site visit.
- helps identify suitable as well as unsuitable partners.

Contents

The telephone questionnaire contains

- a "script" or a few paragraphs that help the process experts introduce themselves and explain the project. (See the Checklist below.)
- a "table of contacts" where the process expert can record the names and phone numbers of various people within the company. The process expert may speak to many people before contacting the person who can actually answer the questionnaire.
- three or four broad questions.
- an "other leads" section that lets the process expert record other potential partners that this company may identify.

Checklist

The process expert should use a checklist to help remember all the areas he or she should cover over the course of the phone call. (The order of the items is suggested, not mandatory.)

Checklist for Initial Telephone Contact With Potential Benchmarking Partner:

- ✓ Introduce yourself and the purpose of the call.
- ✓ Explain how the responses/data will be handled (anonymity/confidentiality policy).
- ✓ Explain why that particular company was chosen for comparison.
- ✓ Explain how you got his/her name.
- ✓ Briefly describe the process under consideration.
- ✓ State why the process is under consideration.
- ✓ Describe the type of information/data to be gathered.
- ✓ Offer reciprocal benefits.
- ✓ Offer to share general findings.
- ✓ Describe anticipated schedule and time requirements.
- ✓ Ask for willingness to answer the written questionnaire.
- ✓ Ask for agreement to participate in possible site visits.
- ✓ Ask for questions/clarification.

Written Questionnaire

Benefits and Uses	The written questionnaire is used to gather process data from potential partners. The results of this questionnaire are used to select partners for actual site visits.
Questionnaire Cover Letter	<p>The cover letter defines why the respondent is filling out the questionnaire.</p> <p>NOTE: Include the project leader's name, telephone and fax numbers, and address on the actual questionnaire in case the cover letter gets separated. Include space for the respondent's name, company name, address, and phone and fax numbers.</p>
Confidentiality	Confidentiality is a major concern. All organizations have rules and regulations, both internal and external, about what is shareable and what is company-protected or sensitive. The benchmarking team needs to recognize this constraint and work within it.
Checklist	The cover letter reiterates many of the points raised during the telephone questionnaire. The project leader may use the following checklist as a guide for writing the cover letter.

Checklist for Written Questionnaire Cover Letter:

- ✓ Introduce yourself as the project leader.
- ✓ Explain the purpose of the project.
- ✓ Give a short explanation of the site visit and who the visitors will be. Listing the process experts by name and background adds credibility.
- ✓ Reassure respondents about privacy issues.
- ✓ Explain benchmarking. You may also enclose literature that explains benchmarking. (Refer to the Benchmarking Resources section at the end of Appendix F.)
- ✓ State the benefits for both parties.
- ✓ Explain why that particular company was chosen for comparison and how you learned about the company's superior process.
- ✓ Describe the type of information/data to be gathered.
- ✓ Repeat the offer to share general findings.
- ✓ Describe anticipated schedule and time requirements.
- ✓ Ask for questions/clarification and give a phone number.
- ✓ Include a realistic time frame for answering and returning the questionnaire. Two weeks may not be enough time for some respondents to answer the questionnaire.

Follow Up	After sending the questionnaire, you may want to follow up with a telephone call in a few days to check if the package arrived and if they have any questions. Or, you may include a self-addressed, pre-stamped post card with the questionnaire package that acknowledges receipt of the questionnaire that the respondent can drop into the return mail.
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Types of Questions

Types of Questions

This section lists the types of questions you may use on any questionnaire and offers examples.

Type	Definition. The respondent must:
Open	<p>Write full text answers.</p> <p><u>Examples:</u> Please comment about.... How do you perform this function?</p>
Binary	<p>Choose one or the other answer. (Usually Yes or No.)</p> <p><u>Examples:</u> Do you have a waste minimization program? Yes ____ No ____</p>
Multiple Choice or Checklist	<p>Choose from a list of ranges or choices. The respondent must choose one or check all that apply. (Give clear instructions.) Always provide an "other" line so respondents can add items.</p> <p><u>Example:</u> What chemical processes do you use? (Check all that apply) ☐ C-41 ☐ E-6 ☐ EP-2 ☐ Other: _____</p>
Ranking	<p>Place the answers in the desired order.</p> <p><u>Example:</u> Rank the 5 items below in the order you consider most important, with "1" as the most important and "5" as the least important. Write your response in the space provided.</p> <p>The most important best management practices for photographic processing are:</p> <p> ☐ Work and machine scheduling ☐ Employee training ☐ Material selection ☐ Washless processes ☐ Most current technology </p> <p><u>NOTE:</u> Ranking questions are difficult to use, because the respondent is likely to misinterpret the question. They are not recommended.</p> <p style="text-align: right;"><i>Continued on the next page...</i></p>

Types of Questions, continued

Types of
Questions,
continued

Type	Definition. The respondent must:
Filter	<p>Take some action based on the answer to the filter question. Based on the answer, the respondent may stop answering all questions. Filter questions help eliminate unsuitable partners quickly. The telephone questionnaire relies strongly on filter questions.</p> <p><u>Example:</u> Would your company agree to a site visit so we can learn firsthand your waste minimization techniques?</p>
Branching	<p>Skip to another point in the questionnaire, based on the answer. The answer portion includes directions on which question to go to next. Clear instructions help prevent the respondent from answering questions that do not apply, which would make the questionnaire data invalid.</p> <p><u>Example:</u> 3. Do you maintain chemical inventory records? If no, go to step 4. If yes, answer the following bulleted questions:</p> <ul style="list-style-type: none"> • Where is • How do.....: <p>4. What is the most common problem.....</p>
Demographic	<p>Give answers that help break the analysis down by categories.</p> <p><u>Examples:</u> Age: Income: Job Category:</p>

Construction Principles

Questionnaire Principles

The following guidelines should be followed to construct a questionnaire:

- **Do not ask a benchmarking partner for information that is in the public domain.** Show respect for the respondent by performing research before making the phone call or sending the written questionnaire.
- **Avoid loaded words that carry negative or leading meanings.** These questions may make respondents nervous.

Loaded wording:

"Do you have any complaints about XYZ?" already carries a negative connotation.

Neutral wording:

"Do you have any comments about XYZ?" allows any response.

- **Avoid stereotypical wording.** For example, use "he/she" when asking questions instead of just "he".
- **Define relative terms.** "Frequent" may mean one measure for one person and something else for another person. The answer to the following example could cover a wide range of answers. To avoid confusion or misinterpretation, use multiple choice questions that present ranges.

Bad example:

"Do you perform this task frequently?"

Better example:

"How often do you perform this task?"

___ 1-2 times/week ___ 3-4 times/week ___ more than 5 times/week

- **Avoid multiple negatives within questions** to avoid confusion. Scan for words such as not, never, or don't.

Bad example:

"Isn't it true that lab technicians should never use?"

Better example:

"Do lab technicians use....?"

Continued on the next page...

Questionnaire
Principles,
continued

- **Avoid acronyms.** Terms that are common within the DOE complex may be unknown to an outside audience. Always use the full term.

Bad example:

Has the R&R group ever done an RIP in order to comply with RCRA?

Better wording:

Has the Risk and Remediation group ever performed a research integration project to comply with the Resource Conservation and Recovery Act?

- **Avoid questions that ask two questions in one.**

Bad example:

"Do you use best management practices and how do you train your employees to use them?"

In the example above, a binary (yes/no) question was combined with an open question. The second part of the question assumes an affirmative answer to the first part of the question.

NOTE: You may use filter or branching questions instead of double-barreled questions.

- **Do not intermix units.** For example, don't change between gallons and quarts when you are expressing liquid measurements.
- **Use between 5 and 9 items** on multiple-choice "scale" questions where respondents must assign a value. (The standard is 7 items.)

