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Pollution Prevention Research Within the Federal Community

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POLLUTION PREVENTION RESEARCH WITHIN THE FEDERAL COMMUNITY

by

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FOREWORD

Today's rapidly developing and changing technologies and industrial products and practices frequently carry with them the increased generation of materials that, if improperly dealt with, can threaten both public health and the environment. The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. These laws direct EPA to perform research to define our environmental problems, measure the impacts, and search for solutions.

The Risk Reduction Engineering Laboratory is responsible for planning, implementing, and managing research, development and demonstration programs to provide an authoritative, defensible engineering basis in support of the policies, programs, and regulations of the EPA with respect to drinking water, wastewater, pesticides, toxic substances, solid and hazardous wastes, and Superfund-related activities. This publication is one of the products of that research and provides a vital communication link between the researcher and user community.

This report, *Pollution Prevention Research Within the Federal Community*, funded through the Pollution Prevention Research Branch, is a major project in the area of Pollution Prevention Within the Federal Community Program to support and promote pollution prevention in other Federal agencies through cooperative research, training, and demonstration projects.

This report is the first concise collection of summaries of pollution prevention demonstrations, assessments, and research projects conducted y the Pollution Prevention Research Branch at and for other Federal Agencies. Many of the projects described here were conducted under the Waste Reduction Evaluations At Federal Sites (WREAFS) program, funded in whole or in part by EPA. Most of the projects conducted for the Department of Defense and Department of Energy were funded under the Strategic Environmental Research and Development Program (SERDP). Still other projects were funded in whole or in part by the cooperating Federal agency.

The information contained here will serve as a reference work and technology transfer to disseminate research results and promote the implementation of pollution prevention activities at Federal facilities, as well as in other public agencies and the private sector.

ABSTRACT

One of the primary ongoing programs for promotion and encouragement of pollution prevention research is a cooperative program between the U.S. Environmental Protection Agency (EPA) and the Federal community at large. EPA's Waste Reduction Evaluations At Federal Sites (WREAFS) Program supports pollution prevention research through joint assessments at selected Federal sites. The three primary objectives of the WREAFS Program are to: 1) conduct pollution prevention opportunity assessments (PPOAs) and case studies; 2) conduct research and demonstration projects jointly with other Federal activities; and 3) provide technology and information transfer of pollution prevention (P2) results.

This report describes the WREAFS Program support of pollution prevention research throughout the Federal community and provides an assessment of the status of implementation on all projects which have been completed to date. These include joint efforts with the U.S. Departments of Defense, Transportation, Energy, Veterans Affairs, Interior, Agriculture, and Treasury[1], the National Aeronautics and Space Administration (NASA), the EPA, the U.S. Postal Service, and the White House. There is also an ongoing interagency project, the Tidewater Interagency Pollution Prevention Program (TIPPP), involving the Department of Defense and NASA. Additionally, several projects are underway with the Department of Defense, Department of Energy, Department of Transportation, U.S. Postal Service, and EPA Office of Federal Enforcement.

These projects identify case study and research opportunities to implement pollution prevention for a range of military and industrial operations including metal cleaning, solvent degreasing, spray painting, vehicle and battery repair, ship bilge cleaning, torpedo overhaul, buoy restoration, lens grinding, hospital operations, laboratory analysis, mail processing, and other processes.

This report was submitted in partial fulfillment of contract number 68-D2-0181 under the sponsorship of the U.S. Environmental Protection Agency. The report covers a period from January 1, 1990 to September 30, 1994 and work was completed as of September 30, 1994.

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[1]A description of the Department of Treasury project is not included in this report.

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LIST OF ACRONYMS

ADC	Alaska Department of Conservation
AFB	Air Force Base
AFESC	Air Force Engineering Service Center
ALC	Air Logistics Center
AOAC	Association of Official Analytical Chemists
APOE	Aerial Port of Embarkation
ASD	Aeronautical Systems Division
ATON	aids to navigation
BARC	Beltsville Agricultural Research Center
BMPs	Best Management Practices
CARC	Chemical Agent Resistant Coating
CCU	Cardiac Care Unit
CFC	chlorofluorocarbon
CFC-113	trichlorotrifluoroethane
COMNAVBASE	Commander, Naval Base
CRADA	cooperative research and development agreement
DCRA	Department of Consumer and Regulatory Affairs
DEG	diethylene glycol
DOD	Department of Defense
DOE	Department of Energy
DRMO	Defense Reutilization and Marketing Office
ECH	Evans Community Hospital
EM	electromechanical metallizing
EPA	Environmental Protection Agency
F2P2	Federal Facilities Pollution Prevention
FAMC	Fitzsimmons Army Medical Center
FFEO	Federal Facilities Enforcement Office
FMECI	Federal Facilities Multi-Media Enforcement/Compliance Initiative
FORSCOM	Forces Command
FY	fiscal year
GL	Geochemical Laboratory
GMF	General Mail Facility
HDPE	high density polyethylene
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HPLC	high performance liquid chromatography
HVAC	heating, ventilating, and air conditioning
HVLP	high volume/low pressure
IAG	interagency agreement
IV	intravenous
KAFB	Kirkland Air Force Base
LAFB	Langley Air Force Base

LIST OF ACRONYMS (continued)

LaRC	Langley Research Center
LARPS	Large Aircraft Robotic Paint Stripper
LCA	life cycle assessment
LCA RD&D	Life Cycle Assessment Research and Development
LCCA	life cycle cost assessment
LHE	Low Hydrogen Embrittlement
LMSC	Lockheed Missile and Space Company
MEK	methyl ethyl ketone
MFRL	Manufacturing and Fabrication Repair Laboratory
MICU	Medical Intensive Care Unit
NASA	National Aeronautics and Space Administration
NAVSTA	Naval Station
NADEP	Naval Aviation Depot
NAWC	Naval Air Warfare Center
NDI	nondestructive inspection
NMP	N-methyl-2-pyrrolidone
NTF	National Transonic Facility
NOSTRA	Naval Ophthalmic Support and Training Activity
NUWC KPT DIV	Naval Undersea Warfare Center, Keyport Division
OC-ALC	Oklahoma City Air Logistics Center
OCC	old corrugated cardboard
ODC	Ozone Depleting Compounds
ODS	Ozone Depleting Substances
OEOB	Old Executive Office Building
OFL	Optical Fabrication Laboratory
OLA	Optical Laboratories Association
ORD	Office of Research and Development
P2	pollution prevention
PMB	plastic media blasting
PNSY	Philadelphia Naval Shipyard
PPOA	pollution prevention opportunity assessment
QA/QC	quality assurance/quality control
R&D	research and development
RCRA	Resource Conservation and Recovery Act
RREL	Risk Reduction Engineering Laboratory
RRRP	Resource Recovery and Recycling Program
SEM	scanning electron microscope
SEPS	Supplemental Environmental Projects
SERDP	Strategic Environmental Research and Development Program
SFE	supercritical fluid extraction
SICU	Surgical Intensive Care Unit
SIMA	Shore Intermediate Maintenance Activity
SNL	Sandia National Laboratories
SOW	statement of work
SPE	solid phase extraction

LIST OF ACRONYMS (continued)

SALTS	Streamlined Alternative Logistics Transmission System
TCA	1,1,1-trichloroethane
TCE	trichloroethylene
TEA	triethanolamine
TIPPP	Tidewater Interagency Pollution Prevention Program
TKN	total Kjeldahl nitrogen
TRADOC	Training and Doctrine Command
TSDF	treatment, storage, and disposal facility
UBBM	undeliverable bulk business mail
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USPS	U.S Postal Service
UV	ultraviolet
VMF	Vehicle Maintenance Facility
VOC	volatile organic compound(s)
WREAFS	Waste Reduction Evaluations at Federal Sites

SECTION 1

BACKGROUND

1.1 INTRODUCTION

The objectives of the Waste Reduction Evaluations At Federal Sites (WREAFS) Program are to identify new technologies and techniques for reducing wastes from industrial and other processes performed by Federal agencies and to enhance the adoption of pollution prevention through technology transfer. New techniques and technologies for reducing waste generation are identified through Pollution Prevention Opportunity Assessments (PPOAs) and are evaluated through joint research, development, and demonstration (RD&D) projects. The information and data from these projects are then provided to both the public and private sectors through various technology transfer mechanisms, including project reports, project summaries, conference presentations, and workshops.

As a result of joint PPOAs, RD&D projects are identified with recommendations for pollution prevention under the implementation phase. The demonstration projects are often conducted under interagency agreements with joint funding by EPA and the cooperating Federal agency. Pollution prevention workshops and other technology transfer methods are used to communicate the results of these projects to the Federal community, other public agencies, and the private sector.

1.2 WREAFS PROGRAM PROCEDURES

The PPOAs are conducted by an assessment team that is composed of personnel from EPA, the Federal facility cooperating in the program, and others who can provide technology and processing expertise. The assessments follow the procedures described in the EPA Report, *Facility Pollution Prevention Guide* (EPA/600/R-92/088) (1). (Single copies are available at no charge from the U.S. EPA CERI Publications Unit, 26 West Martin Luther King Drive, Cincinnati, Ohio 45268.) This guide provides a systematic procedure for identifying ways to reduce or eliminate waste generation. The development of this procedure was supported by the Risk Reduction Engineering Laboratory (RREL), U.S. Environmental Protection Agency, Cincinnati, Ohio.

Figure 1 illustrates the major steps in the pollution prevention program. The steps consist of four major phases: (1) Planning and Organization, which includes organization and goal setting; (2) Assessment, which includes a careful review of a facility's operations and waste streams and the identification and screening of potential options to reduce waste; (3) Feasibility Analysis, including an evaluation of the technical and economic feasibility of the options selected and subsequent ranking of options; and (4) Implementation, which involves procurement, installation, implementation, and evaluation. WREAFS projects typically focus on steps (2) and (3).

Many of the pollution prevention opportunities identified during WREAFS projects involve low-cost changes to equipment and procedures that can often be implemented by the facility without extensive engineering evaluations. Other pollution prevention opportunities identified during these projects will require further study before full implementation can be realized. Typically, opportunities requiring further evaluation are those that have the potential to affect the process and/or require the

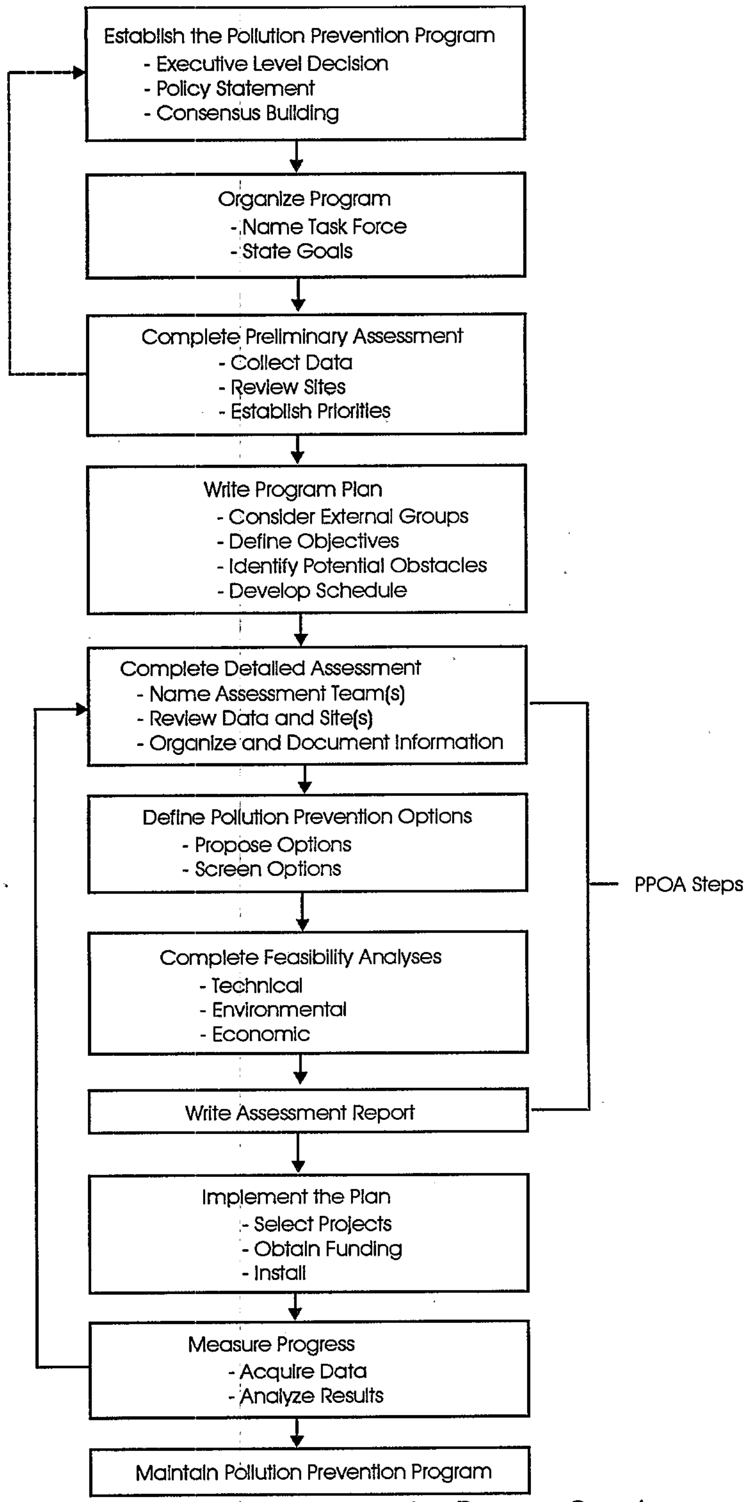

Figure 1. Pollution Prevention Program Overview.

use of new procedures or equipment. In such cases, it may be necessary to conduct demonstration projects.

Depending on the nature and state of development of the pollution prevention option selected for demonstration and evaluation, these projects may include: (1) process design, (2) detailed design and specification, (3) system procurement, (4) installation and start-up, (5) monitoring, and (6) reporting. Some projects may require bench-scale and/or pilot testing prior to, or as a part of, the demonstration project. Other projects may utilize full-scale equipment directly on the production line.

1.3 COMPLETED POLLUTION PREVENTION PROJECTS

As of September 1994, eighteen WREAFS projects have been completed, eight at Department of Defense (DOD) facilities, including two with the Navy, three with the Air Force and three with the Army; one with the Department of Veteran's Affairs; two with the Department of Transportation; one with the Department of Energy (DOE); one with the Department of Agriculture; one with the Department of Interior; one with the U.S. Postal Service (USPS); one with the White House Complex; one with the Department of Treasury; and an interagency effort involving the EPA, Air Force, Army, Navy, and NASA. With these eighteen, the project has been completed and pollution prevention options have been identified for implementation. The degree to which the pollution prevention options have been implemented is highly variable. A description of each project follows, including a summary of the pollution prevention options recommended and a report on the status of implementation.

