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Pollution Prevention Opportunity Assessment for Network Operations' Digital Photo Imagers

N. M. Phillips

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POLLUTION PREVENTION OPPORTUNITY ASSESSMENT FOR NETWORK OPERATIONS' DIGITAL PHOTO IMAGERS

Norman M. Phillips
Sandia National Laboratories/California

MASTER

ABSTRACT

This Pollution Prevention Opportunity Assessment (PPOA) was conducted to evaluate the operations of the digital photo imagers, which are located in Building 912, Room 097B and are used by Section 8910-1, Network Operations (in Department 8910, Infrastructure and Networking Research). This PPOA documents the processes, identifies the hazardous chemical waste streams generated by these processes, recommends possible ways to minimize waste, and serves as a reference for future assessments of the digital photo imaging process.

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Introduction

Department of Energy (DOE) orders 5400.1 and 5400.3 mandate the development of a waste minimization program.^{1,2} The program's goals are to:

- reduce volumes of hazardous wastes and toxicity,
- implement a system of tracking and reporting improvements, and
- devise a method for performing tasks.

To satisfy the requirements of this program, Sandia conducts PPOAs to identify waste-generating processes. The information collected from a PPOA then is used to identify waste minimization opportunities.

This PPOA was conducted on Network Operations' digital photo imagers (DPIs), according to the new *Pollution Prevention Opportunity Assessment Plan* for SNL/California.³ The primary purpose of this PPOA is to document the DPI process, identify the waste streams, and serve as a reference for future assessments.

Summary

Network Operations (8910-1) is part of the Infrastructure and Networking Research Department (8910). Among other duties, the Network Operations team operates two Ilford DPIs, which are located in Building 912, Room 097B. Using these DPIs, Network Operations staff produce slides, prints, and transparencies directly from computer files, which are provided by various site organizations.

The two DPI processors generate most of the hazardous waste (spent developer, bleach, and fixer). These waste photographic chemicals come from depleted processing baths and the overflow generated by the automatic bath adjustment system. When a bath can no longer be adjusted automatically (as determined using photo test strips), it is removed from the processor and replaced with a new bath. The volume of waste generated by this process (approximately four drums per year of photographic chemicals) is low compared to other photo processing labs.

The Infrastructure and Networking Research Department's mission is changing rapidly to support the "information superhighway." As a result, DPI operation is no longer considered an appropriate part of the department's mission. Also, demand for the service has diminished significantly. Therefore, the department is evaluating whether to shut down the DPIs or transfer them to another organization.⁴ Shutting them down would eliminate the waste stream generated and would save the costs of chemicals and of hazardous waste disposal (a total of approximately \$25,000 per year).

The Network Operations staff is evaluating sending the DPI system to reclamation as soon as January 1995. In terms of waste minimization, no significant benefit would be realized by transferring the DPIs to another Sandia organization unless they could be used to replace an existing process that generates hazardous wastes.

Pollution Prevention Opportunity Assessment

Facility

Network Operations' DPIs are located in Building 912, Room 097B (see Fig. 1). The hazardous waste storage and pickup area is located along one wall in Room 097A.

Products

Slides, prints, and transparencies are produced directly from computer files.

Background

Network Operations is part of the Infrastructure and Networking Research Department (8910). However, the mission of the department is changing rapidly to support the "information superhighway." As a result, DPI operation is no longer considered an appropriate

Figure 1. Layout of the Digital Photo Imager Area, Bldg. 912/Rooms 097A&B.

part of the department's mission. Also, demand for the service has diminished significantly. Therefore, the department is evaluating whether to shut down the DPIs or transfer them to another organization.⁴ If the DPIs are transferred, this PPOA can be used to compare the waste generated by the process the DPIs are replacing (if there is one) to that of the new process (digital photo imaging). On the other hand, if the DPIs are no longer considered viable and are shut down, the waste stream would be eliminated.

The processing equipment comprises two Ilford DPI processors, which produce continuous-tone photographic images from desktop computer applications, with a range of more than 16.5 million colors. The system can generate 8.5 x 11-inch prints, transparencies, and 35-mm slides.

Process Description

Figure 2 is a general process flow diagram for the DPI. The following sections describe how a computer file is used in a DPI to generate output (prints, overheads, slides).

Figure 2. Process Flow Diagram for the Digital Photo Imagers.

Image Writing

A computer file is sent to the DPI. An infrared laser diode writes the digital information onto three liquid-crystal light valve cells. Each cell holds one of the image's red, green, and blue color components.

Image Exposure

The image is exposed through each of the three color cells onto film or paper through a series of individual exposures.