Example:

"Very Good, Good, Average, Fair, Poor."

- **Construct a balanced response scale.**

Bad Example:

"Excellent, Very Good, Good, and Poor" is not balanced.

Better Example:

"Very Good, Good, Average, Below Expectations, Poor" is balanced.

- **Construct nonoverlapping ranges.** For example, the ranges 1-100, 100-200, and 200-300 overlap. Use 1-99, 100-199, and 200-299 instead.
- **Provide "Don't know," "None," and "Not applicable" responses.**

Continued on the next page...

Appendix B - Questionnaire Development

Questionnaire Principles, continued

-
- **Allow "Other" responses and provide an underline on multiple choice questions.** Give the opportunity for respondents to supply unanticipated answers.

Example:

___ Other: _____

- **Use intervals for sensitive questions,** such as age, income, or dollar amounts (don't forget the nonoverlapping range rule).
 - **Avoid response scales using relative terms.** For example, the responses "Sometimes, Frequently, Regularly, and Habitually" are too subjective. Use response scales with actual numbers, or, "Daily, Weekly, Monthly, Annually".
-

Formatting Guidelines

Guidelines

As you construct the questionnaire, use the following formatting guidelines:

- **Use headings to:**
 - Separate the questions into categories and group them by related topics.
 - Group questions in a nonthreatening numbering scheme. Question 5.7 doesn't look as ominous as question 57.
 - **Write clear, concise instructions.** For example, if a list of choices is presented, be sure to indicate whether the respondent should "Check one" or "Check all that apply."
 - **Provide clear skip and branching questions.** For example, if the answer to a question is "yes," direct the respondent to the next applicable question. Or, if the answer is "no," direct the respondent to complete the other sections of the current question.
 - **Do not make respondents perform mathematical calculations.** If you do not know how an answer was calculated, you cannot be sure of its validity. Ask for raw information and do the calculations yourself.
 - **Lay out each page so that it is user friendly.** Questionnaire writers tend to put too much text on a page, hoping that they can "fool" the respondent into answering a long questionnaire that looks deceptively short. Add more white space to make the questionnaire more user friendly. An inviting two-page questionnaire will receive more responses than a one-pager with tiny type.
 - **Most respondents would rather check boxes than write lengthy answers.**
 - **Use wording your target audience will understand.** Put definitions in the question, if needed. One person's definition of heavy equipment may not match another person's definition.
 - **Provide graphic cues.** For example, you may put instructions inside of a box or between arrows.
 - **Include a return address.** The questionnaire must have a name and address on the first page. If there's a time crunch, fax it out. If the cover letter gets separated from the questionnaire, the respondent can still get it back to you if the questionnaire contains the contact person's name, address, and fax number.
 - **Use a consistent format.**
-

Questionnaire Review

After you write the questionnaire, review each question and consider the following:

- **Are the two foundation points aligned?** If the purpose and the big question do not agree, you need to rethink your questionnaire.
 - **Delete "nice to know" questions.** They waste the respondent's time and the questionnaire analyst's time. For each question, ask yourself:
 - Do I really need the information?
 - What useful information is this question going to provide for waste minimization?
 - **Do not ask what you are not willing to share.** If you are requesting sensitive information, such as the cost of the waste minimization program, be prepared to share the same information from your site.
 - **Open-ended questions are extremely hard to analyze.** Could the questions be better expressed in another way, such as multiple choice? For example, instead of asking respondents to list their best management practices, provide a checklist of possible practices and provide lines for additional items.
 - **Don't make the respondent assume anything.**
 - **Test each question for reliability and validity**—Check the definitions for reliability and validity given on page B-1 and ask if the question stands up to the definitions.
 - **After writing, structuring, and formatting the questionnaire, ask yourself, "Was the purpose addressed?"**
-

Questionnaire Development Process

Before You Begin

Before you begin to write a benchmarking questionnaire (either telephone or written), the following must be in place:

- Define the internal process
- Define the metrics and criteria
- Complete the list of potential partners and initial public domain research

Questionnaire Process

The table below shows how questionnaires are used in the benchmarking process.

Stage	Description
1	The process experts state the questionnaire's objective and define the "Big Question." (This normally occurs at the questionnaire training workshop.)
2	The process experts create, at the workshop, a list of questions to gather data, based on the process metrics.
3	The technical writer writes the telephone questionnaire, including a script outline, the table of contacts, the questions, and a table for other possible leads, under the supervision of the project leader, after the workshop.
4	The project leader sends the telephone questionnaire to the process experts, dividing the list of potential partners among them. NOTE: Process experts should use the Telephone Questionnaire Checklist to aid them in writing their own personalized script.
5	The process experts conduct the telephone questionnaires with their assigned potential partners.
6	The process experts evaluate the results and contact the project leader, indicating which companies have the greatest potential for benchmarking partnerships.
7	The technical writer writes the written questionnaire under the supervision of the project leader.
8	The project leader sends the written questionnaire to all the process experts for review, comments, and additions.
9	The project leader writes the cover letter for the questionnaire, tailoring it to each potential partner.
10	If possible, pretest the written questionnaire before sending it to potential partners. Choose two people familiar with the project and two people unfamiliar with the project answer the questions. Misunderstandings, assumptions, and weaknesses become apparent when someone must actually complete the questionnaire.

Continued on the next page...

Appendix B - Questionnaire Development

Questionnaire Process, continued

Stage	Description
11	The project leader sends the written questionnaire to the potential partners recommended by the process experts based on the telephone questionnaire.
12	The project leader creates a plan for analyzing the data before sending the questionnaire. For benchmarking, a criteria vs. business matrix may be effective.
13	The project leader sets a schedule and milestones for receiving and analyzing the questionnaire, and writing a report for the participants. NOTE: Make sure the schedule is realistic. You cannot predict or dictate when questionnaires will be returned.
14	The project leader receives the questionnaires and analyzes the data.
15	The project leader, with input from the process experts, chooses the final candidates for the site visits.

Appendix C

Liquid Photographic Waste Stream Telephone and Written Questionnaires

PREFACE: The following pages are copies of the:

- telephone questionnaire used by the process experts to conduct the telephone interviews to narrow the field of potential partners. The first page of the telephone questionnaire contains information for the process expert about the purpose of the questionnaire. The second page provides a suggested "script" for the process expert to use to introduce him/herself. The telephone questionnaire follows, with a section for a table of contacts.
- written questionnaire sent to the potential partners selected through the telephone interviews. A cover letter tailored to each company accompanied the written questionnaire.

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Telephone Survey for Photography Chemical Subgroup

Overview For the Caller

The purpose of this questionnaire is to narrow the field of potential partners for benchmarking the process of reducing photography chemical waste.

Main Points

Here are the main points that the questions are trying to determine:

The company

- must have a process or policy in place for waste minimization of photography chemicals
- must be large enough to make waste minimization economically appealing.
- must be producing a sufficient volume of waste (from one or several product types) to make waste minimization cost effective.
- must be willing to participate in a benchmarking study.

Identification Statement

States who we are and what we are trying to do.

Please feel free to prepare your own script. This script suggests the kinds of things you may want to include.

Script

I am _____ with _____.
I belong to a group that is trying to find the best ways to minimize photography chemical waste production. This group is a team of people from facilities across the country (California, New Mexico, Nevada, Texas, and Washington.) We are contacting companies in U.S. industry that may have good methods for minimizing photography chemical waste. We are trying to get good ideas about waste minimization that we can incorporate into our practices. We are concentrating on liquid waste only at this time.

Instructions

Find out if you are speaking to the right person. Use the table on the next page to record all the people you had to talk to and write down the "final" or "right" person.