NOTE: Although the following projects are described in the present tense, descriptions of facilities, activities, processes, and pollution prevention options reflect the situation at the time the PPOA was conducted. The status of implementation section, however, represents information that was current as of September 1994.

SECTION 2

DEPARTMENT OF DEFENSE
PHILADELPHIA NAVAL SHIPYARD

The PPOA for this facility was completed in 1991. At that time, the shipyard had an ongoing program for pollution prevention. Several industrial operations were selected for application of the EPA pollution prevention procedures. The shipyard has used these results as guidance for evaluating other pollution prevention activities at the facility.

2.1 FACILITY DESCRIPTION

The Philadelphia Naval Shipyard (PNSY), the nation's oldest continuously operating naval shipyard, is located in South Philadelphia on 1,000 acres of land. Since its inception, 127 ships have been constructed with the last ship launched in 1971. The PNSY now specializes in revitalizing and repairing ships already in fleet. The Service Life Extension Program is the shipyard's largest program and its comprehensive keel-up restoration and modernization overhaul extend the life of an aircraft carrier to 150 percent, at approximately one-third of the cost of a new carrier.

2.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The industrial activities selected for this project included: aluminum cleaning and spray painting; spray painting of steel parts including structural columns; and citric acid bilge derusting operations in drydock.

2.2.1 Aluminum Cleaning and Spray Painting

The aluminum cleaning is performed to remove oil and other materials from the surfaces of aluminum sheets prior to tungsten inert gas welding. The cleaning line consists of two process and two rinse tanks. Aluminum sheets are placed in a metal basket which is lowered into a process tank for five minutes, followed by a tap-water rinse in one of the rinse tanks. Process tanks become contaminated with floating oil, suspended solids, and tapwater which is used to replenish the solution due to dragout losses. The tanks are pumped after approximately three months of operation; spent solution is disposed of by contract. Rinsate tanks are disposed of in a similar manner, usually every two weeks.

Spray painting involves solvent degreasing and a water curtain booth for painting. Prior to painting, the parts are degreased with rags dipped in xylene. Parts are sprayed with a zinc chromate primer, followed by a final enamel paint coating. Spraying is conducted in a water curtain booth. Paint solids from overspray and sludge residues are removed and drummed. An organic polymer added to the booth water aids in precipitation of the paint overspray and helps reduce clogging of the booth's water recycle spray nozzles and piping system. A second polymer is added after approximately two weeks which coagulates the dispersed paint into a floating sludge which can be removed by screening and then drummed for disposal. Booth water is recycled for approximately six months and then discharged into the sewer.

2.2.2 Spray Painting of Steel Parts Including Structural Columns

Three booths are used for spray epoxy painting of steel surfaces: (1) a large, shot blasting/painting booth with a dry air filtration system; (2) a shape abrader/spray booth for blasting and painting steel columns; and (3) a water curtain booth. The water curtain booth consists of two 18-foot-long water curtains and uses a booth water deflocculant for water maintenance.

2.2.3 Citric Acid Bilge Derusting Operations in Drydock

PNSY employs a relatively new citric acid/chemical process for cleaning ships' tanks, bilges, and void spaces, which replaces the more traditional mechanical methods of cleaning and derusting metal surfaces. A citric acid/triethanolamine (TEA) solution is used to remove oxides from the metal surfaces, and the surfaces are subsequently neutralized and rinsed with dilute solutions.

Grease and oil are removed from the metal surfaces with a degreaser, which is applied using a hand-held garden-type sprayer. This solution is then washed down with a high-pressure water spray. Existing paint is then stripped, followed by a second rinse. Rust is subsequently removed with a hydroblast of hot, concentrated citric acid/TEA solution (ten percent citric acid, seven percent TEA). Solution runoff is collected and recycled, and is ultimately pumped to a waste container for disposal. Following derusting, a hot neutralizer (less than one percent citric acid, four percent TEA) is sprayed onto the metal surface. A one percent TEA solution is sprayed onto the surface for a final rinse. All run-off is pumped to a waste tank for disposal.

A typical derusting/neutralization/rinse operation generates approximately 3,000 gallons of spent solution, which generally has a pH less than 4.0 and contains toxic metals. The waste is removed by a contractor for treatment and disposal.

2.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

After the assessment and feasibility analysis phases were completed, seven options were evaluated and ranked. These options included: (1) dragout reduction and bath maintenance; (2) two-stage rinse; (3) booth guard system, consisting of a three-phase cycle (biannual cleaning, normal operation, and biweekly paint removal); (4) paint sludge dewatering; (5) high volume/low pressure (HVLP) painting; (6) awareness and training for personnel and procedure-related options; and (7) recovery of concentrated citric acid solution. Of these seven, three were assessed as feasible: (1) awareness and training for personnel and procedure-related options; (2) dragout reduction and bath maintenance; and (3) two-stage rinsing.

2.3.1 Awareness and Training for Personnel and Procedure-Related Options

Paint and paint wastes comprise the second largest hazardous waste stream generated at the shipyard. Painting is a process in which the technique and habits of the operator may have considerable influence on the amount of waste generated. A training program emphasizing operator involvement and responsibility could reduce waste paint resulting from overspray, unused paint remaining in cans, and paint solidification prior to use. This program would also help establish and encourage effective lines of communication between operators and supervisors.

2.3.2 Dragout Reduction and Bath Maintenance

With this option, the use of a hand-held spray rinse applied over process tanks would eliminate the use of the two rinse water tanks and would return 90 percent of the dragout to the process tank. As a result, contaminants would accumulate in the process tanks at a faster rate and might interfere with the cleaning process. A bath maintenance system employing an oil skimmer for floating oil and grease removal, and a cartridge filter for suspended solids removal, would extend the usable life of process tanks from three months to one year.

2.3.3 Two-Stage Rinsing

Employing a two-stage rinse operated with the tanks in series rather than in parallel would prolong the lives of the rinsing tanks. As one rinse tank becomes contaminated, the rinse water would be changed out. The tank containing the fresh water would always be used as the final rinse.

2.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Recovery of concentrated citric acid solution represents a viable candidate for further research, development and demonstration. This would involve the implementation of equipment for recovery of citric acid/TEA solution. This process would employ an electrodialytic membrane unit for separation and removal of dissolved metals. This technology has been applied to similar chemical solutions but its application to this waste has not been previously demonstrated.

2.5 STATUS OF IMPLEMENTATION

Due to downsizing of the military, the Shipyard is ceasing industrial activity in September 1995 and will fully close in September 1996. For this reason, the PNSY has not implemented any of the measures recommended in the PPOA.

SECTION 3

DEPARTMENT OF DEFENSE
NAVAL UNDERSEA WARFARE CENTER, KEYPORT DIVISION

Pollution prevention opportunities were identified in 1991 at two industrial units at the Naval Undersea Warfare Center, Keyport Division (NUWC KPT DIV) in Keyport, Washington. At that time, several departments were involved in an ongoing program to further the process of pollution prevention at NUWC KPT DIV.

3.1 FACILITY DESCRIPTION

NUWC KPT DIV is located within the central Puget Sound area of northwestern Washington State. The property was acquired by the Navy in 1913 and first used as a quiet water range for torpedo testing. Later, it was used for torpedo repair. The facility acquired its name in recognition of its mission in various undersea warfare weapons and systems engineering and development activities.

3.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The principal activities currently conducted at NUWC KPT DIV are the design and testing of torpedoes. These activities generate a variety of potentially hazardous wastes, including waste fuel, oil, hydraulic fluid and grease, various metal and plating bath liquids, paint and thinner, Freon®, alcohol, mineral spirits and other solvents, resins, acids and caustics, chromate and cyanide salts, pesticide residues, wastewater treatment sludge, waste dye, and detergent. The major component of waste management involves the use of Otto Fuel II (Otto fuel) which is used for propelling torpedoes. Otto fuel is composed of propylene glycol dinitrate with lesser amounts of 2-nitrodiphenylamine and di-n-butylsebacate. Otto fuel is a monopropellant (i.e., it burns without oxygen). All Otto fuel-contaminated solid waste is currently treated as an explosive, reactive waste.

Two torpedo maintenance shops, the Mark 48 torpedo shop and the Mark 46 torpedo shop, were selected by the Navy for evaluation. These two shops have similar operations, processes, and waste streams. In the Mark 48 shop, torpedoes are disassembled into large sections and sent to appropriate depots on base where they are further disassembled into components, updated, cleaned, repainted, reconstructed, and reassembled. The hydraulic fluid and fuel tanks are drained and refilled in the Mark 48 shop; fuel tanks and other major sections are then reassembled. The Mark 46 shop primarily houses defueling, disassembling, cleaning, reassembling, and refueling activities. Wastes generated at these sites include: Otto fuel combustion byproducts consisting of cyanide-containing liquid wastes and sludges; Otto fuel-contaminated solvents and oils generated during parts cleaning; Otto fuel-contaminated wastewaters; Otto fuel-contaminated solids, primarily clothing and rags; used oil; used hydraulic fluid; and diethylene glycol (DEG) and Otto-fuel contaminated rinse waters. All the waste streams are classified Resource Conservation and Recovery Act (RCRA) reactive wastes.

3.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

NUWC KPT DIV has performed well in the handling, storage and minimization of waste materials on-base. During this assessment, no major pollution prevention options were identified that NUWC KPT DIV has not already implemented or plans to implement. However, the following five options were identified to aid in the process: (1) volume reduction of Otto fuel-contaminated clothing; (2) automated cleaning of parts and fuel tanks; automated fuel tank draining; (3) modification of the deep sink draining schedule; and recycling of mineral spirits.

3.3.1 Volume Reduction of Otto Fuel-Contaminated Clothing

This option entails segregating used clothing and removing uncontaminated portions. Otto fuel has a distinctive yellow color that facilitates identifying contaminated clothing. Often, only small areas of clothing are contaminated. Two methods could be used to deal with contaminated clothing: (1) cut out contaminated sections of clothing and dispose of these sections as hazardous waste, leaving the remainder of the clothing waste stream nonhazardous; and (2) use disposable sleeves and leg cuffs, allowing the remaining uncontaminated clothing to be salvaged. These activities would require a minimal capital outlay; savings would be realized in reduced disposal costs.

3.3.2 Automated Cleaning of Parts and Fuel Tanks

Automated cleaning of parts and fuel tanks would result in more efficient and faster cleaning, smaller amounts of hazardous waste liquids, and smaller amounts of contaminated clothing. Three dip tanks in the Mark 46 shop are to be replaced with automatic parts washers using biodegradable cleaning liquids. More extensive or complete automation of cleaning operations within the two shops would aid in reducing wastes. This automation may include the use of an aqueous cleaning media in an agitator or jet system, or an ultrasonic cleaner. While this option would require capital outlay for the purchase of a cleaning unit, it would allow for reduced disposal of cleaning solutions and reduced raw materials purchased. Payback period for this option is 0.4 years and is one of the two fastest payback periods (total capital investment/net operating cost savings) represented by these recommendations.

3.3.3 Automated Fuel Tank Draining

Automated fuel tank disassembly by robotics has been in use at the Mark 46 shop since 1987, resulting in more efficient and faster operations and smaller amounts of waste liquids and contaminated clothing. During the automated operations, fueling and defueling are handled in a self-contained closed unit, eliminating the need for frequent cleaning or decontamination and decreasing the occurrence of spills. At the time of the assessment, future plans at the Mark 46 shop included the use of a robot for rinsing fuel tanks, which would eliminate the need for nine pounds of DEG per tank during cleaning. Similar equipment could be installed in the other shop and would have a relatively short payback period due to decreased costs of labor, contaminated clothing disposal, and spill cleanup.

3.3.4 Modification of the Deep Sink Draining Schedule

Converting from automatic weekly draining of the deep sinks to an "as needed" schedule would result in reduced cost due to a smaller purchasing volume of cleaning solvents, reduced volume of hazardous waste disposal and fewer manhours expended. This option also has a very fast payback period, requiring schedule modification only and no capital outlay.

3.3.5 <u>Recycling of Mineral Spirits</u>

Mineral spirits used for parts cleaning are currently treated as a RCRA hazardous waste, combined with other liquid waste streams, and sent to an off-site treatment, storage, and disposal facility (TSDF) for incineration. This option proposes batch recycling of the mineral spirits generated in the Mark 48 shop, which would divert this stream from the general liquid waste stream. Otto fuel present in the spent mineral spirits would be destroyed through a heating process. Hydrogen cyanide in the vent gas would be removed by a carbon adsorption unit, and the remaining liquid distilled to recover the mineral spirits. Up to 86 percent of the spent solvent could be recovered through this recycling process. This option has a short payback period, involving moderate to high capital outlay for equipment but providing savings through decreased disposal costs and purchase of mineral spirits.

3.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

The following five research needs were identified during the course of this assessment: (1) evaluate cost effectiveness of clothing with disposable sleeves and cuffs; (2) develop a test for determination of spent deep sink cleaning liquids; (3) evaluate the cost feasibility of using robotics for draining, defueling and rinsing torpedoes; (4) identify potential recycling options for waste hydraulic fluid; and (5) evaluate current practices for used torpedo engine oil.

3.5 STATUS OF IMPLEMENTATION

NUWC KPT DIV personnel have investigated two of the pollution prevention recommendations identified in the PPOA: (1) reduction of Otto fuel-contaminated clothing and (2) modification of the deep sink draining schedule for the Mark 48 and Mark 46 shops. NUWC KPT DIV concluded that the first recommendation was highly labor-intensive, as it called for physically cutting out contaminated sections of clothing; this recommendation was not implemented.

Rather than modify the deep sink draining schedules as recommended in the PPOA, a new cleaner was developed in conjunction with Exxon Corporation. This new product is an aliphatic hydrocarbon cleaner known as Actreo 1171L Navy Cleaner. The used cleaning solvent is sold as an off-spec chemical product, thereby reducing disposal costs. Additional savings have been achieved by the installation of filters which extend the life of the solvent. Currently, the tanks are emptied twice a month, but NUWC KPT DIV is working to reduce this activity to once a month, in order to reduce handling operations.

SECTION 4

DEPARTMENT OF DEFENSE
TINKER AIR FORCE BASE
OKLAHOMA CITY AIR LOGISTICS CENTER

The objective of this project was to identify and assess alternative processes that would enable the Oklahoma City Air Logistics Center (OC-ALC) to minimize pollutant generation while meeting overall mission objectives. This project, initiated in 1991, was funded jointly by EPA and the U.S. Air Force.