Chemical Processing

Rollers guide the exposed photographic medium through the five processor tanks, each filled with liquid: developer, bleach, fixer, and two water baths. The rollers continue to carry it through a dryer and into the output tray.⁵

Figure 3 shows the layout of one of the DPI processors, which is self-contained. Figure 4 shows the process flow. The processing solutions come in packs of two, 7.5-liter bottles. One bottle is used to fill the processing tank and then to collect the used solution overflow. The second bottle is used for automatic replenishment. When the replenishment bottles are almost empty and the waste bottles are almost full, a warning light indicates that they need

Figure 3. Layout of the Digital Photo Imager Processor.⁵

Figure 4. Process Flow Diagram for a Digital Photo Imager Processor.

to be replaced. According to the user's manual, if the unit processes approximately 30 copies daily, the solutions should remain stable for about three months before they must be replaced.⁵

Waste Stream Profiles

The two processors use all of the hazardous chemicals in the DPI process. Figure 4 shows the process flow, and Table 1 shows the working bath chemistry for the processors.

Waste Generation

The DPIs generate a relatively low volume of hazardous waste annually (approximately four drums): depleted fixer, bleach, developer baths, and overflow chemicals generated by the automatic adjustment of the baths. Most of this waste comes from the processors.

To determine if the automatic adjustments are keeping the baths up to the proper concentrations, Network Operations staff use photo test strips to check the solutions before beginning the process. If the baths are no longer adjustable to the proper concentration, they are replaced with fresh chemicals.

Table 2 and Fig. 5 summarize the amount of chemical wastes generated by the DPI in 1993 and from January to September 1994.

Table 1. Digital Photo Imager Working Bath Chemistry

Type of Bath and I.D.	Chemical Composition of Working Bath ⁶	Weight %	Volume of Bath (L)	pH
1. Ilford P-4 Developer	water ethoxydiglycol potassium sulfite hydroquinone potassium metaborate boric acid	83-88 2-5 1-4 1-3 1-3 <1	7.5	9.5
2. Ilford P-4 Bleach	water sulfuric acid potassium iodide	90-95 2-5 1-3	7.5	<1
3. Ilford P-4 Fixer	water ammonium thiosulfate ethoxydiglycol ammonium bisulfate EDTA Na4	50-60 10-30 5-10 1-5 0.1-1	7.5	6.9
4. Wash bath	water	100	7.5	—
5. Wash bath	water	100	7.5	—

Table 2. Hazardous Waste Generation Summary (1993 – 1994)^{7,8}

Waste Stream ID	Waste generated (kg) In 1993	Waste generated (kg) 1/94 – 9/94	Disposal Cost (does not include administrative costs)	Transportation Cost
Fixer	255	287	\$200/drum*	None
Bleach	263	269	\$180/drum	\$87/drum
Developer	240	237	\$180/drum	\$48/drum
Empty Containers	28	41	\$175/drum	\$25/drum
Batteries	8.5	11.5	\$3.75/kg	Included in the cost of disposal
Toner	3.1	2.7	\$175/drum	\$25/drum
Aerosol	0.8	0.2	\$400/drum	None
Filters	0	5	\$175/drum	\$25/drum
Film/Silver	0	0.6	None	None
Total	798.4	854.0	Approx. \$965 (1/94 – 9/94)	

*Each drum holds ~210 kg (55 gallons).

Figure 5. Waste Generation Summary Chart (1993 – 1994).

Environmental Protection Department personnel commingle the spent fixer from the DPI with the spent fixer from the Photo Lab. These fixers contain silver, which is reclaimed by an outside contractor, thereby reducing the cost of disposal. On-site silver reclamation has been evaluated, but because of the small amount of silver to be reclaimed, it is not considered cost effective. The spent bleach, developer, and other wastes are sent off-site for disposal as hazardous waste.

Material Balance

Figure 6 is a material balance for the DPI process. The data used for the material balance is based on one processor and is calculated from the annual waste generation of both of the processors. The estimated values are based on process knowledge and on experience with similar processes.

Figure 6. Digital Photo Imager Material Balance.

Waste Minimization Recommendations

Based on the results of this PPOA, the DPI operation generates a relatively low volume of photographic chemical waste annually. However, implementation of the following recommendations will further minimize the waste generated:

- Evaluate the possibility of shutting down the processors, which would eliminate the waste stream (this is being done now). If the processors are not needed, shutting them down would be the best recommendation. Organizations that use this service may find that a similar service, such as that provided by the Digitizing Support Lab, would meet their requirements.
- Evaluate the possibility of reclaiming the equipment through another Sandia organization (this option is being considered for possible implementation in January 1995).
- Investigate alternatives to internal reclamation, such as reclamation by another DOE facility, or recycling/refurbishment by the manufacturer.

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