Script

I am calling to find out if your company would be interested in participating in a telephone survey. This involves answering a few questions today with the possibility of being sent a written, more detailed questionnaire. We will eventually select two companies that deal effectively with photography chemical waste to visit in a benchmarking-type visit to do an information exchange in the area of photography chemical waste minimization.

Instructions

Answer any questions about who we are and what we are doing. Refer them to Victoria Levin (505) 844-8956, fax (505) 844-1723 if there are any questions you can't answer.

Telephone Questions for Photo Subgroup

Name of the Company I am calling: _____

Location of Company: _____

Date	Person Contacted	Title	Phone Number

Person that is the real and final contact (and phone and title):

Telephone Questionnaire -- Actual Questions

Effluent

1. Are you required to treat your effluent?
☐ Yes.
☐ No.
2. Does your company have a photography chemical waste minimization process in place?
☐ No. (If no, graciously conclude the interview.)
☐ Yes.

Staff/Size

3. How many lab. processing technicians do you have on staff? (Not including photographers)
☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16 or more

Business/Product

4. What kind of photographic products do you produce?

☐ Custom film/print	☐ X-ray
☐ Amateur products	☐ Digital
☐ Aerial products	☐ Other? _____

Photo Process

5. What chemical processes do you use?

☐ Color
☐ B&W

☐ X-ray
☐ PMT

☐ Other: _____

Willingness to Participate

6. Would your company be interested in participating in a benchmarking project with us to help us improve our photography chemical waste minimization process? We would like to exchange information that may be mutually beneficial to both facilities.

- ☐ No. If no, thank them for their time and conclude the interview.
☐ Yes. If yes, tell them about future plans (a written questionnaire may follow, as well as the possibility of a site visit.)

Closing remarks

In any event, thank them for their time.

Ask for the correct and detailed mailing address so that you can:

- ☐ Send results of the telephone questionnaire.
☐ Send a written questionnaire, if they are chosen to be part of the process.

Name: _____

Position: _____

Address _____

City, State, ZIP: _____

Questionnaire for Sandia National Laboratories Photographic Chemical Liquid Waste Minimization Benchmarking Project

Please fill out the following questionnaire and return by fax to:

Victoria Levin, FAX: (505) 844-1723

For more information, call Victoria Levin at (505) 844-8956.

Mailing address:

Sandia National Laboratories

Organization 6625, Environmentally Conscious Life Cycle Systems Department

P.O. Box 5800

Albuquerque, NM 87185

This questionnaire is from:

Name: _____

Company Name: _____

Address: _____

City, State, ZIP Code: _____

Phone: _____ FAX: _____

1. Staff/Size:

1.1 How many lab processing technicians do you have on staff? (Do not include photographers)

☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16 or more

2. Business/Processes:

2.1 What kind of photographic products do you process? (Check all that apply.)

☐ Custom film/print	☐ X-ray
☐ Amateur products	☐ Digital
☐ Aerial products	☐ Other, including: _____
☐ Movie film	

3. Photo Process:

3.1 What chemical processes do you use? (Check all that apply.)

Color

- ☐ C-41
- ☐ E-6
- ☐ RA-4
- ☐ EP-2
- ☐ EA-5
- ☐ VNF/ME-4
- ☐ Other, including: _____

Black & White

- ☐ D-19
- ☐ PROSTAR
- ☐ Other, including: _____

X-ray

- ☐ X-OMAT
- ☐ HSD/HSF
- ☐ Other, including: _____

PMT

- ☐ PMT
- ☐ Other, including: _____

4. Effluent:

4.1 How do you treat your liquid effluent? Check all that apply.

☐ Dilution	☐ Replenish
☐ Regeneration	☐ Offsite Disposal
☐ Evaporation	☐ Filtration
☐ Electrolytic	☐ Reverse Osmosis
☐ Ion Exchange	☐ Other: _____
☐ Neutralization	_____

5. Record Keeping

5.1 Do you maintain chemical and product inventory records?

- ☐ No. Go to question 6.
- ☐ Yes. Please answer the following related questions:

5.2 In what form do you keep your records? Check all that apply:

- ☐ Paper files
- ☐ Computer files
- ☐ Other. Please list: _____

5.3 What kind of information is available in your records? (Check all that apply)

- ☐ Volume of individual chemicals purchased
- ☐ Volume of waste chemicals disposed of
- ☐ Volume of products produced per unit of time (day, week, month, year, etc.)
- ☐ Other. Please list the types of data you feel are important in your system:

6. Best Management Practices:

The following is a list of Best Management Practices used to minimize liquid chemical effluents. We are also interested in other Best Management Practices you use. Please check all the practices that apply to your facility.

- ☐ Work and machine scheduling (Don't start the machine unless needed)
- ☐ Avoid excess inventory (Just-in-time, JIT)
- ☐ Maintenance schedule and documentation (Potential interaction with process monitoring)
- ☐ Employee training (Knowledge of and following procedures)
- ☐ Low replenishment chemistry (Correct replenishment rate; least volume of liquid by product rate)
- ☐ Machine selection and modification capability (Work load, wash water)
- ☐ Capacity and Efficiency
- ☐ Most current technology (State of the art equipment and chemical processes)
- ☐ Control Processes and documentation (Process monitoring)
- ☐ Material selection (Most nonhazardous product and chemicals)
- ☐ Regeneration of bleaches
- ☐ Proper trimming of analyzers and translators
- ☐ Minimize size of test prints
- ☐ Re-engineer process (e.g., use digital imaging)
- ☐ Washless processes

Please describe below other Best Management Practices that you use (or you may attach a sheet to this questionnaire):

7. New Technology

7.1 How did you find out about the advanced processes and procedures you use in your facility?

☐ Periodicals	☐ State publications
☐ Federal publications	☐ Consultants
☐ Vendor reps	☐ Trade shows
☐ Other labs	☐ Others. List below.

7.2 What publications or organizations are good sources for information on photographic chemical minimization?

☐ Minilab Developments	☐ Photo Lab Management
☐ Photographic Processing	☐ Photo Electronic Imaging
☐ Photo Marketing	☐ Photographic Trade News
☐ Others. List below:	

8. Costs

8.1 Would you be willing to share waste minimization process cost information?

- ☐ No, not at all.
- ☐ Yes, with the understanding that the information is completely confidential and will not be published, except for internal memos.
- ☐ Yes, with the understanding that the information will be circulated through a Sandia National Laboratories report. (This report is available to the public through the Freedom of Information Act.)

9. Interest in Improvement:

9.1 Are you interested in sharing your future plans to improve your liquid waste management?

☐ Yes ☐ No

9.2 Would you be interested in receiving input from us on improving photographic chemical liquid waste management?

☐ Yes ☐ No

10. Willingness to Participate:

10.1 Are you willing to have visitors at your site? ☐ Yes ☐ No

Any Additional Comments You May Have:

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Appendix D

Managing the On-Site Interview— A Training Guide

PREFACE: The following abbreviated training guide is a condensation of the information presented by Teresa Torres and Lynn Ritchie of the Process Improvement/Benchmarking Department at Sandia National Laboratories.

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Introduction—Managing the On-Site Interview

Overview

This guide presents information on how to

- prepare for a site visit,
- conduct the visit, and
- perform post-site activities.

The last section covers sensitive issues encountered during the benchmarking information exchange process.

Purpose of a Site Visit

The purpose of a site visit is to gather information on how to improve your waste minimization processes.

Avoid Pitfalls

One of the pitfalls of site visits is "industrial tourism" where the interview team visits the site but spends their time "sight-seeing" instead of focusing on the waste minimization process. Careful planning and staying focused on the process can help team members make the site visit an effective part of the benchmarking process. Another pitfall is the tendency for the team to talk about their own processes instead of listening to the partner's contributions.