4.1 FACILITY DESCRIPTION

The OC-ALC, located at Tinker Air Force Base (AFB) near Oklahoma City, Oklahoma, is one of five logistic bases owned by the Air Force Material Command, the largest Air Force command in terms of funding and employment. The Center's physical plant, located on almost 5,000 acres, includes two runways, 200 acres of ramp space, 118 acres of indoor maintenance area and almost 80 acres of covered warehouse storage space. Daily operations are conducted in over 700 buildings, including an industrial maintenance facility which approaches one mile in length. The only inland Aerial Port of Embarkation (APOE) in the continental United States, the OC-ALC employs over 22,000 civilian and military persons, with 6,000 dedicated to depot-level repair, overhaul and modification of aircraft jet engines and weapon system components. The Center is host to several major defense missions, including the Navy's E-6A Strategic Communications Wing One.

The Center engages in a wide range of activities on a large scale. OC-ALC's plating facility, one of the largest in the world, has over 230 plating process tanks for plating metals, such a nickel, chrome, and silver. Each year over 300,000 aircraft and engine components are repaired for return to the field, and several more are produced from raw stock for use as spares. OC-ALC also offers complete scientific, engineering, and industrial process laboratory services for DOD and other government agencies.

4.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

Four major chemical waste generators were evaluated: (1) overhaul/repair processes associated with chlorofluorocarbons (CFCs); (2) electroplating; (3) component cleaning; and (4) painting/depainting. Processes generating these wastes are discussed in more detail in the following section.

4.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

The following discussion summarizes several of the pollution prevention options identified at OC-ALC.

4.3.1 Ozone-Depleting Substance Alternatives

At the time the PPOA was conducted, trichlorotrifluoroethane (CFC-113) was used to remove oily residue on fuel control bodies and other aircraft and engine components after they were cleaned with PD-680, a Type II solvent. A possible alternative involves using an aqueous or semi-aqueous cleaning system, such as Freemont 776 detergent, in the existing spray washer or in an immersion-type washer.

Other possible alternatives recommended in the PPOA include additional alternative degreasers, alternatives to use of aerosols containing chlorofluorocarbons, alternatives to use of CFC-113 in cleaning applications, and alternative refrigerants.

4.3.2 Plating Alternatives

The silver plating process uses cyanide solutions in the plating and stripping baths, significantly increasing the cost of waste disposal. Substitution of commercially available non-cyanide solutions for the copper strike, silver stripping, and silver plating process steps could reduce disposal costs by $33,000 per year, with a payback period of about two years. A second alternative is to eliminate the need for silver plating. Additional research is required to determine the viability of this alternative.

Other plating-related pollution prevention recommendations include alternatives to the use of perchloroethylene vapor to remove wax maskants from aircraft components after plating. Alternatives include conventional aqueous and semi-aqueous cleaners, an azeotropic blend of perchloroethylene and water, and a two-step process using hot mineral oil and aqueous cleaning.

4.3.3 Component Cleaning Alternatives

Vapor degreasers in the oil cooler overhaul process use perchloroethylene solvent to displace water on the components, remove oil residue from parts after testing, and clean parts prior to painting. The process generates waste streams in the form of volatile organic compounds (VOC) and contaminated liquid solvent. Three alternatives were recommended to eliminate the perchloroethylene vapor degreaser: (1) aqueous cleaner power flushing and rinsing of fin-type oil coolers; (2) steam clean paint preparation for fin-type oil coolers; and (3) oven drying of core-type oil coolers.

4.3.4 Depainting/Painting Alternatives

Phenol/methylene chloride paint strippers are used at OC-ALC to remove various types of paint or top coat from aircraft and components being overhauled. Depainting with solvents results in waste streams of liquid solvent, air emissions, and paint residue. Some substitute methods may cause surface damage or create coating-contaminated media which must be disposed of as hazardous waste. One possible solution is a hybrid method, in which a solvent softener is used to prepare the coating, thus allowing a non-solvent depainting method to perform more effectively.

4.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Many of the possible solutions identified by this project must be tested and further evaluated to determine if they would be adequate substitutes for the processes/substances in use at OC-ALC.

Toward this end, research was initiated to address two process areas at Tinker AFB: brush plating, and cleaning and solvent alternatives.

4.4.1 Brush Plating Implementation and Evaluation

Chromium and nickel tank plating are used extensively in the engine overhaul and repair process for the resizing of parts that have worn thin from service, usually due to metal-on-metal contact. The coating, which can be machined back to the required dimensions of the part, provides a hard surface with excellent protection against wear and corrosion. The chromium and nickel tank plating processes consist of several steps including degreasing, masking, alkaline cleaning, etching, plating, rinsing, and demasking. After plating, each part must be machined back to its original dimensions. The masking, demasking and machining steps make the overall tank plating process labor intensive, requiring numerous plating tanks to accommodate the workload. These tanks are constantly heated, requiring a significant quantity of energy. Additionally, many of the plating solutions contain hazardous materials that present an environmental threat due to the potential for spills and leaks.

One project was conducted to evaluate the potential of brush plating (electromechanical metallizing or EM) as a substitute process for hard chromium and nickel tank plating, to reduce the quantity of waste generated during the repair and overhaul of gas turbine engines. The results indicate that the nickel-based brush plating solutions do not provide the hardness or (Taber) wear resistance achieved by chrome plating. Nickel-sulfamate brush plated coatings exhibited acceptable fatigue results on specific base metals.

A follow-on study is being conducted to address two related areas: (1) the feasibility of implementing brush plating using alternate alloys as a substitute for the hard chrome tank plating; and (2) the potential of substituting Low Hydrogen Embrittlement (LHE) zinc-nickel planting as a substitute for LHE cadmium brush plating, which is used during in-situ plating of landing gear and other aircraft high-strength steel.

4.4.2 Cleaning Alternatives Implementation and Evaluation

Methods to reduce the use of methyl ethyl ketone (MEK) as cleaners and solvents in aircraft radome depainting operations are being evaluated. A WREAFS-developed formulation of n-methyl-pyrrolidone, propylene carbonate, and dibasic ester is being evaluated through a life cycle assessment (LCA) to investigate the energy and environmental impacts of the product as a substitute for MEK in depainting operations.

4.4.3 MEK Recovery/Reuse

To reduce MEK-laden air discharged to the atmosphere, research is being conducted to evaluate a new pollution prevention technology, i.e., a regenerative adsorption system applicable to the adsorption of VOC. This process captures the MEK on a resin adsorbent. The MEK is subsequently released with controlled heat and recovered by condensation, and may be reused in paint stripping operations.

4.5 STATUS OF IMPLEMENTATION

The OC-ALC has been actively engaged in pollution prevention as a result of the PPOA conducted by EPA. Base personnel considered the assessment to be a thorough documentation of the OC-ALC's processes, containing reasonable economic analyses of potential pollution prevention projects. In order for pollution prevention projects to receive Base funding, they must exhibit a minimum payback period of three years; to date, the four recommendations identified by the assessment have met this criterion.

4.5.1 Ozone Depleting Substance Alternatives

The assessment recommended use of alternatives for ozone-depleting substances such as CFC-113. In response to this recommendation, the OC-ALC has replaced its vapor degreasing units with high-pressure washers using soap and water. The OC-ALC has reduced its use of ozone-depleting substances by 75 percent, from 600,000 pounds per year to 50,000 pounds per year, by implementing this recommendation. It should be noted, however, that the new detergent used in these washers is sodium silicate-based. Use of these washers and detergents has increased the amount of oily sludge generated from the washers. This oily sludge waste is classified as a RCRA hazardous waste and must be hauled away and disposed of. The Base employs an outside contractor to haul away and dispose of the waste at an approved site in Oklahoma. However, OC-ALC is investigating ways to reduce this waste. In fiscal year (FY) 1995, OC-ALC plans to reduce the volume of sludge waste by employing a dewatering scheme proposed by Battelle.

The perchloroethylene vapor degreasers used for component cleaning have also been removed and high-pressure washers have been installed.

4.5.2 Plating Alternatives

The OC-ALC has replaced the cyanide solution in all of their plating processes with a non-cyanide solution. Commercially available, non-cyanide solutions are used in the copper strike, silver stripping, and silver plating process steps.

4.5.3 Depainting/Painting Alternatives

Depainting/painting operations, such as phenol/methylene chloride paint strippers, were also targeted for pollution prevention. Several pollution prevention alternatives have been implemented in these operations, including the following:

- Using benzyl alcohol in place of phenol/methylene chloride
- Using high-pressure water instead of methyl chloride
- Replacing MEK with polycarbonates
- Testing a resin to capture and recycle MEK used

In 1993, the Base reduced its emissions of perchloroethylene, MEK, chromium, methylene chloride, and xylene by 100,000 pounds (29 percent of the total emissions). In addition, the phenol/methylene chloride emissions were reduced from 400 tons in 1992 to 40 tons, representing a 90 percent reduction.

Finally, in 1995, the Base plans to implement a high-pressure mobile robotic paint stripper, the Large Aircraft Robotic Paint Stripper (LARPS). Using high pressure and low volume, this unit will be capable of stripping paint from assembled airplanes without the use of volatile solvents. Specifically, LARPS will be able to electronically plot an entire aircraft to determine areas which require stripping, and then strip the paint using a high-pressure water spray. Areas not requiring stripping, as identified through the plotting process, will not be stripped.

SECTION 5

DEPARTMENT OF DEFENSE
SCOTT AIR FORCE BASE

A PPOA was completed in 1991 for three selected processes at Scott Air Force Base in Illinois. Of these, one process offered a very quick payback (0.24 years). Changes identified in the other two processes could lead to net reductions in operating costs of $5,000 per year.

5.1 FACILITY DESCRIPTION

Scott AFB is located near Belleville, Illinois. About 5,000 military personnel and 3,000 civilians work and/or live at the base. The base is part of the Military Airlift Command (MAC) and operates and maintains a fleet of C-9 medical aircraft, including 12 C-9s which are outfitted, flown, and maintained by base staff.

5.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The three processes selected for this project were (1) nondestructive inspection (NDI) of C-9 medical aircraft wheel hubs; (2) painting/depainting/parts cleaning operations of all aerospace ground equipment at the base; and (3) printed circuit board manufacture.

5.2.1 Nondestructive Inspection

Two test methods are used to inspect landing wheels for signs of fatigue such as cracks or other discontinuities that penetrate to the surface. An eddy-current method is used to inspect the bead seat area, and a liquid penetrant inspection method is used to check all other areas. The eddy-current method places an electric current in proximity to a conductive test specimen such as the aluminum wheel and measures impedance changes due to discontinuities. This activity does not generate waste.

The liquid penetrant process involves immersing aluminum wheel halves in a penetrant tank for a sufficient period of time for the penetrant to permeate into discontinuities accessible from the surface. Parts are removed from the penetrant tank and are placed over a drip station where excess penetrant drains back to the penetrant tank. The wheels are rinsed in water and reimmersed in an emulsion solution, removed, and rinsed again. The parts are then soaked in a developer that deposits a thin layer of solid material onto the surface, and are subsequently placed above the developer and allowed to drain. Excess solution is returned to the tank. The parts are dried at a specified temperature, and are then inspected under ultraviolet (UV) light. Cracks and imperfections are indicated by fluorescent lines or spots. Following inspection, parts are repaired or rejected from service.

Three waste streams are generated during the NDI process, including waste liquid penetrant, emulsion solution, and developer. The penetrant tank is periodically emptied and replaced with fresh solution. Spent solution is drummed for disposal. The penetrant is classified as a D001 (flammable) waste, although the flashpoint is above the 140°F criteria established for D001 waste. Waste penetrant is incinerated in a cement kiln. A small amount of penetrant is lost to the sewage treatment plant along with rinse water from the first rinse step.

The emulsifier tank eventually becomes contaminated with excess penetrant that was not removed during the rinse step. The solution is changed approximately every six months. The batch, which is approximately 100 gallons, is transferred to the sewage treatment plant through a floor drain. In addition, small amounts of emulsifier drain to the sewage treatment plant along with the post-emulsion rinsewater. The solution is not hazardous, although the manufacturer recommends disposal by incineration.

The developer solution also becomes contaminated, primarily with penetrant, and is changed following the same schedule as the emulsifier tank. The developer solution contains high levels of sodium chromate and is classified as a D007 hazardous waste. Despite hazardous characteristics, each 100-gallon batch of developer solution is sent to the sewage treatment plant through a floor drain.

5.2.2 Painting/Depainting/Parts Cleaning Operations

The paint shop processes all aerospace ground equipment for Scott Air Force Base. Before painting, parts are either dry-sanded or dipped into a bath of stripping solvent. Stripping solvent becomes contaminated with paint sludge and is disposed of off site as a F002 hazardous waste. Parts which require a clean, grease-free surface for further processing are taken to the Clean Shop, where they are immersed in a bath of Safety Kleen degreaser for 45 minutes, followed by scrubbing and rinsing. Contaminated degreaser solution is removed by Safety Kleen, Inc., and is recycled and redistributed back to customers. The solvent consists primarily of mineral spirits and is classified as a D001 hazardous waste because of its 105°F flash point.

Following degreasing, some parts, such as aluminum alloy landing wheels, are dipped into a weak acid solution to remove oxidized metal from the surface. Following the acid bath the parts are dipped into a corrosion inhibitor. Both the acid and corrosion inhibitor solutions are replenished as needed; neither solution generates a waste stream.

The paint shop uses approximately 24 gallons of paint per year. About 90 percent of the paint is polyurethane, with the remainder consisting of various lacquers and varnishes. Wastes generated include overspray solids, booth compound, booth wastewater, waste paint and thinner, and VOC. Paints are applied with spray guns in water curtain booths. When used properly, the spray guns typically transfer about 50 percent of the coating to the target surface. Solids contained in the overspray become entrained in the water curtain and accumulate as floating scum or sludge. Approximately 220 gallons of solids are drummed and hauled away each year. Booth water is drained and replaced every two months; contaminated water is transferred to the sewage treatment plant without the addition of treatment chemicals. In addition, the protective film coating which is applied to the metal booth walls to prevent the adhesion of paint materials eventually deteriorates and peels from the surface. This material is discarded in a sanitary landfill. Paint thinner used to clean paint gun nozzles is discarded along with unused paint. These wastes are placed in 30 gallon drums for disposal by Safety Kleen, Inc. VOC are released during paint application, and are not controlled at the facility. The amount of VOC generated depends on the amount and composition of paint used.

5.2.3 Printed Circuit Board Manufacture

Scott AFB maintains a laboratory-scale circuit board production facility. The proprietary process generates three principal wastes, including an electroless copper solution, sodium persulfate solution, and ammonium persulfate solution. The sodium persulfate and ammonium persulfate solutions may be corrosive hazardous wastes (D002). The electroless copper solution probably contains formaldehyde, a listed nonacute hazardous waste (U122).

5.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

Several pollution prevention options were identified for NDI, painting/depainting/parts cleaning, and printed circuit board manufacture.

5.3.1 Nondestructive Inspection

NDI is of primary interest because of its wide-spread use throughout the military and airline industry. Several options were identified, with the most feasible options being: (1) altering the method used to replace emulsifier and developer in the tanks, and (2) using a dry silica-based developer.

5.3.1.1 Alter Replacement Method--

Emulsifier and developer tanks are currently emptied every six months. Since the primary contaminant floats at or near the surface of both solutions, it was recommended that the floating emulsifier be skimmed from the surface by installing a drain valve on the side of the tank and adding fresh solution. Twenty five percent of the tank's contents would be removed every six months and the entire tank would be drained only once every two years, extending the lifetime of the bath. This would result in a payback period of about three months. A quality assurance/quality control (QA/QC) test program was deemed necessary to evaluate this option. The skimming and removal schedules are easily adjusted to suit specific requirements.

5.3.1.2 Dry Silica-Based Developer--

New inspection systems are available which use a dry, non-hazardous silica-based developer in place of the wet chromate solution. Dry developer solution is applied in an enclosed booth by one of two methods: (1) a swirl cloud, whereby the part is placed in a shallow tank above a bed of dry developer which is subsequently expanded with air; or (2) a dynamic cloud, which subjects the part to a fine spray of dry developer similar to a painting operation. Excess particulate is collected by a filter system. This system meets the same technical specifications as the wet developer and would eliminate the need for the wet chromate solution. However, its use would require additional space for a dry developer booth and the capital costs are high in relation to the dollar savings.

5.3.2 Painting/Paint Removal/Parts Cleaning

Several pollution prevention options were identified for this area, including alternative coating removal methods, replacing wet spray booths, and replacing spray guns.

5.3.2.1 Alternate Coating Removal Methods--

A plastic media blasting (PMB) method has been suggested to replace solvent-based coating removal operations. At the time of the PPOA, the PMB equipment was located on site and lacked only a few minor fittings before operation could begin.

5.3.2.2 Replace Wet Spray Booths--

A comprehensive water treatment program for the wet spray booths was recommended, which included the addition of coagulant to reduce sludge disposal frequency and costs. Alternatively, converting the paint booths to a dry operation would eliminate the generation of sludge and wastewater. Overspray solids in a dry system are collected by filters, which must then be disposed of.

5.3.2.3 Replace Spray Guns--

The use of HVLP paint guns reduces the amount of overspray to about 10 to 20 percent, and substantially reduces VOC emissions. More efficient paint application results in smaller volumes of paint being used and less waste generated. Additional options for reducing VOC emissions include the use of powdered coatings and/or the use of electrostatic spray systems.

5.3.3 Printed Circuit Board Manufacture

The manufacturing process for printed circuit boards is complex and closely regulated, making it difficult to modify. Recommendations for pollution prevention include the substitution of a reducing agent such as sodium hypophosphite for the electroless copper plating solution, which would eliminate the use of formaldehyde, or the recovery of copper from spent electroless plating solution with the use of sodium borohydride precipitation followed by filtration.

5.4 STATUS OF IMPLEMENTATION

Scott AFB has acted on many of the recommendations made in the PPOA. The main pollution prevention opportunity concerned changing the standard operating procedures for the emulsifier and developer tanks. The recommendation called for skimming contaminants and replacing lost solvent instead of emptying the tanks. The AFB purchased an oil/water separator for use in the skimming operation; however, installation could not take place due to the major renovation work required. The process, including the separator, will be moved to a new facility in Hanger 1. The AFB is conducting many general pollution prevention projects including:

- Using a waste oil burner to heat buildings
- Converting some vehicles to natural gas
- Implementing an R-134 recovery system
- Instituting environmental training programs

One pollution prevention project of interest is the establishment of a hazardous materials pharmacy supply. Since all hazardous materials entering the AFB must be checked into and out of the pharmacy, the pharmacy acts as a tracking system for all hazardous materials on the Base. This system tracks movement of materials and can identify unnecessary material purchase and movement, thereby reducing waste.

SECTION 6

DEPARTMENT OF DEFENSE
AIR FORCE PLANT NUMBER 6

This project, completed in 1991, evaluated emulsion cleaners as an effort related to the WREAFS program. The purpose of the project was to provide assistance to Air Force Plant No. 6 personnel by documenting relevant work by other aircraft fabrication facilities.

6.1 FACILITY DESCRIPTION

Air Force Plant No. 6, located in Marietta, Georgia, is operated for the Air Force by Lockheed Aeronautical Systems Company. The facility is part of the Aeronautical Systems Division (ASD), headquartered at Wright-Patterson Air Force Base near Dayton, Ohio.

6.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

This facility operates six vapor degreaser units that use trichloroethylene (TCE) to prepare steel and aluminum parts for a variety of subsequent manufacturing steps in the production of C-130 aircraft. Approximately 1.2 million pounds of TCE were use in 1988; this figure decreased to about 650,000 pounds in 1990. This decrease was primarily due to reduced production and workload at the facility. The goal is to eliminate TCE use completely by substituting a water-soluble emulsion cleaner.

6.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

Concerns about the detrimental effects of TCE on worker safely and health, as well as potential environmental impacts, have led to an interest in substituting less damaging, water-soluble cleaners for TCE. The initial stage of this project reviewed research conducted by Boeing Aircraft, the Air Force Engineering Service Center (AFESC), DOE, General Dynamics, Lockheed Missile and Space Company (LMSC), Martin Marietta, and Northrop, on the substitution or elimination of solvent-based cleaners. Boeing Aircraft is evaluating the performance of a given substitute during actual aircraft production. One of AFESC's projects evaluated the substitution of cleaners with biodegradable solvents, involving field testing at Tinker AFB in Oklahoma. Enhancement methods such as ultrasonic and mixer agitation at various temperatures were evaluated as part of that study. The DOE is evaluating substitutes for performance and corrosion. General Dynamics originally evaluated forty substitutes and has narrowed the list to four candidate cleaners for further consideration. LMSC and Martin Marietta evaluated substitutes for 1,1,1-trichloroethane (TCA) use in vapor degreasers.

The criteria by which substitute solvents were evaluated in the initial stage of this project include the following: pH level; corrosiveness; cleaning ability; corrosion between fraying surfaces; foaming; effect on cadmium-plated surfaces; effect on adhesion; water break-free; visual; etching ability; sandwich corrosion; intergranular attack; corrosion resistance; paint adhesion; and sulfur, phosphates, and chromates content. Of the ten cleaners targeted for evaluation as substitutes for halogenated solvents, six were selected by one or more of the evaluators for implementation or further evaluation. Five were eliminated due to phosphates, flammability concerns, non-recyclability, or unacceptable etching of the magnesium substrate.

6.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

EPA is continuing to work in cooperation with Lockheed and the Air Force Aeronautical Systems Division to investigate the potential for implementing emulsion cleaners as a replacement for TCE. Lockheed has selected cleaner Brulin 815 GD for pilot testing. The successes, problems and costs associated with using a substitute degreasing solvent and alkaline cleaner will be documented and the information transferred to similar facilities in the DOD and DOE. This may expedite the use of emulsion cleaners at other facilities.

6.5 STATUS OF IMPLEMENTATION

After pilot-testing Brulin 815 GD to replace TCE as a parts cleaner, Air Force Plant No. 6 has modified one of its process lines utilizing an 800-gallon tank for the use of this emulsion cleaner. The savings have been substantial in terms of waste disposal and process time, although specific data are currently not available to quantify these savings. Two additional lines containing a 3,400-gallon and 15,000-gallon tank are waiting to be modified.

Air Force Plant No. 6 has instituted other general pollution prevention measures, including the measures outlined below.

- As of April 1994, all ozone depleters have been replaced. TCE has been replaced by Brulin 815 GD; TCA has been replaced by alternative solvents Shopmaster RC and D108; CFC-113 has been replaced by a process change to soap and water.
- Paints have been replaced by low VOC, lead-free, waterborne paints.
- Cadmium plating has been abolished.
- Use of methylene chloride has been eliminated through process changes; alternatives are being sought for MEK.

SECTION 7

DEPARTMENT OF DEFENSE
FORT RILEY

This project was a PPOA conducted at the U.S. Army Forces Command (FORSCOM) maintenance facilities at Fort Riley, Kansas in 1990. Ten other FORSCOM installations provide potential for application of similar pollution prevention options.

7.1 FACILITY DESCRIPTION

Fort Riley is a U.S. Army FORSCOM installation in north-central Kansas that provides support and training facilities for the 1st Infantry Division (Mechanized), Non-Divisional Units, and tenant activities. Fort Riley provides the Army with the capability to house and train an Army division and associated land combat forces, as well as to service Army functions in the midwest area.

7.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

At Fort Riley, large hazardous waste streams are generated, consisting of spent automotive cleaning solvents and various RCRA listed wastes, including waste battery acid, waste caustic cleaners and spent parts wash water. Currently the waste battery acid is collected in 15-gallon plastic drums, and caustic cleaners are collected in 55-gallon metal drums. Both are classified wastes and are sent by truck to the hazardous waste storage facility. Wastewater from the automotive parts washer is discharged to an on-site nonhazardous waste evaporation pond system.

Two areas were selected for evaluation: the battery repair and service shop, which generates waste battery acid; and the automotive subassembly rebuild area, which generates waste automotive washwater and spent caustic cleaner.

7.2.1 <u>Battery Repair Shop</u>

Acid from car and truck batteries consists of 32 to 37 percent sulfuric acid containing trace amounts of lead and cadmium. This material is drained from batteries which are no longer in service or which require repair, and is shipped in 15-gallon drums to the Defense Reutilization and Marketing Office (DRMO) storage facility for ultimate disposal as hazardous waste (D002, D006, D008). The battery service area drains about 7,200 gallons per year of battery acid for disposal. The drained batteries are inverted, and either disposed of if determined to be unusable, or repaired and refilled with fresh 37 percent sulfuric acid, recharged and reused.

7.2.2 <u>Automotive Subassembly Rebuild Shop</u>

Prior to rebuilding various automotive subassemblies (e.g., engines, clutches, transmissions) the units are disassembled and placed in a specially designed high pressure hot-water washer for cleaning. This washer continuously circulates hot alkaline solution through high-pressure jets to provide the cleaning action. The solution has a pH greater than 12 and contains trace concentrations of lead, chromium, and cadmium, in addition to the oils, grease, and dirt removed from the automotive parts. In the past the waste was drained to an onsite nonhazardous waste evaporation pond. However, because of its characteristics, this waste is being reclassified as RCRA D007 and D008 waste and will have to be disposed of as hazardous waste.

7.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

The pollution prevention options recommended for Fort Riley are recycling and reuse options, as described in the following paragraphs.

Recommended pollution prevention options include recycling of waste battery acid from cars and trucks, and recirculation of washer wastewater. Recycling both the battery acid and the wastewater would cost about $35,000, resulting in an annual operating cost savings of about $149,000. Payback period for simultaneous implementation of the two options would be less than five months. Adequate testing of refortified, recycled battery acid and monitoring of the detergency of the washer wastewater would be required.

7.3.1 Recycling of Waste Battery Acid

After collection, the waste battery acid would be transferred to an acid-resistant tank and mixed by recirculating pumps. The acid strength would be adjusted to 37 to 38 percent H_2SO_4 using 78 percent sulfuric acid (60° Baume) as needed to yield standard battery acid. This refortified acid would be pumped through an acid-resistant filter to remove particulates and would be collected in drums for use in the battery repair operation. Recycled acid could be used in place of virgin materials in reconditioned or new batteries. To prevent accumulation of dissolved metals, 25 percent of the used acid would be purged, neutralized, treated for heavy metal removal, and disposed of as nonhazardous waste to an onsite lagoon.

7.3.2 Recirculation of Washer Wastewater

The proposed pollution prevention option for the metals-contaminated alkaline wastewaters involves using equipment external to the automotive parts washer for purifying the alkaline detergent. Cleaned alkaline detergent solution would be reused for further automotive parts cleaning operations.

The proposed process includes emulsion breaking to cause emulsified oils to float. De-emulsified oils and other tramp oils and grease are removed by skimming, while suspended particulates are removed by filtration through an in-line cartridge filter. After adding fresh alkaline detergent as necessary, the recycled washwater would be returned to the automotive parts cleaner. As with the proposed system for recycling battery acid, the buildup of impurities would be prevented by purging 25 percent of the used washwater, and recycling the remaining 75 percent. Purged alkaline washwater would be neutralized with an appropriate amount of waste battery acid, treated to remove heavy metal impurities, and disposed of as a nonhazardous waste.

7.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Proposed particulate filtration and de-emulsification processes would qualify as research, development and demonstration projects. In-plant experimentation is necessary to determine such operating and design details as the appropriate type of filter elements for this operation, the number of cartridge filters needed to provide a clean solution, and the number of times the washwater can be recycled while still maintaining its cleaning effectiveness.

7.5 STATUS OF IMPLEMENTATION

Fort Riley has not implemented the measures recommended by the PPOA at the present time. Upon review of the report, Fort Riley personnel determined that the options recommended were not appropriate for the processes on the site. Specifically, they felt that the recommendation to reuse or recycle and filter the solution from the parts washer was not appropriate because the PPOA recommendation was based only on the alkalinity of the parts washer solution, and did not address the alkalinity of the detergent used in this process. The detergent is the active ingredient in the solution and Fort Riley personnel believe it should have been considered when investigating potential pollution prevention options.

It was also recommended that this solution be mixed with the waste battery acid to neutralize the acid. This option was considered, but it was determined that the alkalinity of the parts washer is not strong enough to effectively neutralize the acid. Fort Riley personnel have instead decided to discontinue the practice of draining acid from batteries, and instead, will ship the batteries wet. This will significantly decrease the amount of waste battery acid the personnel must handle and dispose.

SECTION 8

DEPARTMENT OF DEFENSE
FITZSIMMONS ARMY MEDICAL CENTER
OPTICAL FABRICATION LABORATORY

A PPOA at the Fitzsimmons Army Medical Center (FAMC), Optical Fabrication Laboratory (OFL) near Denver, CO was completed in 1991. The facility generates three RCRA hazardous wastes; pollution prevention options were developed for two of the three wastes.

8.1 FACILITY DESCRIPTION

The OFL produces about 1,400 pairs of spectacles per month, with 85 to 90 percent of the production involving the fabrication of glass lenses. The remaining 10 to 15 percent involves plastic lens fabrication.