Preparing for the Site Visit

Key to Success Preparation is the *key* to successful on-site interviewing. The preparation portion consists of

- Researching all public domain information about the partner
 - Developing interviewing skills and techniques
 - Defining roles and responsibilities
 - Supplying necessary documents
 - Working out logistics
 - Pretesting the interview
 - Going over the final checklist
-

Researching Partner Information

- Research Guidelines**
- **Perform research for background information.** Learn as much about your partner as you can prior to the interview. Use a librarian or information specialist to help assemble all information already in the public domain.
 - **Create a Partner Profile** that is a quick reference guide about the company. Define the characteristics that are important to you. For example, you may include the name, address, number of employees, the contact person with whom you have been working, type of business, industry focus, sales revenue, and so on. Compile the Partner Profile from the public domain information. Do NOT ask the partner for this information.
-

Developing Interviewing Skills

- Prepare the Team**
- **Offer "Just-In-Time" training for the interviewing team.** The closer the training is to the time it is needed, the better the team members perform.
 - **Develop interviewing strategies.** Learn to discern between "nice to know" vs. "need to know" kinds of questions. At the on-site interview, ask more open-ended type questions to elicit more qualitative information. The interview questions seek to open up the responses, which is the opposite of the questionnaire process. (The questionnaire process focuses the questions and seeks narrowly defined answers that do not need interpretation.)

For on-site interview strategies, refer to the section Conducting the Site Visit on page D-7.

Defining Roles and Responsibilities

Primary Roles

The project leader determines the roles and responsibilities for the interview team. The primary roles are listed below.

The Questioner	A process expert with strong interviewing skills. This person elicits as much information as possible with broad category questions.
The Listener	Refers to a list of detailed questions to make sure enough information is collected to satisfy all the questions. (Usually a process expert.)
The Notetaker/Facilitator	The person who records the interview and moderates the meeting. Takes detailed notes and monitors the agenda to keep the site visit on track, usually the project leader. The facilitator keeps the questions geared to "need to know" information and steers away from "nice to know" information.

Size of the Team

The interview team is a subteam of the entire benchmarking team. To avoid overwhelming the partner, try to balance the number of interviewers from the benchmarking team with the number of interviewees from the industry partner. Three team members are recommended.

Supplying Needed Documents

Types

You will need to develop or supply the following documents:

- Agenda
- Confirmation memos (attach agenda and interviewing questions)
- Interviewing guide
 - Question guide
 - Note-taking guide
- Handouts
- International Benchmarking Clearinghouse Code of Conduct
- Items that fulfill any of the partner's requests

Develop Interview Topics

In order to develop the agenda and interviewing guide, the team meets to define the topics and the questions that the interview should cover. The team should

- Brainstorm on the topic areas that emerged during the process definition and questionnaire stages.
- Prioritize and select the top 4 to 6 topic areas.
- Brainstorm questions for each topic area.
- Evaluate and prioritize questions, and then select 2 to 3 appropriate questions per topic area.

**Agenda
Components**

The following provides a list of agenda components:

Component	Description
Introduction	<ul style="list-style-type: none">• Introduce all personnel present, and include a brief description of the roles assigned to the benchmarking team.• Provide background information about the DOE, the process experts' sites, or the project.
Purpose	<ul style="list-style-type: none">• State the objectives of the project, including a mission statement or a goal.• State the purpose of the site visit and voice your expectations.
Ground Rules	<ul style="list-style-type: none">• Lay out the ground rules, including time limits, planned breaks, housekeeping information, and remind participants that questions, topic areas and discussion must be limited to the process and benchmarking.
Present Internal Process	<ul style="list-style-type: none">• Present an overview of the process used by the DOE process experts.
Listen to Partner's Process	<ul style="list-style-type: none">• Listen to the process presentation by the partner.
Conduct Interview	<ul style="list-style-type: none">• Conduct the interview and information exchange, allowing time for summarization and follow-up questioning by other team members.
Tour Facilities	<ul style="list-style-type: none">• Tour the site facilities, limiting the scope to the process under study.
Regroup with Team	<ul style="list-style-type: none">• Caucus with team members before the final session, if possible, to check on missed items or additional questions.
Closing	<ul style="list-style-type: none">• Wrap up any remaining items at a brief, final meeting. During the wrap-up, mention the benchmarking report and give an estimate of when the report will be complete.

Working Out Logistics

**Preparation
Strategies**

- **Establish a time frame.** Always defer to the interviewees' needs and work schedule.
- **Schedule interviews in the morning.** A complete site visit should probably take about four hours.

Continued on next page ...

**Preparation
Strategies,
continued**

-
- **Confirm all appointments.** For example, send a reminder to the company contact one week before the visit. One or two days before the visit, make a phone call to the company contact.
 - **Identify the appropriate company representatives.** In the confirmation letter, mention specific job types so the company can provide personnel that are the team members' counterparts.
 - **Coordinate travel plans.** Ensure everyone on the team can arrive at the site on time as a group. Be attuned to holidays and conflicts with regular work, such as budget planning time.
 - **Follow up on any and all requests.** The potential partner may say the company doesn't understand the benchmarking process, or ask for additional information before a final decision to participate may be made. Respond to every request.
 - **Inform the partner of your needs**
 - Ensure an adequate meeting place by letting them know how many people will be attending and if there is a need for audio/visual aids. For example, you may want to display your process flow chart.
 - Share your expectations so they will be able to respond.
 - Ask for a walk-through of the process and be sure that it appears on the proposed agenda that you send to the partner for approval.
-

Pretesting the Interview

**Practice
Improves
Performance**

Teams should practice conducting an interview within their roles. The interview process should be natural and the team should be sure of themselves and how they will interact together. Piloting, or pretesting, the interview helps you

- Verify and clarify roles, topics, and procedures.
- De-sensitize information. Make sure you are not asking for any inappropriate data.
- Catch errors through general editing/proofing.
- Build interviewing skills and techniques.
- Build confidence.
- Work on eliminating company jargon.

Practice at a local level, with internal review. Observers can provide feedback.

Perform Final Check

- Final Checklist** Before the actual visit takes place, make sure the following are in place:
- Confirmation letter
 - Confirmation phone call
 - Partners know that they will be asked to present a process overview
 - Agenda has been sent to partner
 - Question set that covers the topic areas has been sent to partner
 - Roles and responsibilities are set
 - Logistics of meeting place and travel are in place
 - Documents and handouts are ready
 - Know your partner's company through background information obtained during research
-

Conducting the Site Visit

On-Site Interviewing Strategies

Interview Guidelines

Use the following guidelines to conduct the interview:

- **Create a balance between control and rapport.** Chat with interviewees at first to ensure everyone is relaxed and comfortable. Use the agenda to maintain focus and stay on the topic, but not to stifle the respondents. There should be a willingness to share, but you have to make sure that your mission is being accomplished.
 - **Watch body language to make sure that the interviewee feels comfortable.** If the person being interviewed is watching and making eye contact with the "Listener", the team may decide to switch roles so the interviewee can feel more comfortable with the other person acting as the Questioner. If a person is sitting with his or her arms crossed, it may be cold in the room, or the interview may not be going well. If the interviewee seems to have difficulty working with one "Questioner," perhaps another team member should take over the role. If one of the team members notices problems, suggest a break and trade responsibilities.
 - **Use listening skills.** Work on really listening instead of simply hearing what you want to hear. Don't be too eager to jump to the next question. Give time for thoughtful responses.
 - **Use frequent feedback, paraphrasing, and summarizing** to restate what the person said and make sure that you really understood the answer. Try a phrase like, "This is what I think I heard you say." Organizing the interview by topics helps structure the interview. As you complete a topic, summarize the information that was offered and give the interviewees a chance to add to it.
 - **Let the Questioner lead.** One person, the Questioner, asks the main questions. If all members barrage the partners with questions, the interview becomes an interrogation. If the Listener formulates a good question that the Questioner has not asked, the Listener can use the paraphrasing or summary section to ask additional questions.
 - **Use clipboards** to hold the list of questions or a checklist. The Questioner and Listener check the items off as they are answered completely.
 - **Roll with the punches.** If the interview seems to be faltering, take a break, assess what needs to be done and try again.
 - **Try to ask the hypothetical question:** "What would be the ideal process for you in your work situation?" This question may draw out ideas that the partner may not be able to implement, but the team may be able to use.
-