8.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The areas primarily involved in the PPOA were the glass and plastic lens fabrication, where uncut lenses are received from optical suppliers and are matched with eyeglass prescription orders. Lenses are precoated with a polymer film of volatile solvents containing MEK, methanol, and ethanol. Precoated lenses are blocked, ground to desired curvature, washed, and deblocked. Cleaned lenses are then ground to fit frames, chemically hardened, and placed in frames.

Glass lens fabrication operations at the OFL generate three RCRA hazardous wastes, including waste lead-bearing lens blocking alloy (RCRA D008), alkaline washwater from ground and polished lens cleaning and deblocking operations (D002), and spent Stoddard solvent from the tool cleaning operations (D001). Additionally, one nonhazardous waste is generated, consisting of ground glass fines from lens grinding and polishing operations. These wastes were recycled to the extent possible, but OFL was particularly concerned about the alkaline washwater from lens deblocking which contains particles of lead-bearing alloy, as well as the hon-hazardous ground glass from grinding operations.

Waste lead-bearing blocking alloy particulates are reclaimed and recycled at the OFL. Spent Stoddard solvent is recycled offsite by Safety-Kleen, Inc. The PPOA primarily focused on the alkaline washwater from lens deblocking which contains particulates of lead-bearing alloy, and the nonhazardous ground glass fines generated during grinding operations.

Alkaline washwater which has a pH of 13 to 14 is discharged periodically from the glass-lens washing machines at the rate of approximately 200 gallons per month. The washwater passes through a trap to collect large particulates of lead-bearing lens blocking alloy, and is discharged to the onsite wastewater treatment plant. Effluent from the treatment plant is ultimately used to irrigate the FAMC grounds, which could result in the discharge of lead to the groundwater underlying the site.

Lens grinding operations generate approximately 37.5 tons per year of a mixture of waste glass fines and water. The nonhazardous ground glass fines are collected from the onsite grinding coolant filtration operations for disposal at a local sanitary landfill. These fines, when dry, could generate particulate emissions, thus creating possible inhalation problems during transportation if they are transported in uncovered or improperly covered containers, or at a landfill if they are improperly covered or managed.

8.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

The nonhazardous glass fines were examined from a recycle standpoint, eliminating a disposal cost. Several options were considered for the RCRA suspect hazardous materials in the alkaline wastewaters.

8.3.1 Glass Fines

Fine glass particulates may be used as feedstock for glass or ceramic tile production. Although transportation costs would limit the marketable area, this option would result in an annual savings of up to $1,000 by eliminating landfill disposal costs.

8.3.2 Alkaline Wastewaters

Two options were recommended for the alkaline wastewaters: (1) substitution of a non-lead bearing blocking alloy and (2) filtration of wastewater prior to disposal.

8.3.2.1 Substitute Blocking Alloy--

This option may not be economically feasible. Although a technically adequate alloy substitute exists, its use would increase operating costs by $33,000 per year.

8.3.2.2 Wastewater Filtration--

In this option, submicron-size particles would be captured by a cartridge filter installed in the line leaving the trap from the lens washing/deblocking operation. Installation of a cartridge filter in the wastewater line could cost less than $500, and result in annual savings of over $1,000. This technique could recover up to 500 pounds per year of lead-bearing alloy that would ultimately be recycled to the lens blocking operation.

8.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Three specific needs were identified as a result of this study (1) develop a milder glass cleaning solution to replace the alkaline one; (2) assess the feasibility of developing another less costly blocking alloy containing no toxic metals (e.g., lead); and (3) develop and/or adapt an aqueous cleaner for tool cleaning operations to replace Stoddard solvent.

8.5 STATUS OF IMPLEMENTATION

The OFL has been involved with a wide range of assessments for pollution prevention opportunities, having spent considerable staff time researching potential alternative methods related to optical fabrication procedures that produce waste streams of concern.

Several of the waste streams cited in these studies are the subject of a joint EPA/Navy/industry cooperative research and development agreement (CRADA) to be completed in 1995. The CRADA, which involves the EPA Office of Research and Development's (ORD's) RREL, the Navy Ophthalmic Support and Training Activity and Gerber Optical Incorporated, is studying the wastes generated from the use of Gerber's "Step One" Surface Blocking System to prepare lenses for surface generating (grinding). Pollution prevention alternatives for lens blocking materials and other related substances are also being assessed under this effort. Any promising results obtained in these studies may also be considered for use at the Fitzsimmons OFL.

SECTION 9

DEPARTMENT OF DEFENSE
FORT CARSON
EVANS COMMUNITY HOSPITAL

A PPOA at the Evans Community Hospital (ECH), completed in 1992, evaluated xylene, ethanol and methanol waste streams generated in the hospital's histology and hematology laboratories.

9.1 FACILITY DESCRIPTION

The Fort Carson ECH is located in Colorado Springs, CO. The histology and hematology laboratories perform human tissue processing and slide staining for histologic and cytologic evaluations to support clinical diagnoses.

9.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The histology and hematology laboratories dispose of approximately 40, 66, and 63 gallons per year of xylene, ethanol and methanol, respectively. These solvents are primarily used during human tissue processing and slide staining. The method of disposal at the time of the assessment was by transport and incineration. Cross contamination of xylene and ethanol occurs during tissue processing and slide staining in the histology laboratory, thus, the wastes cannot be easily separated. It is possible for the hematology laboratory's methanol to be kept separate from the other wastes; however, at the time of the assessment, all three solvents were mixed in the same drum for disposal.

9.2.1 <u>Tissue Processing</u>

The histology laboratory's automatic tissue processing equipment employs one solvent reservoir 0.4 gallons of xylene and two solvent reservoirs 0.9 and 0.2 gallons of ethanol. These baths are emptied on a weekly basis and are replaced with fresh solvent. Waste xylene and ethanol are pooled together with significant volumes of waste methanol from the hematology laboratory. The wastes are placed in 55-gallon drums for eventual transport by a disposal contractor.

9.2.2 <u>Slide Staining</u>

Automatic slide staining equipment in the histology laboratory uses three 0.2-gallon solvent reservoirs, two containing xylene and one containing ethanol. The ethanol bath used during slide staining of histologic or cytologic specimens is changed weekly. The xylene baths are operated in series on a weekly rotating basis, in that the first bath is discarded, the second bath is moved forward to replace the first bath, and a fresh xylene reservoir replaces the second bath which has been rotated forward. As described above, waste xylene and ethanol are placed in 55-gallon drums for disposal. Methanol is used for slide staining and other purposes in the hematology laboratory, and is pooled together with the other solvents for disposal.

9.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

The two pollution prevention options identified for xylene and ethanol used in the histology laboratory included (1) solvent substitution and (2) solvent recovery.

9.3.1 Solvent Substitution

Xylene substitutes are available for laboratory applications. Although little information is available regarding the toxicity of these substitutes, the primary hazardous constituents are aliphatic petroleum distillates, classified as D001 (flammable) hazardous waste. A program was conducted at ECH to evaluate available xylene substitutes. Results indicate that the substitutes are nondrying to skin, leave no oily residue for faster and easier slide cleaning, and allow for complete paraffin infiltration, rendering tissues less brittle than xylenes. However, preference was shown for continuing the use of xylene primarily because the substitutes are not as effective at tissue cleaning and are relatively expensive. Furthermore, xylene is still the preferred choice because of its maximum paraffin infiltration of tissues, which results in greater specimen visibility and enhanced microscopic examination.

9.3.2 Solvent Recovery

At the time of the PPOA, xylene, ethanol, and methanol wastes generated by the histology and hematology laboratories were being mixed in a single drum for disposal. To implement a solvent recovery program, it would be necessary to keep the solvents separate to maximize their potential for recovery and reuse. While methanol used in the hematology laboratory can be segregated from the other solvents, xylene and ethanol will always be mixed because of cross contamination which occurs during tissue processing. The only method available to effectively separate these solvents is distillation. Solvent distillation either by spinning band or atomized plate techniques can offer efficient separation of the laboratory solvents, although pure ethanol can never be effectively separated from a mixture of ethanol and xylene. A procedure has been suggested by which ethanol reclaimed using distillation methods (usually 95 percent pure) is used in all containers except the final rinse bath, which would be filled with fresh (absolute) alcohol.

Due to a relatively high initial investment, a solvent recovery system is economically attractive for laboratories with a large throughput (at least 8,000 slides per month). Solvent recovery has a payback of 97 months for laboratories similar in size to the histology laboratory at ECH, which processes between 1,000 and 8,000 slides per month.

9.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Additional research is required regarding the potential hazards and safe use of xylene substitutes. Since substitutes were not identified for methanol, a program should be implemented at ECH to segregate the methanol wastes.

9.5 STATUS OF IMPLEMENTATION

9.5.1 Solvent Substitution

ECH has initiated a solvent substitution program as recommended. Two replacement solvents are used in the vacuum infiltrator processor, with trade names "Prosoft" (alcohol substitute containing propylene glycol ether and ester and propanol) and "Propar" (xylene substitute containing propylene glycol ether and alkanes). The rationale for this substitution is the reduction of toxic constituents in the laboratory waste stream. Xylene use in this process is estimated to have been reduced by two-thirds. The remaining xylene use is located in a single station on the processor which is used for purging the equipment after a day's use. Xylene is also still used to clean paraffin from slides after mounting of tissues.

Some issues have been encountered regarding the long-term suitability of the replacement solvent products, including their possible involvement in the deterioration of seals, which may have contributed to machine malfunctions, and the inability to obtain support for the use of substitutes from makers of planned replacement equipment. The latter issue appears to have been resolved, as the manufacturer of the processor has recently determined that the two substitute solvents named above are appropriate for their current uses at ECH. The only other ECH observation regarding the substitute solvents is that it takes somewhat longer to process specimens than with the original solvents. At current production levels, this is not a problem for ECH, since the processor is an automatic unit which is currently set up at the end of the work day and programmed to run overnight.

9.5.2 Solvent Recovery

Installation of distillation equipment was considered and rejected due to lack of capital and space constraints. Waste solvents from the histology laboratory are now stored in two separate containers (one containing xylene, ethanol and Prosoft, the other containing Propar) rather than being completely co-mingled.

SECTION 10

DEPARTMENT OF VETERANS AFFAIRS
CINCINNATI-FORT THOMAS MEDICAL CENTER

The pollution prevention opportunities identified at the Department of Veterans Affairs' Cincinnati - Fort Thomas Medical Center (VA-Cin) in 1991 focused on ways to reduce the discarded medical supply waste stream.

10.1 FACILITY DESCRIPTION

The VA-Cin is a government-owned general medical and surgical hospital. The facility maintains 415 authorized and 342 operating beds and is large in comparison to other private and federal hospitals. The facility provides outpatient services for approximately 500 individuals per day. In addition to the medical waste generated on-site, the facility also manages wastes for an associated research facility, nursing home, and home health care services.

10.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The pollution prevention assessment investigated the use of disposables in patient care to identify future opportunities to minimize solid wastes. Because the unit cost of disposing infectious waste far exceeds general waste disposal costs, VA-Cin already practices effective pollution prevention by segregating infectious from non-infectious wastes and by using durable cloth gowns and drapes instead of disposable paper products. The VA-Cin facility produces about 0.6 pounds of infectious waste per patient per day, which is low compared to the typical range of 0.5 to 4 pounds for most hospitals. Unlike some states, the state of Ohio allows the disposal of laboratory wastes together with the general waste stream provided that the laboratory wastes are sterilized first. Adding autoclaved laboratory wastes to the infectious waste stream would increase the daily generation rate to 0.87 pounds per patient.

Hospital wastes consist primarily of disposable products. Approximately 80 percent of the hospital supplies at VA-Cin are disposed of after a single use. The use of disposables has increased over the last few years in response to concerns over patient safety and staff occupational exposure to the AIDS virus. In contrast to the sharp increase in disposables which occurred 10 to 15 years ago, primarily as a result of the development of new disposable products, the recent increase in disposables reflects a greater use of existing products. The preference for disposables includes cost, convenience, improved quality assurance/quality control of manufacturing, avoided constraints on space and staff associated with reprocessing reusables, and health and safety assurance for sterile integrity.

The largest consumers of disposables at VA-Cin include the following departments: Laboratory Services; Surgery; Surgical Intensive Care Unit (SICU); 5 South (a patient floor); Medical Intensive Care Unit (MICU); Hemodialysis; and the Outpatient Clinic. The Supply, Purchasing and Distribution Department, the Laboratory, and the operating room account for 85 to 90 percent of all disposables used in the hospital. The two general types of disposable supplies used are plastics and paper (non-woven) products.

10.2.1 Laboratory Services

This department consists of four laboratory areas: hematology, clinical chemistry, microbiology, and histopathology. In a nine-month period ending June 30, 1989, the laboratories conducted 41,097 venipunctures, 9,935 bacterial cultures, 4,730 blood cultures, 854 fungal cultures, and 815 tuberculosis cultures.

The hematology laboratory staff draw and analyze blood samples from 50 to 60 patients per day. Hematology generates two 30-gallon bags of infectious waste each day, which is rendered noninfectious via autoclaving and is disposed of as general trash. Sharps (needles, broken glass) are placed in special containers and are incinerated weekly.

Clinical chemistry staff conduct urine and blood serum analyses, and also generate two 30-gallon bags of autoclaved waste each day. The microbiology laboratory generates at least three 30-gallon bags of autoclaved trash each day, consisting primarily of glass products.

Staff at the histopathology laboratory analyze tissue specimens and body parts, producing no more than one five-gallon trash bag of infectious waste per day. Pathological wastes and disposable specimen containers are incinerated on-site.

10.2.2 Surgery Department

Approximately 15 operations are performed daily, with wastes carefully segregated as they are generated. The surgery department generates between one and two 30-gallon bags of waste blood and body fluids per operation. An estimated 70 percent of the waste volume consists of contaminated paper waste. Examination gloves and surgical sponges represent the greatest volume of single-use disposable items in the waste stream. Blood and body fluid wastes are collected by a contract infectious-waste hauler for off-site treatment and disposal. Sharps are placed in special containers and are incinerated on-site.

Operating room packs, prepared with all disposable products necessary for the particular operation, are also used in the surgery department. The packs are generally used in full, although occasionally some items are disposed of unused.

10.2.3 Surgical Intensive Care Unit

The SICU maintains eight beds. The unit uses cloth gowns and reusable procedure trays, although staff have indicated that they would prefer to use the disposable packs similar to those used in surgery. Waste is segregated into three categories: sharps; blood and body fluid wastes, which consist mainly of suction liners and tubes; and general trash. Sharps are packaged in special containers and are incinerated on-site. Blood and body fluid wastes are strictly segregated into one or two 30-gallon bags per day. However, for patients requiring isolation, SICU may generate as many as ten five-gallon bags of waste per patient per day. Blood and body fluid wastes are collected by a contract infectious waste hauler for off-site treatment and disposal. Foley bags and chest tubes are flushed of their fluids and placed in general trash, and intravenous (IV) bags go directly into the general trash.

10.2.4 Five (5) South: Patient Floors

Thirty-six beds are maintained on the patient floors. Patients generally wear reusable cloth gowns, although paper gowns are used if cloth is unavailable. Wastes are segregated into sharps, blood and body fluids, and general trash, although in practice many nurses dispose of non-infectious waste in the blood and body fluid waste containers. The unit generates between one and two 30-gallon bags of infectious waste per day, which are collected by a contract infectious-waste hauler for off-site treatment and disposal.

10.2.5 Medical Intensive Care Unit/Cardiac Care Unit

The MICU/Cardiac Care Unit (CCU) operates eight beds. The unit reuses clean woven cloth gowns and pressure bags, which are used to introduce blood to a patient. Wastes are segregated into sharps, blood and body fluids, and general trash, although again many nurses dispose of non-infectious waste in the blood and body fluid waste containers. Infectious wastes are collected by a contract infectious-waste hauler for off-site treatment and disposal.

10.2.6 Hemodialysis

The hemodialysis unit treats about 55 patients per week and uses nearly all disposable products, including aprons and masks. Disposable dialyzers are resterilized and reused about 20 times before disposal. At least four 30-gallon bags of blood and body fluid are generated each day in this unit. This waste includes most of the disposable items. Blood and body fluid wastes are collected by a contract infectious-waste hauler for off-site treatment and disposal. Sharps are placed in special containers for incineration on site.

10.2.7 Outpatient Clinic

Services performed at the outpatient clinic include surgical procedures, medical examinations, chemotherapy, dermatology, urology, plastic surgery, orthopedics, and ear, nose, and throat treatments. Plastic-coated paper gowns are used for chemotherapy and are disposed of as cytotoxic waste. The same type of gown is often used for other services, although the clinic also uses reusable wovens including sheets, pillow cases, towels, and blankets. Badly soiled linens are often discarded rather than laundered. Gomco suction apparatus, suture removal sets, and scalpels are all reused.

The outpatient clinic generates one 30-gallon bag of blood and body fluid wastes each day, which is disposed of together with the hospital's other infectious waste streams. Chemotherapy wastes are transported for off-site disposal by a cytotoxic-waste hauler. Sharps are placed in special containers for incineration on site.

10.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

Through a review of available literature, the site visit to VA-Cin and an understanding of the limitations facing waste reduction in a hospital setting, pollution prevention recommendations were made involving: (1) reusing disposables; (2) using wovens versus nonwovens; and (3) product substitution.

10.3.1 Reuse of Disposables

As the cost of solid and medical waste disposal (including incineration) escalates, the reintroduction of reusables may be warranted. Hospital automation, specifically in the processing and sterilization of soiled linens, is enabling many institutions to reconsider the application of reusable surgical linens as a cost-effective option to the disposal of paper products.

Glass products used in the VA-Cin laboratories, including test tubes, sample cups, Petri dishes, slides, pipettes, and pipette tips, could represent a source of recycled glass instead of being disposed of as waste. Glassware made of borosilicate cannot be recycled with general consumer waste glass and would require special handling. Additional concerns exist over the ability of autoclaving to adequately sterilize the waste glass for further processing. Pending a decision to recycle the glass waste, substitution of glass for currently used plastic items would further reduce the waste stream.

Approximately 1,500 glass Petri dishes are used each week by the Microbiology Laboratory. A recommendation was made to consider using an off-site facility for cleaning and reprocessing the Petri dishes for reuse. The eight other hospitals existing within a two-mile radius of VA-Cin may also take advantage of a Petri dish recycling service.

Plastic IV bottles which typically never come into contact with body fluids remain uncontaminated during use and could therefore be safely reused for a single patient. These could be substituted for the disposable IV bags.

Economic factors affect the decision to use disposable or reusable products, through waste treatment and disposal costs, storage and reprocessing space, labor constraints, and durable product availability. Infection control, however, is the primary limiting factor when considering reusable or disposable products.

10.3.2 Wovens Versus Nonwovens

The use of wovens would decrease the volume and weight of hospital waste significantly. The advantages of woven material include its nonabrasiveness, allowance for freedom of movement, puncture resistance, and ease of maneuverability. Reusable fabric can also be made water repellent, therefore resistant to blood and body-fluid penetration, and in addition the higher density of treated fabric provides an effective barrier against bacteria. When costs are integrated, the use of wovens may represent a better use of hospital resources. Although in some cases paper products will remain in use for specific applications, the universal use of paper products in any health care facility should be avoided.

10.3.3 Product Substitution

Plastic covers for pillows can be replaced with vinyl/nylon laminate covers. These covers would prolong the life of the pillows, decrease the risk of infection and reduce waste by continuing the use of woven pillow covers. In some cases within the laboratories, reprocessing of glassware may prove an economical alternative to plastic disposables. Surgical sponges represent a significant fraction of the infectious waste stream. A recommendation was made to investigate, as a pollution prevention/waste minimization alternative, whether sponges are being used for purposes better suited for absorbent, reusable towels (e.g., clean-up activities).

10.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Suggestions for research and development possibilities in the health care industry include: (1) conducting cost studies for certain health care products in cooperation with other Federal agencies, such as Veterans Affairs and Health and Human Services; (2) working with trade associations and other Federal agencies, such as the Food and Drug Administration in reviewing technical, legal and policy impacts of reusing disposables; (3) stimulating the development of cooperative reprocessing service centers; and (4) developing procurement guidelines for the VA which will stimulate the production and distribution of reusables and recyclables.

10.5 STATUS OF IMPLEMENTATION

Due to safety concerns at the medical facility, VA-Cin has not implemented any of the pollution prevention options outlined above. Instead, VA-Cin has instituted a simple recycling program that has been very successful to date. The program consists of recycling cardboard and white paper and has expanded in August 1994 to include aluminum cans. The program has significantly reduced the solid waste generated by the facility, i.e., trash removal from the facility has been reduced to once per week from the earlier levels of three times per week.

VA-Cin has also implemented a reuse program for their floor maintenance pads (i.e., various grades of buffing pads). These pads are now being washed and reused. Estimated savings from this program are $10,000 to $15,000 per year.

VA-Cin is investigating the use of a reusable bed pad. This bed pad would alleviate the need for bladder protection products for some patients. This program is in the preliminary stages; the waste reduction potential of this program is as yet unknown.

SECTION 11

DEPARTMENT OF TRANSPORTATION
U.S. COAST GUARD SUPPORT CENTER NEW YORK
GOVERNORS ISLAND

This project, conducted in 1990, attempted to develop management initiatives and as technical changes that could be implemented for pollution prevention purposes. Technical pollution prevention evaluations conducted at this site centered on paint removal by blasting, painting, and solvent recovery.

11.1 FACILITY DESCRIPTION

Governors Island is located off the southern tip of Manhattan and is accessible primarily by a Coast Guard- operated ferry. The island encompasses 175 acres and consists solely of Coast Guard facilities which are grouped together under the name "Support Center New York." The Island serves as a support center for Coast Guard activities conducted within the New York area and for tenant commands located on the Island, and is the home port for a number of Coast Guard cutters. There are 22 different commands represented on the Island, each reporting to Headquarters in Washington or to an off-site location. Support Center New York supports all activities on the Island, although it does not have authority over all commands.

11.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

11.2.1 Management Activities

The Governors Island facility generates a substantial amount of hazardous waste in the form of lead-acid batteries, lead-contaminated blast grit, paint, and paint-related material. The Hazardous Waste Office estimated that actual disposal costs for hazardous wastes total $150,000 per year, while total annual costs for disposal including overhead for materials handling activities are approximately $270,000. During the assessment, the hazardous waste management activities on Governors Island were reviewed. The resulting study included: (1) identification and review of successful pollution prevention programs currently in place; (2) identification of pollution prevention problem areas; and (3) identification of potential management solutions for problems.

11.2.1.1 Successful Pollution Prevention Programs in Place--

These programs include use of lead-free paint throughout the Coast Guard, development of a new paint with lower VOC content, use of solar batteries in aids-to-navigation, and elimination of engine coolants containing dichromate additives. In addition, a pollution prevention policy has been established for the facility and instructions specifically citing pollution prevention objectives have been provided. Pollution prevention initiatives implemented at the facility include the following: establishment of a hazardous waste tracking system; purchase of a compactor for waste paint cans; installation of a new baghouse and recycling program which has reduced blasting grit volume by 50 percent; use of disposable brushes to reduce paint thinner wastes; installation of a silver recovery unit on the x-ray apparatus in the sickbay; recycling of Safety-Kleen products; and reusing certain materials sent for disposal by others.

11.2.1.2 Pollution Prevention Problem Areas--

Problem areas identified include governmental issues concerning lack of motivation for compliance, funding and procurement practices, and site organization and facilities. Examples of governmental issues include: end-of-year spending, resulting in the purchase of new paint when current reserves are sufficient; lack of proper storage for preservation of paint quality, contributing to excessive waste; high turnover of military personnel, contributing to problems of hazardous waste handling; and lack of employee awareness, contributing to the unnecessary generation of hazardous waste at the facility.

Examples of organizational- and facility-related issues include: the presence of tenant commands with no centralized procurement or accountability, resulting in poor management of supplies; and the use of multiple disposal contractors by tenant commands, causing significant generation of hazardous waste, primarily paint. Storage areas throughout the facility are unheated, causing stored paints to degrade and require premature disposal. It has been estimated that 50 percent of the paint disposal is unnecessary.

11.2.1.3 Potential Management Solutions--

Solutions recommended by the study include the following: work toward cultural changes emphasizing commitment on all levels; forcefully express policies; provide employee training and incentive awards; and conduct detailed engineering evaluations of the waste generating processes. These solutions would require a concerted effort from both Coast Guard Headquarters in Washington and from Governors Island for policy changes, funding, implementation and technology transfer. Additional recommendations include addressing storage areas and procurement practices. For example, central warehousing could eliminate the loss of paint from storage in unheated lockers, and a centralized purchasing system would eliminate duplication of supplies with short shelf lives. Other possibilities include allowing for effective substitution of pollution prevention products, and expanding accountability and reporting protocols to make individual commands more aware of their waste generating potential.

11.2.2 <u>Technical Evaluation for Pollution Prevention</u>

Several technological operations and processes related primarily to buoy maintenance and refurbishment were identified as key areas for consideration of pollution prevention opportunities. Maintenance of buoys used as navigational aids is one of the Coast Guard's responsibilities. Buoys require refurbishing every four to six years. Old and degraded paint is removed by blasting with steel shot through a high-pressure air gun and several coats of durable paint are reapplied. The steel shot is recycled approximately five times, until it becomes too fragmented for use. Spent shot is collected, stored, and disposed of as a hazardous waste because it contains low levels of lead. In 1988, approximately 120 55-gallon drums weighing about 750 pounds each were disposed of. Estimated costs for steel shot purchase and disposal are approximately $38,000 per year.

Frequent painting preserves the appearance and protects the integrity of equipment exposed to aggressive saltwater environments. Buoys and other equipment are spray painted using a Binks Airless 1 spray gun and a high-pressure air system. Buoys are spray painted with several different paints, including an epoxy anti-foulant. A total of approximately 5,300 gallons of various coatings are used annually. It is estimated that the transfer efficiency of paints using this equipment is only about 50 percent.

11.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

Of the several options examined, the following were considered most feasible for the near future, both from an environmental and a cost perspective: (1) low-pressure guns to replace the airless guns; (2) replacement of steel shot with plastic media; and (3) use of an on-site still for recovery of reusable solvent.

11.3.1 Low Pressure Spray Guns

Use of an HVLP spray gun significantly reduces overspray from an estimated 50 percent with an airless gun to only 15 percent with the HVLP gun. This immediately translates into a reduction in the amount of paint used, resulting in a comparable reduction in the amount of VOC emitted to the atmosphere. In addition, by reducing the overspray, sludge buildup in the water curtain is decreased and the time between required cleanouts is reduced. The cost of the new HVLP gun system and compressor is less than $1000 and retraining of operators is minimal, making this an attractive option. Closed system spray gun cleaners are now available at a relatively low cost ($500 at the time of the assessment). These systems avoid discharge of solvent to the air while using a minimum amount of solvent. Estimated payback for the conversion is only 0.5 months.

11.3.2 Plastic Shot

The use of plastic shot as an alternate blasting media is an emerging technology and should be readily implemented at Governors Island. The changeover from steel shot to plastic shot can be made with essentially no capital investment and only minor adjustments. The changeover would significantly reduce the weight of the dust due to the plastic material's lighter density (50 pounds per cubit foot versus 300 pounds per cubic foot for steel), while increasing the recycle capability from five cycles for steel to 20 for plastic. Lead from the older lead-based paints will remain a problem until all the buoys have been painted with the new no-lead paint; however, unlike steel, the plastic dust can be incinerated. This option is highly cost-effective, with payback occurring in only 3.4 months.

11.3.3 On-Site Still for Solvent Recovery

Waste paint and solvent thinner are major sources of waste and significant contributors to disposal costs, consequently, reclamation of solvents may have cost and environmental benefits. Small scale stills (15 to 20 gallons per day) for reclamation by distillation were evaluated as a possible alternative to disposal. This operation is estimated to recover 50 to 90 percent of the volatile solvents from paints and contaminated solvents.

11.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Additional research is needed to ensure that plastic shot will effectively remove rust and will not adversely affect the paint application process.

11.5 STATUS OF IMPLEMENTATION

The Governor's Island installation has implemented one of the options identified in the PPOA: the use of plastic shot as an alternative blasting media. However, no data on waste reductions from the changeover have been gathered.

The U.S. Coast Guard is also in the process of evaluating several of the other pollution prevention alternatives that were discussed above for many of their installations. In addition, a replacement for the current buoys is being pursued. A dense foam buoy which has color embedded in the foam is being tested. This buoy would require no further painting or repainting. The use of low-pressure spray guns is being evaluated for many facilities, although no data are available on the results of that evaluation.

Due to budget constraints, the on-site solvent recovery unit that was suggested has not been pursued. The Governors Island installation has purchased and installed a distillation unit for recovering antifreeze; however, data on the effectiveness of that unit are not available.