**Site Visit
Strategies**

At the interview

- Have a positive attitude
 - Establish eye contact
 - Use openings that put people at ease
 - Make sure the appropriate personnel are present
 - Have a confidentiality statement preapproved and signed, if needed
 - Have a detailed agenda
 - Invite the interviewees to visit your site (process-specific locations only)
 - Document partner's requests
 - Seek cooperation to obtain any further clarification or additional information. If you need to get further information later, you have prepared the way.
 - Stay flexible
-

Post-site Visit Activities

Tasks	<p>Work continues after the visit, including</p> <ol style="list-style-type: none"> 1. Conduct team debriefing 2. Document site visit 3. Perform analysis 4. Follow up on final details
Conduct Team Debriefing	<p>Perform a team debriefing as soon as possible after the site visit. If you have team members from multiple DOE sites, you may need to perform this action at the hotel or airport before everyone departs. Try to allow extra time for this very important step.</p> <p>Review the partner's answers to clarify, verify, and agree on what was elicited. If information was missed, plan how to obtain it.</p>
Document the Site Visit	<p>Document the results as soon as possible after the site visit. Notes may become cryptic in a few weeks. Route the document to all interview team members for comment, input, and modifications.</p>
Perform Analysis	<ul style="list-style-type: none"> • Assemble and compare information from all sites. Perform a "gap analysis" to identify the differences between your operations and the partners' operations. • Identify the best practices and enablers that make the partner's process superior. • Identify specific recommendations to improve your operations.
Follow Up	<ul style="list-style-type: none"> • Issue thank-you letters to all partners within 48 hours of the visit. • Perform timely follow-through on all requests. • Send the site report to the partners.
Documentation Requirements	<p>For Sandia National Laboratories, all documents issued for publication must go through a classification process and legal department scrutiny. Each site must determine its own requirements.</p> <p>If the information is particularly sensitive, do not use the partner's name in the document.</p> <p>In order to protect information, you may need to prepare a variety of documents written for different levels of use. For example, you may need to prepare several reports, such as:</p> <ul style="list-style-type: none"> • A complete report to DOE for internal use only • A sanitized report for unlimited distribution • A partner's report

AIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIM STANDARDS
BY APPLIED IMAGE, INC.

2 of 2

Information Exchange

Introduction The site visit is not only an interview, it is an informative exchange. The goal is to perform an effective, efficient, ethical, and legal benchmark. There are limitations on what can be shared. Use the following material to guide the information exchange.

Kinds of Information The kinds of information that might be shared include:

- Plans
 - Drawings
 - Formulas
 - Policies
 - Intellectual Property
 - Security
 - Personnel
 - Media
 - Opinion
-

Limits and Boundaries As employees in the DOE complex, we encounter limits and boundaries imposed on sharing information, represented by terms such as:

- Classified
 - Trade secret
 - Proprietary
 - Company confidential
 - Personal
 - Sensitive
 - Unrestricted
 - Unclassified Controlled Access Information
 - In the public domain
 - Open
-

Influences The following can affect the exchange of information:

- DOE policies and regulations
- Management & Operations (M&O) policies and regulations
- Company policies and regulations
- Ethics and codes of conduct
- Expectations

No specific set of guidelines, policies, or regulations have been developed to direct the information-sharing element of benchmarking. However, DOE Policies and Regulations, M&O Policies and Regulations and M&O Laboratory Policies set boundaries.

Ethical Standards	<p>Ethical standards have been established for information sharing between partners in benchmarking, as outlined by the International Benchmarking Clearinghouse. According to these standards, the benchmarking team members should agree that they</p> <ul style="list-style-type: none"> • Will seek to gain no competitive advantage • Will share with the goal of mutual improvement • Will not ask for sensitive data • Will check with legal counsel when doubts about information gathering or sharing occur, and if necessary, negotiate a mutually satisfactory, specific nondisclosure agreement satisfactory to both parties. • Will honor a partner's request that the information be treated as internal privileged communication
Code of Conduct	<p>The International Benchmarking Clearinghouse Code of Conduct asks the benchmarking team to adhere to the following:</p> <ul style="list-style-type: none"> • Stay within legal bounds • Be willing to give what you get • Respect confidentiality • Don't reference information without permission from the partner • Understand expectations • Act in accordance with expectations • Be honest • Follow through with commitments
DOE Directives	<p>The following DOE policies and regulations may affect benchmarking:</p> <ul style="list-style-type: none"> • DOE Order 1430.1C—Management of Scientific and Technical Information • DOE Order 1430.2B—Scientific and Technical Information Management Program • DOE Order 1430.3A—Policy for dissemination of and Access to Departmental Unclassified Scientific and Technical Information. • 5 USC 552—Freedom of Information Act <p>NOTE: The above list provides examples, but may not be all-inclusive.</p>
M&O Directives	<p>The following Management & Operations policies and regulations may affect benchmarking:</p> <ul style="list-style-type: none"> • Compliance with the M&O contractor/DOE contract • Conform to sound practices, policies, and principles followed by the M&O.
Example, Sandia National Laboratories	<p>For example, personnel from Sandia National Laboratories must conform to the following policies:</p> <ul style="list-style-type: none"> • SLP 1003—Technology Transfer • SLP 1004—Government-Industry Data Exchange Program

continued on the next page...

Example, Sandia National Laboratories, Continued	<ul style="list-style-type: none">• SLP 1008—Information Management• SLP 1008-4—Unclassified Controlled Access Information - Special Categories• SLP 1008-5—Unclassified Controlled Access Information - Internal Categories• SLP 1015—Disclosures of Proprietary Information• Technology Transfer, Employee Handbook• Information Surety, SAND92-2208
Other Sites	<p>Benchmarking project leaders need to investigate policies for participating sites. Before embarking, be aware of your own company's policy on what information is "shareable." Try to gather information so that it can be given an unlimited distribution.</p>
Confidentiality Statements	<p>Some partners may require a signed confidentiality statement.</p> <p><u>Example:</u></p> <p>All information concerning the business and affairs of any party participating in this benchmarking activity shall be regarded as confidential, if requested, and will not be shared with any other company or disclosed in a public forum.</p>
Topics to Avoid	<p>The information exchange is process related. DO NOT DISCUSS the following:</p> <ul style="list-style-type: none">• Proprietary or confidential data• Product performance information• Product pricing

Appendix E

Interview Question Set

PREFACE: The following list of questions was used by the interview team during site visits.

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Data Gathering Questions for On-site Interview

1 WASTE MINIMIZATION POLICY AND PLANS

- 1.1 May we have a copy of your waste minimization plan?
- 1.2 Who is responsible for overseeing the program?
- 1.3 How is the program funded?
- 1.4 What are the goals of the program and results?
- 1.5 Do you save money by minimizing wastes or do the recovery costs exceed what you recover?
- 1.6 How was the waste minimization program designed?
 - Discussion with vendors?
 - Chemical suppliers?
 - Regulatory agencies?
 - Other photo experts?
 - Waste minimization experts?
- 1.7 How much has your liquid waste gone down since you instituted a formal waste minimization plan?