SECTION 12

DEPARTMENT OF TRANSPORTATION
U.S. COAST GUARD BASE KETCHIKAN

A PPOA was conducted at the U.S. Coast Guard's Base Ketchikan in Alaska in 1990. This project was jointly funded by EPA Region X and the Risk Reduction Engineering Laboratory.

12.1 FACILITY DESCRIPTION

Over 100 Coast Guard and civilian personnel are employed at Base Ketchikan, Alaska. The primary functions of the Base are to maintain several hundred aids to navigation (ATON) in Alaskan waters and to support and maintain several Coast Guard cutters and boats, which are used for search and rescue operations, law enforcement, and ATON maintenance. Four tenant commands, with accompanying housing and medical facilities, are located on the Base.

12.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

Major waste generating activities are buoy maintenance and vessel maintenance. The Base also receives hazardous wastes generated by Coast Guard units in southeast Alaska.

12.2.1 Buoy Maintenance

Most of the 300 ATON maintained by the Base are steel buoys. Preventative maintenance performed annually includes battery replacement, wiring repairs, lights and bells maintenance, lighthouse generator checks, and anchor checks. The buoy hulls are overhauled every five to six years, with an average of 82 buoys overhauled each year. The overhaul process involves pressure spraying to remove barnacles and other marine growth, blasting to remove all paint, preparing the surface for repainting, buoy repairs as needed, and repainting. Wastes generated in the process include batteries, blasting waste (blasting media and paint dust), waste paints, thinners, and paint slops.

12.2.2 Vessel Maintenance

Vessel maintenance includes engine maintenance, oil changes and coolant replacement, periodic maintenance of all on-board systems, and an overhaul approximately once every five years. Maintenance is performed on an average of five vessels each year. Paint removal from hulls is accomplished by dry blasting using granulated smelter slag or gravel blasting material. Steel shot cannot be used because it damages the aluminum vessel hulls. Wastes generated from these processes include waste oil, coolant, bilge waste, spent blasting media, paint wastes, thinner, and solvents. Bilge waste consists of a mixture of water, oil, diesel fuel, and coolant, and comprises the largest volume of hazardous liquid wastes disposed of at the Base.

12.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

Pollution prevention options were identified for the six primary areas of waste generation: (1) paint blasting; (2) painting vessels and buoys; (3) use of solvents; (4) bilge waste; (5) waste oil; and (6) antifreeze/coolant waste.

12.3.1 Blasting Waste

Options for reducing blasting wastes and toxic waste paint include: (1) using lead-free non-toxic paints; (2) constructing concrete floors for marine ways to collect paint removal wastes; (3) using recyclable plastic blasting media; (4) retesting the waste for hazardous components; and (5) reducing the frequency of repainting.

12.3.1.1 Lead-Free, Nontoxic Paints--

Using lead-free, nontoxic paints is an effective, long-term method for reducing hazardous painting wastes.

12.3.1.2 Concrete Floors--

Until all existing toxic paint is removed and nontoxic paints are used exclusively, installing concrete floors beneath vessel painting operations would allow for collection of toxic blasting wastes. While initially expensive ($200,000), this option would result in an annual payback of $30,000 with a payback period of 6.7 years.

12.3.1.3 Plastic Blasting Material--

An inexpensive option for reducing waste is to use plastic blasting material to remove paint. Such material can be used up to 20 times and with such precision that one coat of paint can be removed at a time, eliminating the need to strip the paint to bare metal. However, the plastic material cannot dislodge rust or heavy encrustation from metal buoys.

12.3.1.4 Retesting Wastes--

To reduce expensive hazardous waste disposal costs, the blasting waste should be retested to confirm that it is hazardous.

12.3.1.5 Reduce Painting Frequency--

Reducing the frequency of repainting would reduce the generation of blasting waste.

12.3.2 Painting Vessels and Buoys

Several of the options associated with painting vessels and buoys are (1) substituting lead-free, nontoxic paint; (2) using HVLP paint guns; and (3) using a benchtop distillation system to recycle paint waste and thinner.

12.3.2.1 Lead-Free, Nontoxic Paints--

As with blasting operations, using lead-free, nontoxic paints is an effective, long-term method for reducing hazardous painting wastes.

12.3.2.2 HVLP Paint Guns--

Using HVLP paint guns will provide an estimated $12,250 savings per year, with an initial investment of only $1,300 and a payback period of less than one year. The HVLP gun improves paint transfer efficiency so that more of the paint reaches the surface and less evaporated solvent is released as VOC.

12.3.2.3 Benchtop Distillation System--

Liquid paint waste and thinner can be recycled with a benchtop distillation system. The recycled thinner is adequate for cleaning use, but not for thinning paint. The resulting paint sludge, while still hazardous, would be reduced in volume, providing an annual savings of $6,200 and a payback in 0.6 years.

12.3.3 Solvents

The Base uses a variety of solvents, including Stoddard, trichloroethane-based engine cleaners and degreasers, paint thinners (primarily MEK), and epoxy cleaners. In one year, almost 800 gallons of solvent waste were disposed of as hazardous wastes. Several options for reducing the use and disposal of solvents are (1) using commercial substitutes; (2) steam pressure washing prior to solvent use; (3) filtration; and (4) proper handling.

12.3.3.1 Solvent Substitutes--

Several commercial solvent substitutes are available; however, each must be used to determine if it is compatible with materials being cleaned and performs the task adequately. While less toxic, some substitutes exhibit other characteristics, such as flammability, that may render them hazardous.

12.3.3.2 Steam Pressure Washing--

Steam pressure washing prior to solvent use will reduce the volume of solvent needed.

12.3.3.3 Filtration--

Regular filtration or removal of dirt and sludge can also extend the solvent's useful life significantly.

12.3.3.4 Proper Handling--

Proper handling of solvents will reduce the loss of solvent through evaporation and spillage. Examples of proper handling include: securing container lids; using spigots, pumps, or funnels when transferring the solvent; segregating solvents so that they are not mixed with other wastes (rendering the waste unfit for recycling); and segregating chlorinated and non-chlorinated solvents.

12.3.4 Bilge Waste

Bilge, a mixture of water, oil, diesel fuel, and coolant, comprises the largest volume of liquid wastes disposed of as hazardous waste at the Base. Options for reducing this waste include base-wide use of oil-water separators and an ultrafiltration system.

12.3.4.1 Oil-Water Separators--

Base-wide use of oil-water separators and avoidance of detergents or other emulsifying agents that inhibit oil/water separation would result in an annual savings of more than $18,000 with a payback period of 1.4 years.

12.3.4.2 Ultrafiltration--

If bilge emulsions are inadequately treated by the oil/water separator, an ultrafiltration system could be used to reduce the bilge waste stream. Ultrafiltration systems incorporate a first stage coalescer followed by a second stage membrane separation unit. While these units require more maintenance, the expense can be recovered within two years, from the resulting reduction in hazardous waste disposal costs.

12.3.5 Waste Oil

Oil is generated by engine lubrication on boats, cutters, and shore facilities and generators. Possible pollution prevention measures identified include segregating the oil waste for later recovery and by-pass filtration systems.

12.3.5.1 Segregation--

The best solution for reducing waste oil is to segregate it from other wastes, particularly halogenated solvents, and recycle it for on- and off-site energy recovery.

12.3.5.2 By-Pass Filtration--

By-pass filtration systems would also extend the life of oils, reducing purchase and disposal costs. With a total investment of $17,000, savings of at least $60,930 can be realized with a payback period of less than one year.

12.3.6 Antifreeze/Coolant

Purifying engine antifreeze/coolant with commercially available filtration systems can avoid both disposal and purchase costs. With a cost of less than $8,000 and an annual savings of $6,880, the payback period for use of such a filtration system is 1.2 years. Large scale purification is also commercially available.

12.4 STATUS OF IMPLEMENTATION

A Base pollution prevention committee has been established at Base Ketchikan and is acting in cooperation with the Alaska Department of Conservation (ADC). The Base has shown reductions in the waste streams generated; however, documentation is not available to quanify the amounts and types of reductions.

Two pollution prevention programs in effect currently deal with waste oil and waste batteries. Waste oil is now burned for heating value. Waste batteries are given to the local auto parts store which has arrangements for recycling them.

SECTION 13

DEPARTMENT OF ENERGY
SANDIA NATIONAL LABORATORIES

PPOAs at the Department of Energy Sandia National Laboratories (SNL) were completed in 1993. Several areas were identified for waste reduction within the SNL complex. Specifically targeted were the Geochemical Laboratory (GL) and Manufacturing and Fabrication Repair Laboratory (MFRL). This project was jointly funded by EPA and DOE.

13.1 FACILITY DESCRIPTION

SNL is located in Albuquerque, New Mexico, within the boundaries of Kirkland Air Force Base (KAFB). SNL is owned by the United States government and is operated by Sandia Corporation, a subsidiary of AT&T, under a prime operating contract with the DOE. SNL consists of five technical areas and several remote test areas, whose primary mission is national security with an emphasis on nuclear weapons development and engineering. In the process of pursuing this mission, SNL has evolved into a multiprogram laboratory pursuing broad aspects of national security issues. As by-products of production, research and development, and environmental restoration activities, Sandia generates a variety of waste materials, all of which are carefully controlled and regulated by the Federal government and state and local agencies.

The GL performs analyses of earth materials and simulates earth conditions. The MFRL repairs printed circuit board assemblies and wiring and box assemblies (mother boards) for use in satellite systems.

13.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

13.2.1 Geochemistry Laboratory

The GL performs primarily physical and chemical composition analyses of earth materials, and simulates earth conditions (e.g., subjecting rock samples to extreme temperature and pressure). Varied analytical instruments are used at the GL, including an atomic emission spectrophotometer, a scanning electron microscope (SEM), x-ray diffraction analyzer, scintillation counter, and an ion chromatograph. Various wet chemistry techniques are also used. Grinding, sieving, and polishing equipment are used for sample preparation. Additionally, the GL operates a small machine shop comprised of a drill press, lathe, and grinder.

Three types of research projects are performed by the GL, segregated primarily by the degree of researcher control over project design. Type 1 projects account for approximately 40 percent of GL's work load, and are funded by a sponsor and completed by one to two GL personnel over a period of several years.

Type 2 projects account for approximately 50 percent of the GL workload, and include those involving a proposal submitted by another group who asks assistance from the GL. Type 2 projects are the most likely to be terminated before completion and, consequently, generate the largest quantity of wastes. For example, funding for a project examining brine inclusions in salt formations at DOE's Waste Isolation Pilot Plant site was withdrawn before project completion, leaving the GL with

50 pounds of rock salt to be disposed of as chemical waste. Bench top wet chemistry research in a Type 2 project also contributes to waste production.

Type 3 projects, accounting for approximately 10 percent of the GL workload, include projects where the GL is asked by other SNL researchers to perform a specific task. These projects are typically short, of one to three days duration.

Materials such as rock and soil samples are archived in one of two libraries established at the GL, to allow for possible retesting or because of their unique origin or composition. The second library consists of a chemical library, where chemicals not consumed during projects are allowed to accumulate. Both libraries accumulate samples until additional space is unavailable, at which time the accumulated samples are disposed of as chemical waste. Unique rock and soil samples are either retained indefinitely or archived at sites where they were collected.

The largest waste stream by volume generated by the GL consists of Polaroid film backs from SEM photography, estimated at 14 kilograms per year. The largest waste stream by weight consists of discarded, unused samples of cement core, soil, and rock. Since this waste is disposed on an infrequent basis, annual generation data are not available. Spent solutions and solids from various analytical techniques are generated at an estimated 77 kilograms per year.

13.2.2 Manufacturing and Fabrication Repair Laboratory

The MFRL repairs printed circuit board assemblies, wiring, and box assemblies for use in satellite systems, and also repairs similar assemblies for ground equipment. Currently, about 70 percent of the electronic boards are destined for satellite applications, and the remainder are used in miscellaneous ground equipment. Approximately 80 percent of the 1,100 repairs performed from October 1991 to September 1992 involved boards, with the remainder divided between boxes and cables. Board repairs involve changing and modifying design by adding or replacing electrical components, and occasionally replacing faulty electrical components. Box and cable repairs involve soldering new resistors, capacitors, transistors, etc. All repairs are inspected to ensure that the work has been adequately completed.

Wastes generated by the MFRL total approximately 683 pounds per year, and consist primarily of bulk solvent (approximately 88 percent), with various amounts of solvent-contaminated laboratory trash, rinse water, conformal coating waste, isopropanol, solder and lead scraps, potting compound waste, isopropanol-contaminated laboratory trash, adhesive-contaminated laboratory trash, and flux-contaminated laboratory trash. These various wastes are generated at an annual rate of approximately 80 pounds. MFRL wastes are generated primarily from board repair projects, although a portion is related to the repair of box assemblies and cables. Total waste generation on a per unit basis can vary significantly from one repair to another, but averages 0.62 pounds (0.07 pounds excluding bulk solvent).

13.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

The number of laboratories at SNL and the nature of laboratory work result in a large number of small quantity waste stream generators. Site-wide pollution prevention opportunities offer the greatest potential for waste reduction.

The need for generating reproducible laboratory results and a strong reliance on standard methods hinder implementation of pollution prevention initiatives that could compromise a researcher's findings. Scientists are reluctant to carry out many pollution prevention activities due to the complexity of Federal and state hazardous waste regulations. Feasibility of pollution prevention opportunities identified therefore depends to a large extent on the attitude and confidence of SNL's researchers. Elevating pollution prevention objectives to the level of other crucial scientific principles through education and training may result in significant reductions in waste generation.

13.3.1 Geochemistry Laboratory

Pollution prevention options for the GL focused on management activities. Through education and training efforts, pollution prevention can be built into the research process. Additional options for pollution prevention with respect to specific project types include:

- Type 1 Projects - design pollution prevention into proposals for research activities; build in funding for proper waste management; return unused, contaminated samples to point of collection of SNL grounds.

- Type 2 Projects - escrow a portion of available funds to cover cost of project closeout; contact other labs within SNL before ordering chemicals to determine their local availability; encourage chemical suppliers to accept returned, unopened chemicals and issue refund or credit; exert tighter controls on sample sizes sent to GL.

- Type 3 Projects - determine sample quantities needed and alternatives to sample analyses; expand use of microanalytical techniques; retain or return to requester unused portions of samples.

Site-wide options for pollution prevention include the following:

- Chemical Material Management System - provide a life cycling and control mechanism for chemical materials.

- Central Purchasing - educate procurement personnel to spot material substitution opportunities.

- Central Distribution - determine usage patterns of operations that commonly use and dispose of certain chemicals; order specialty chemicals through the site-wide stockroom; identify other potential users.

- Checkout System - require employees retiring or leaving the laboratory to report the status of chemicals and samples present in their laboratories.