2 RECORD KEEPING

2.1 How do you record your recovery activities to satisfy yearly accumulation requirement?

2.2 How many square feet of the following materials do you process each month:

- Black and white print materials
- Color prints
- Black and white film
- Color film-negative and positive
- X-ray
- Motion picture film
- Other

3 PHOTOPROCESSOR OPERATIONS

- 3.1 Are formal operating procedures used to control your photoprocessing operations?
- Are they in writing?
 - Are they available in each photoprocessing work area?
 - Do you do training on your Operating Procedures?
 - Do procedures include operation and maintenance of silver recovery equipment?
- 3.2 How much training do you give your employees involved in the photoprocessing processes?
- 3.3 Are your photoprocessors inspected regularly for
- Solution leaks
 - Replenishment rates
 - Agitation rates
 - Wash water rates
 - Labeling of solution tanks
 - Up-to-date logs or records
 - Other
- 3.4 Do you practice any of the conservation methods listed below:
- Processors started only when needed
 - Stand-by modes used on processors
 - Solution tanks covered when not in use
 - Squeegees used where possible to minimize carry-over of solutions
 - Other
- 3.5 How are minimum solution replenishment rates determined?
- Physical calibration
 - Control strips
 - Practical experience
 - Vendor recommendation
 - Other
- 3.6 When are batch solutions discarded?
- When product quality degrades
 - When production run is finished
 - After a pre-set time
 - Other

Appendix E - Interview Question Set

3.7 Do you use a stabilization type rinse or a water wash?

If you are using a water wash processor, how do you manage the wash water?
Once through
Recycled and recirculated

3.8 What method of water wash do you use?

Flowing
Still
Counter current

3.9 Do you recover and regenerate any of the following used solutions?

Developer
Bleach or bleach fix
Fixer
Activator
Other

3.10 How are rinse water rates set?

Use test strips
Photoprocessor instructions
Chemical supplier recommendations
Operator experience
Other

3.11 How is rinse water used?

Once-through
Counter current
Recycled through clean-up system
Still rinse
Flowing rinse
Other

4 SILVER RECOVERY

- 4.1 Where in your processing steps is silver recovered?
- Wash
 - Bleach or bleach fix
 - Fixer
 - Stabilizer
 - Other
- 4.2 Has the quantity of recoverable silver been determined?
What is it?
- 4.3 Is silver now recovered from:
- Developer solutions
 - Fixer solutions
 - Bleach or bleach-fix solutions
 - Rinsewater
 - Combined aqueous effluents
 - Silver-bearing solids (e.g. paper, film)
- 4.4 Which silver recovery processes are used? On which streams?
- Evaporation
 - Electrolytic
 - Recirculating electrolytic
 - Batch electrolytic
 - Precipitation
 - Ion exchange
 - Hybrid of two or more processes
- 4.5 Do you filter your solutions before treatment, to remove physical materials that might interfere with the proper operation of your silver recovery equipment?

5 ION EXCHANGE

5.1 Do you inspect your ion exchange columns on a set schedule for the following:

Physical damage

Leaks at connectors, hoses, and columns

Adequate flow rate of solution through the column to prevent channeling or plugging

Adequate secondary containment

Proper labeling

Logs and written records current

5.2 How do you determine the efficiency of your ion exchange columns?

Silver estimating strips

Analytical tests

Experience

Time used in system

Volume passed through the system

Other

6 ELECTROLYTIC

- 6.1 How do you check your electrolytic units for proper operation
Correct voltage applied for the solution being treated
Color of the silver being collected
Silver concentration in the processes solution
Other
- 6.2 Do you inspect your electrolytic units regularly for:
Leaks
Agitation
Adequate secondary containment
Proper labeling
Logs and other records current
- 6.3 Do you adjust the pH of your solutions before you treat them electrolytically?

Appendix E - Interview Question Set

7 MISC.

7.1 What would be the ideal waste minimization system?

7.2 Is there anything else you would like to add?

Appendix F

Resources

PREFACE: This section is a compilation of U.S.-wide resources for waste minimization. It includes EPA sources on hazardous materials, information from Eastman Kodak Co., benchmarking resources, and miscellaneous sources.

For specific information about this project, including benchmarking techniques, common DOE waste streams, or liquid photographic waste minimization techniques, call Victoria Levin at (505) 844-5946.

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DOE Site Waste Minimization Managers			
Name	Organization	Phone	Fax
S. Cheng	DAO	(513) 865-4778	(513) 865-4489
P. Seabaugh	EG&G	(513) 865-3095	(513) 847-5264
D. Caughey	KCAO	(816) 997-3449	(816) 997-7310
D. Stoltz	AS-KCD	(816) 997-4175	(816) 997-2049
G. Schmidtke	PAO	(813) 545-6179	(813) 541-8370
D. Pendas	MMSD	(813) 541-8814	(813) 541-8909
J. Thurston	AAO	(806) 477-3134	(806) 477-6472
B. Hill	Battelle	(806) 477-5695	(806) 477-5954
P. Berglund	LAEO	(505) 665-5049	(505) 665-4504
P. Josey	LANL	(505) 665-3421	(505) 665-8195
T. Pietrok	KAO	(505) 845-5649	(505) 845-4710
J. Fish	SNL/NM ORG/7574	(505) 848-0984	(505) 848-0998
A. Johnson Duarte	SNL/CA	(510) 294-3266	(510) 294-3418
M. Hall	ITRI	(505) 845-1076	(505) 845-1198
J. Stelmach	GJPO	(303) 248-6010	(303) 248-6023
A. Gorski	GJPO/Geotech	(303) 248-6573	(303) 248-6040
A. Nguyen	UMTRA	(505) 845-6129	(505) 845-4023
A. Vollmer	UMTRA/Jacobs	(505) 845-4026	(505) 845-4053
P. Sallani	WPSO	(505) 887-8117	(505) 887-0707
C. Wright	WPSO/Westinghouse	(505) 234-8289	(505) 885-4562

Waste Reduction Technical/Financial/Assistance Programs

The EPA Pollution Prevention Information Clearinghouse (PPIC) was established to help reduce industrial pollutants through technology transfer, education, and public awareness. PPIC collects and disseminates technical and other information on pollution prevention through a telephone hotline and an electronic information exchange network. Indexed bibliographies and abstracts of reports, publications, and case studies about pollution prevention are available. PPIC also lists a calendar of pertinent conferences and seminars; information about activities abroad and a directory of waste exchanges. Its Pollution Prevention Information Exchange System (PIES) can be accessed electronically 24 hours a day without fees.

For more information contact:

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

or

U.S. Environmental Protection Agency
401 M Street S.W.
Washington, D.C. 20460

Myles E. Morse
Office of Environmental Engineering and Technology Demonstration
(202) 475-7161

The EPA's Office of Solid Waste and Emergency Response has a telephone call-in service to answer questions regarding RCRA and Superfund (CERCLA). The telephone numbers are:

(800) 424-9346 (outside the District of Columbia)

(202) 382-3000 (in the District of Columbia)

U.S. Navy's Best Manufacturing Practices Program

The Best Manufacturing Practices Program encompasses surveys of companies and government industrial facilities; reports and publications; a computerized database; workshops and seminars; and the powerful, user friendly Program Manager's Workstation expert system. The BMPP also sponsors presentations, seminars, and an annual workshop.

BMP Program
2101 Crystal Plaza Arcade
Suite 271
Arlington, VA 22202
or FAX: (703) 271-9059

Nationwide Sources

The following programs offer technical and/or financial assistance for waste minimization and treatment.

Within the Continental United States

Alabama

Hazardous Material Management and
Resources Recovery Program
University of Alabama
P.O. Box 6373
Tuscaloosa, AL 35487-6373
(205) 348-8401

Alaska

Alaska Health Project
Waste Reduction Assistance Program
431 West Seventh Avenue, Suite 101
Anchorage, AK 99501
(902) 276-2864

Arkansas

Arkansas Industrial Development Commission
One State Capitol Mall
Little Rock, AR 72201
(501) 371-1370

California

California State Department of Health Services
Alternative Technology Section
Toxic Substance Control Division
714/744 P Street
P.O. Box 942732
Sacramento, CA 94234-7320
(916) 324-1807

The state of California's published guides for hazardous waste reduction, including waste studies and checklists for business self-auditing.

Connecticut

Connecticut Hazardous Waste Management Service
Suite 360
900 Asylum Avenue
Hartford, CT 06105
(203) 244-2007

District of Columbia

EPA Headquarters Library
401 M Street, SW
Washington, DC 20460
(202) 260-5922

EPA reference library that holds the "Hazardous Waste Collection," its database and any other sources of information on hazardous waste.

Hazardous Waste Treatment Council
1440 New York Ave., SW, Suite 310
Washington, DC 20005
(202) 783-0870

This organization advocates minimization of hazardous waste and the use of alternative treatment technologies including chemical and biological treatments, fixation, neutralization, reclamation, recycling and thermal treatments. The council assists state, national, and international officials in developing programs to minimize land disposal, maintains a library of materials on new technologies and operates a speakers bureau.

National Recycling Coalition
17 M Street, NW, Suite 294
Washington, DC 20036
(202) 695-6883

National Resource Recovery Association
1620 I Street, NW
Washington, DC 20006
(202) 293-7330

U.S. Chamber of Commerce
1615 H Street, NW
Washington, DC 20062
(202) 659-6000

Appendix F - Resources

Florida

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

Southern Waste Information Exchange
Florida State University
Institute of Science and Public Affairs
Tallahassee, FL 32313
(904) 644-5516

Georgia

Hazardous Waste Technical Assistance
Program
Georgia Institute of Technology
Georgia Technical Research Institute
Environmental Health and Safety Division
O'Keefe Building, Room 027
Atlanta, GA 30332
(404) 894-3806

Environmental Protection Division
Georgia Department of Natural Resources
Floyd Towers East, Suite 1154
205 Butler Street
Atlanta, GA 30334
(404) 656-2833

Illinois

Hazardous Waste Research and Information
Center
Illinois Department of Energy and Natural
Resources
1 East Hazelwood Dr.
Champaign, IL 61820
(217) 333-8940

Illinois Waste Elimination Research Center
Pritzker Department of Environmental
Engineering
Alumni Building, Room 102
Illinois Institute of Technology
3200 South Federal Street
Chicago, IL 60616
(313) 567-3535

Indiana

Environmental Management and Education
Program
Young Graduate House, Room 120
Purdue University
West Lafayette, IN 47907
(317) 494-5036

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

Iowa

Center for Industrial Research and Service
205 Engineering Annex
Iowa State University
Ames, IA 50011
(515) 294-3420

Iowa Department of Natural Resources
Air Quality and Solid Waste Protection Bureau
Wallace State Office Building
900 East Grand Avenue
Des Moines, IA 50319-0034
(515) 281-8690

Kansas

Bureau of Waste Management
Department of Health and Environment
Forbesfield, Building 730
Topeka, KS 66620
(913) 269-1607

Kentucky

Division of Waste Management
Natural Resources and Environmental
Protection Cabinet
18 Reilly Road
Frankfort, KY 40601
(502) 564-6716

Louisiana

Department of Environmental Quality
Office of Solid and Hazardous Waste
P.O. Box 44307
Baton Rouge, LA 70804
(504) 342-1354

Maryland

Maryland Hazardous Waste Facilities Siting Board
60 West Street, Suite 200 A
Annapolis, MD 21401
(301) 974-3432

Maryland Environmental Service
2020 Industrial Drive
Annapolis, MD 21401
(301) 269-3291
(800) 492-9188 (in Maryland)

Massachusetts

Office of Technical Assistance
Executive Office of Environmental Affairs
100 Cambridge Street, Room 1094
Boston, MA 02202
(617) 727-3260

Source Reduction Program
Massachusetts Department of Environmental Protection
1 Winter Street
Boston, MA 02108
(617) 292-5982

Michigan

Resource Recovery Section
Department of Natural Resources
P.O. Box 30028
Lansing, MI 48909
(517) 373-0540

Minnesota

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

Minnesota Technical Assistance Program
1313 5th Street S.E., Suite 207
Minneapolis, MN 55414
(612) 627-4555
(800) 247-0015 (in Minnesota)

Missouri

State Environmental Improvement and Energy Resources Agency
P.O. Box 744
Jefferson City, MO 65102
(314) 751-4919

New Hampshire

New Hampshire Department of Environmental Sciences
Waste Management Division
6 Hazen Drive
Concord, NH 03301-6509
(603) 271-2901

New Jersey

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

Hazardous Waste Advisement Program
Bureau of Regulation and Classification
New Jersey Department of Environmental Protection
401 East State Street
Trenton, NJ 08625
(609) 292-8341

Risk Reduction Unit
Office of Science and Research
New Jersey Department of Environmental Protection
401 East State Street
Trenton, NJ 08625
(518) 457-3273

New York

New York State Environmental Facilities Corporation
50 Wolf Road
Albany, NY 12205
(518) 457-3273

Appendix F - Resources

North Carolina

Pollution Prevention Pays Program
Department of Natural Resources and
Community Development
P.O. Box 27687
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-7015

Southeast Waste Exchange
Maxie May
University of North Carolina, Charlotte Urban
Institute
Charlotte, NC 28223
(704) 547-2307

Governor's Waste Management Board
325 North Salisbury Street
Raleigh, NC 27611
(919) 733-9020

Technical Assistance Unit
Solid and Hazardous Waste Management
Branch
North Carolina Department of Human
Resources
P.O. Box 2091
306 North Wilmington Street
Raleigh, NC 27602
(919) 733-2178

University of North Carolina, Asheville
Environmental Quality Institute
One University Heights
Asheville, NC 28804-3299
(704) 241-6104

Center for environmental issues.

Ohio

Division of Solid and Hazardous Waste
Management
Ohio Environmental Protection Agency
P.O. Box 1049
1800 WaterMark Drive
Columbus, OH 43266-1049
(614) 481-7200

EPA Office of Research and Development:
Center for Environmental Research Information
(CERI)
CERI/Publications Office
26 Martin Luther King Dr.
Cincinnati, OH 45268
(513) 569-7562

Ohio Technology Transfer Organization
Suite 200
65 East State Street
Columbus, OH 63266-0330
(614) 466-4286

Oklahoma

Industrial Waste Elimination Program
Oklahoma State Department of Health
P.O. Box 53551
Oklahoma City, OK 73152
(405) 271-7353

Oregon

Oregon Hazardous Waste Reduction Program
Department of Environmental Quality
811 Southwest Sixth Avenue
Portland, OR 97204
(503) 229-5913

Pennsylvania

Pennsylvania Technical Assistance Program
501 F. Orvis Keller Building
University Park, PA 16802
(814) 865-0427

Center for Hazardous Materials Research
Center
University of Pittsburgh Applied Research
Center
320 William Pitt Way
Pittsburgh, PA 15238
(412) 826-5320

The University of Pittsburgh's research
center on hazardous waste issues seeks to
develop practical solutions to the problems
associated with hazardous waste
management.

Bureau of Waste Management
Pennsylvania Department of Environmental
Resources
P.O. Box 2063
Fulton Building
3rd and Locust Streets
Harrisburg, PA 17120
(717) 787-6239

Rhode Island
Office of Environmental Coordination
Department of Environmental Management
83 Park Street
Providence, RI 02903
(401) 277-3434
(800) 253-2674 (in Rhode Island only)

Ocean State Cleanup and Recycling Program
Rhode Island Department of Environmental
Management
9 Hayes Street
Providence, RI 02908-5003
(401) 277-3434
(800) 253-2674 (in Rhode Island)

Center for Environmental Studies
Brown University
P.O. Box 1943
135 Angell Street
Providence, RI 02912
(401) 863-3449

Tennessee
Center for Industrial Services
102 Alumni Hall
University of Tennessee
Knoxville, TN 37996
(615) 974-2456

Virginia
Office of Policy and Planning
Virginia Department of Waste Management
11th Floor, Monroe Building
101 North 14th Street
Richmond, VA 23219
(804) 225-2667

Washington
Hazardous Waste Section
Mail Stop PV-11
Washington Department of Ecology
Olympia, WA 98504-8711
(206) 459-6322

Wisconsin
Bureau of Solid Waste Management
Wisconsin Department of Natural Resources
P.O. Box 7921
101 South Webster Street
Madison, WI 53707
(608) 267-3763

Wyoming
Solid Waste Management Program
Wyoming Department of Environmental Quality
Herchler Building, 4th Floor, West Wing
122 West 25th Street
Cheyenne, WY 82002

U.S. EPA Regional Offices

Region 1 (VT, NH, ME, MA, CT, RI)
John F. Kennedy Federal Building
Boston, MA 02203
(617) 565-3234

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

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

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

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

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

Region 7 (NE, KS, MO, IA)
756 Minnesota Avenue
Kansas City, KS 66101
(913) 236-2800

Appendix F - Resources

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

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

Region 10 (AK, WA, OR, ID)
1200 Sixth Avenue
Seattle, WA 98101
(206) 442-5810

Industrial & Trade Associations

**National Association of Photographic
Manufacturers, Inc.**
550 Mamaroneck Avenue
Harrison, NY 10528
(914) 698-7603

Miscellaneous

EPA Main Number for Washington, DC, Office
(202) 260-2090

EPA Inspector General's Whistle Blower
(800) 424-4000

EPA Pollution Prevention Clearinghouse
(202) 260-1023

**EPA Control Technology Center Hotline -
Air Toxics**
(919) 541-0800

EPA Pollution Prevention Office
(202) 260-3557

EPA Public Information Center
(202) 260-2080

EPA Waste Minimization Office
(703) 308-8402

**Hazardous Materials Newsletter Information
Line**
(802) 479-2307

For response teams (public or industrial)
requiring information on tools, materials,
emergency planning, etc.

Hazardous Materials Technical Center (HMTc)
800-638-8958

A varied informational service dealing with
hazardous material issues. This DoD-
sponsored service is free to DoD activities
and is available to others on a fee basis.

**National Institute for Occupational Safety and
Health**
800-356-4674

National Response Center Hotline
800-424-8802

Emergency number to report accidental
chemical spills under CERCLA/Title III
legislation.

U.S. Department of Transportation Hotline
(202) 475-8321

Contact to receive assistance on federal
hazardous substance transportation
regulations.

Outside the Continental United States

Guam

**Solid and Hazardous Waste Management
Program**
Guam Environmental Protection Agency
ITCE E. Harmon Plaza, Complex Unit D-107
130 Rojas Street
Harmon, Guam 96911
(671) 646-8863

Publications Offered by Kodak

For questions and support, contact a Kodak Customer Service Representative at 800-242-2424. Kodak will provide the name and phone number of a local Kodak representative.

Kodak publishes a variety of publications related to waste minimization for photographic processes. For a complete list, see KODAK Publication L-1, *KODAK Index to Photographic Information*. To obtain a copy of L-1, send a request with \$1 to Eastman Kodak Company, Dept. 412-L, Rochester, New York 14650-0532.

J-2A Health, Safety, and Environmental Emergency Card

Contains the phone number of Kodak's emergency hotline to answer questions about health, safety, and environmental problems from photographic chemicals.

J-4 Safe Handling of Photographic Chemicals

Describes how to handle, store, and use photographic chemicals safely. Briefly discusses OSHA guidelines, Materials Safety Data Sheets, protective clothing and equipment, and what to do in cases of an emergency.

J-9 Silver Recovery with the KODAK Chemical Recovery, Cartridge, Model II

Describes KODAK Chemical Recovery Cartridges and lists recommended operating conditions.

J-10 Recovering Silver from Photographic Materials

Discusses various methods of recovering silver from waste sensitized products and used processing solutions.

J-10A Potential Silver Yield from KODAK Photographic Products

Lists amounts of potentially recoverable silver from various Kodak film and paper products. Includes figures for silver recovered from processing solutions and from scrap film.

J-20 Disposing of Minilab Effluent

Describes how to dispose of processing solutions used in a minilab to meet local effluent regulations.

J-21 CHOICES—Choosing the Right Silver Recovery Method for Your Needs

Describes current silver-recovery methods and gives guidelines for choosing a method.

J-35 CHOICES—Choosing the Right Chemicals for Photofinishing Labs

Gives methods for reducing effluent discharge by using developer regeneration, bleach-fix regeneration, and separate bleach and fixer for Process RA-4, and developer, bleach, and fixer regeneration with Process C-41.

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J-36 *CHOICES—Choosing the Right Chemicals for Minilabs*

Describes the various process options available for using KODAK EKTACOLOR RA and FLEXICOLOR Chemicals in minilabs.

J-52 *Disposal of Small Volumes of Photographic Processing Solutions*

Defines the small user and describes simple treatment and disposal methods for used processing solutions to meet local effluent regulations.

J-53 *The Use of Water in Photographic Processing*

Discusses the theory of photographic washing and describes how to improve washing efficiency and use water-conservation techniques.

Benchmarking Resources

Altany, David. Copycats, article in INDUSTRY WEEK, November 5, 1990.

International Benchmarking Clearinghouse, American Productivity and Quality Center,
123 North Post Oak Lane,
Houston, TX 77024-7797
(713)685-4666

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Oak Ridge TN 37831-8180	1	John Marchetti
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Germantown, C-407
US DOE
Washington DC 20505-0002
1	Bob Hill
MMES - Y-12 Plant
Bldg. 9704-2, MS 8010
Oak Ridge TN 37831		

6	Robert Meibbaum
EG&G/EM
Photo/Video Dept.
P.O. Box 1912
Las Vegas NV 89125	2	Becky Redeker
Bonneville Power Admin.
P.O. Box 3621 -AJ
Portland OR 97208
3	Michael Meltzer
LLNL LC-26
P.O. Box 808
Livermore CA 94550	2	Bill Reed
Eastman Kodak Company
Commercial and Government Systems
Rochester NY 14653-7128
3	Susan Michaud
ORNL/MMES
P.O. Box 2008
Oak Ridge TN 37831-6395	3	Pat Sallani
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Carlsbad NM 88221
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Allied Signal Inc. KC
D/922, SC-8
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2	Hilary Noskin
LANL
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Largo FL 34643
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BCS Richland, Inc.
Photography & Audiovisual Services
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Richland WA 99352-3562	3	James Scott
Princeton Univ. Plasma Physics Lab
Forrestal Campus, Receiving 3
US Rt. 1 North
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Georgia Institute of Technology
School of Civil Engineering
Atlanta GA 30332-0355	1	Pyrtle Seabaugh
EG&G - Mound Plant
Mound Applied Technologies
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Pinellas Plant
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EH-231
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