- Chemical Exchange - require supplying researcher to certify that contents of an opened container have not been altered by the addition of contaminants or improper storage; explore ways to use expired chemicals for other applications.

- Chargeback System - use chargeback money for site-wide pollution prevention options.

13.3.2 Manufacturing and Fabrication Repair Laboratory

Several pollution prevention options were identified for the MFRL including: (1) testing the rinse water; (2) eliminating ziplock bags; (3) reusing swabs; and (4) eliminating bench cleaning.

13.3.2.1 Test Rinse Water--

Testing rinsewater which is disposed of as a D008 hazardous waste may reveal that it is non-hazardous, resulting in reduced disposal costs and allowing the water to be used for other non-potable purposes.

13.3.2.2 Eliminate Ziplock Bags--

Nonflammable contaminated laboratory trash is placed in Ziplock bags and carried to a 30-gallon container in the storage room. The container is also lined with a plastic bag, which is removed when full, transported to the waste disposal area and combined in a special container with other wastes. The ziplock bags are labelled with a bar code for tracking purposes, but contain mostly air and thus occupy unnecessary space. The use of ziplock bags could be eliminated by keeping a lined 20-gallon polyethylene container in the vapor degreasing room for disposal of contaminated laboratory trash. Similar 20-gallon containers are already used for waste disposal at SNL.

13.3.2.3 Reuse Swabs--

By breaking off the ends of contaminated swab sticks and using the non-contaminated end, the volume of hazardous waste could be reduced with no capital costs involved. This practice would reduce an estimated 80 percent of the laboratory waste resulting from swab use.

13.3.2.4 Eliminate Bench Cleaning--

Bench cleaning is sometimes performed to deflux soldered connections, generating laboratory trash. Boards are cleaned in the vapor degreaser after repair, regardless of whether they were bench cleaned. Eliminating the bench cleaning step altogether would reduce the generation of solvent- and flux-contaminated trash, and would also reduce the use of wipes and swabs.

13.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

The pollution prevention options discussed in the previous sections are for very small waste streams, and represent but a few of the types of activities that could be identified using a systematic pollution prevention assessment system. An ongoing effort should be initiated to prioritize waste-streams according to quantity and/or type for further examination.

13.5 STATUS OF IMPLEMENTATION

The recommendations of the PPOA performed as part of the WREAFS program have not been directly implemented at Sandia National Laboratory. However, these recommendations have indirectly influenced pollution prevention activities at SNL.

The complexity of the EPA recommendations encouraged the Department of Energy to develop its own internal graded approach to PPOAs. A team including DOE personnel and contractors developed the PPOA guidance document currently in use at SNL. This document, entitled *Model Pollution Prevention Opportunity Assessment Guidance*, (2) is based on EPA's PPOA guidance but has been reduced in size and made more specific to the DOE laboratory facilities and their low volume waste streams. The DOE PPOA guidance document is currently used to help identify waste streams that may be reduced or eliminated at SNL.

SECTION 14

DEPARTMENT OF AGRICULTURE
BELTSVILLE AGRICULTURAL RESEARCH CENTER

A PPOA to identify opportunities for waste reduction at the Beltsville Agricultural Research Center was completed in 1992.

14.1 FACILITY DESCRIPTION

The U.S. Department of Agriculture's Beltsville Agricultural Research Center (BARC) is located in Beltsville, Maryland. BARC employs approximately 1,000 scientists and technicians who perform research work in all areas related to the Agricultural Research Service's activities, including livestock diseases, animal and human nutrition, animal genetics and physiology, plant productivity and diseases, and other topics.

14.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The investigation focused on three areas: (1) general hazardous materials handling and usage; (2) total Kjeldahl nitrogen (TKN) analysis; and (3) high performance liquid chromatography (HPLC) analysis.

14.2.1 General Hazardous Materials Handling and Usage

The BARC facility generates over 5,000 gallons of hazardous wastes annually at a disposal cost of $423,000. A strong site-wide hazardous waste management program led by the Safety, Occupational Health, and Environmental Section Office includes state-of-the-art marshalling facilities for solvent bulking, site-wide hazardous waste training, the presence of collateral hazardous waste duty officers in each research institute, an electronic mail system for onsite chemical trading, and recycling programs. A charge-back policy has been instituted whereby management units are assessed for disposal costs. These incentives, together with the environmental ethic of many researchers and their desire to minimize raw material costs, had already lead to significant onsite pollution prevention prior to the assessment.

14.2.2 Total Kjeldahl Nitrogen Analysis

The TKN method is used to determine protein nitrogen in biological materials. Samples are oxidized in hot, concentrated sulfuric acid which converts bound nitrogen to ammonium ions. Subsequent steps include treatment with an excess of a strong base, distillation, and titration of liberated ammonia to determine nitrogen content. Waste reagents used in the TKN analysis include the digest, which is alkaline and contains metals used as catalysts, and the distillate, which is either acidic or basic. Amounts vary depending on the nitrogen content of the sample. Samples with low nitrogen content are analyzed by macro-Kjeldahl techniques which use increased sample sizes and typically generate 500 to 600 milliliters of waste per sample. Samples with high nitrogen content are analyzed by micro-Kjeldahl analyses, which use smaller sample sizes and generate waste at approximately 50 to 100 milliliters per sample. BARC's total acid and base waste streams during 1990 were approximately 850 gallons.

14.2.3 High Performance Liquid Chromatography Analysis

HPLC is used extensively at BARC laboratories to separate, isolate, and identify components of mixtures. Solvents are used as mobile phase to introduce samples and to elute analytes through and off the chromatography column at specific times, based on their differing affinities for the column packing material. A pump regulates solvent flow, and a sensitive detector identifies and quantifies compounds eluting from the column. Typical solvents used include aqueous mixtures of methanol and acetonitrile. The HPLC effluent is flammable and may exhibit other characteristics of hazardous waste.

Organic solvents are also used during sample preparation to isolate a specific analyte or characteristic class of compounds, or potential interferents for the sample matrix. Sample preparation at BARC includes liquid-liquid extraction, in which aqueous samples are extracted with organic liquid, or solid-liquid extraction, in which solid samples are extracted directly in solvent. Secondary extractions may also be performed. Extraction solvents primarily include chloroform, hexane, methanol, and methylene chloride.

During 1990, approximately 2,600 gallons of waste solvents were disposed of at the BARC facility. A significant amount of this waste stream consists of organic solvents which were used in connection with HPLC analyses and sample preparative procedures.

14.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

14.3.1 General Hazardous Materials Handling and Usage

Impediments to implementing pollution prevention techniques at BARC include the large number of small waste streams generated and the need for approval of new laboratory methods by independent boards such as the Association of Official Analytical Chemists (AOAC). However, several pollution prevention options exist in this area, including training and assessments, process or equipment modification, waste segregation, and a pollution prevention policy.

14.3.1.1 Training and Assessments--

A "Pollution Prevention Officer" could be appointed within each research institute to assist researchers with reduction and recycling initiatives. A network of such officers could be established to foster communication and reduce repetitive pollution prevention development efforts. Periodic laboratory pollution prevention assessments could be used to uncover additional pollution prevention opportunities and monitor the success of ongoing programs.

14.3.1.2 Process or Equipment Modification--

One option recommends that pollution prevention officers should be aware of new technology that will prevent pollution in a laboratory setting. Where the technology is expensive, resources could be pooled and the technology or equipment shared by several laboratories. Atmospheric emissions of chemicals from laboratories could be reduced by such actions as using commercially available glassware and automated extraction systems. In addition, for some samples, emissions can be reduced through solid phase extraction techniques, as opposed to classical liquid evaporation techniques that release the solvent carrier into the fume hood and subsequently to the atmosphere.

14.3.1.3 Waste Segregation--

Hazardous waste volumes are often unnecessarily increased due to the addition of waste streams that are not hazardous. Segregation of hazardous from nonhazardous wastes can significantly reduce hazardous waste generation rates and subsequent disposal costs.

14.3.1.4 Pollution Prevention Policy--

Each laboratory should have a written pollution prevention/waste management/reduction policy. Minimum requirements would include annual chemical inventories and the dating of chemicals as they are received.

14.3.2 Total Kjeldahl Nitrogen Analysis

The TKN process could be replaced with commercially available automated microcomputer-based analysis systems that use combustion techniques to remove nitrogen and a thermal conductivity detection system to measure nitrogen release. This would eliminate the need for solvents, but the cost of $30,000 may be a limiting factor for laboratories conducting a small number of analyses each year. For those laboratories involved in a sufficient number of analyses, however, the payback period using a nitrogen autoanalyzer instead of the TKN process is 2.6 years. The payback for substituting a phenate autoanalyzer is 7.4 years. Use of the autoanalyzer also improves worker safety by eliminating hot acids and bases and trioxide fumes generated during digestion. Although acid and base wastes are eliminated, copper fillings and anhydrous chemicals used for water removal must be disposed of when spent.

14.3.3 High Performance Liquid Chromatography Analysis

Pollution prevention options include replacing the standard HPLC analysis with solid phase extraction (SPE) techniques or supercritical fluid extraction, and column/particle size reduction.

14.3.3.1 Solid Phase Extraction Techniques--

Solid phase extraction techniques employ small disposable columns containing sorbent for bonding and eluting analytes of interest. Solvent usage can be reduced by over 95 percent when performing certain extractions, because one to two millimeters of solvent in an SPE filter or cartridge can accomplish the same function as 200 to 300 milliliters of solvent in a standard HPLC system.

14.3.3.2 Supercritical Fluid Extraction--

Supercritical fluid extraction (SFE) is an innovative technique that may replace chlorinated solvent extractions. In SFE, a gas is compressed above its critical temperature and pressure points, and is thus transformed into a supercritical fluid exhibiting high diffusion coefficients and low viscosities. Varying the temperature and pressure (density) of the supercritical fluid allows for very selective extractions. With a capital cost of $30,000, a projected annual usage of 150 extractions per week, and the elimination of purchase and disposal costs for organic solvents, the payback for this option is less than 18 months.

14.3.3.3 Column/Particle Size Reduction--

Converting from a typical column configuration (4.6 millimeters internal diameter by 25 centimeters length) to a smaller column internal diameter reduces the amount of sample needed, and hence, reduces the wastes generated from the sample preparation step. Reducing the packing particle size enhances sensitivity by narrowing the analyte peakwidths. Solvent consumption can also be reduced by using a shorter column length, which produces shorter elution times while preserving the separation resolution. Although these techniques may not be feasible for all HPLC analyses, their use could reduce waste by as much as 80 percent with a payback period of less than three months.

14.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Total quantities of hazardous wastes must be measured to determine the economic viability of various pollution prevention options.

14.5 STATUS OF IMPLEMENTATION

The BARC PPOA report and project summary were received in December 1993. Because the report was received so recently, there has not been time to fully explore and evaluate the recommendations contained. The report and summary have been distributed among the upper management at BARC. Major conclusions of the PPOA were discussed at a quarterly meeting of the chairpersons of the Institute/Center safety committees, and were also included in the required hazardous waste training courses conducted for all waste generators and new employees.

Although it is too early to attribute any reductions in hazardous waste generation to the recommendations of the PPOA, some of the options presented are already in practice, including the appointment of "hazardous waste advisors" in each center who are laboratory personnel trained to be local points of contact on hazardous waste management. Greater efforts and education have been directed toward waste segregation to reduce hazardous waste generation rates and disposal costs.

A survey to assess the feasibility of the PPOA recommendations is currently being considered, and BARC will continue to work collaboratively with waste generators, primarily scientists, to further the goals of the PPOA. However, pollution prevention activities are difficult because of the relatively small quantities of a large variety of chemicals being used at BARC. The acquisition and incorporation of new technologies must be phased in over time as new projects begin and funds become available. Ongoing projects must continue using the same technologies to avoid introducing new variables which might influence the results.

SECTION 15

DEPARTMENT OF INTERIOR
BUREAU OF MINES ALBANY RESEARCH CENTER

A pollution prevention workshop was held at the Bureau of Mines Albany Research Center in 1992. The first part of the workshop introduced participants to basic pollution prevention concepts. During part two, participants applied pollution prevention concepts to three areas at the Albany Research Center.

15.1 FACILITY DESCRIPTION

The Albany Research Center, located on a 42-acre site of the former Albany College in Albany, Oregon, is one of five Bureau of Mines Centers in the United States researching metals and minerals. The Center was established in 1943 to investigate possible mineral-related uses for the abundant low-grade resources of the area and to develop new metallurgical processes using the area's plentiful supply of electrical energy. The Center's staff of 150 engineers, scientists and technical support personnel perform research on ways to more efficiently recover, process, and use needed metals and minerals.

15.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The types of wastes disposed of by the Albany Research Center in 1991 included: chlorinated solvents, mixed combustible liquids, metal salts, chromic salts, barium salts, aluminum nitrate, mercury wastes, styrene monomer, unused flammable liquids, and lead-contaminated concrete and analysis wastes. Because of the quantities of wastes, the facility is designated as a RCRA large-quantity generator.

15.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

A complete pollution prevention opportunity assessment was not conducted at the Albany Research Center. Instead, a pollution prevention workshop was held which generated options in the following three basic areas: (1) inventory control; (2) solvent extraction research; and (3) corrosion research.

15.3.1 Inventory Control

15.3.1.1 Waste Generation Data--

Material balances performed by facility managers may help avoid shifting pollutants from one medium to another. Complete periodic inventories of chemical stock would help to make the ordering process more effective, minimizing over-ordering.

15.3.1.2 Sharing Chemicals--

A centralized receiving department can function as an internal waste exchange. Departments with excess chemicals can "advertise" through the receiving department. In addition, depending on the volume of surplus chemicals, it may be possible to give away or sell these substances through one of the dozen or so waste exchanges located throughout the United States. Schools or universities may also accept small amounts of chemicals as a donation.

15.3.1.3 Good Housekeeping--

All personnel who handle toxic substances should be trained in materials handling. For example, personnel should be discouraged from disposing of chemicals down sink drains by educating them about the harmful environmental effects, and possible legal actions, resulting from this common practice.

15.3.1.4 Waste Management Practices--

Mixing waste streams often increases treatment costs and makes recycling more difficult. Many transporters offer laboratory (lab) pack services in which small containers of different wastes are placed in large drums called lab packs. The exact chemicals must be known in the event that any of the containers break inside the lab pack. A laboratory should also practice purchasing controls. Purchasing controls require extensive pre-planning of research projects and calculation to determine the amount of materials required.

15.3.1.5 Other Options--

Several other options are to determine if suppliers will accept obsolete raw materials; ask mines and other suppliers to take back excess material not used in tests; use "first-in, first-out" inventory control to reduce overstock and outdated chemicals; designate one person to be responsible for checking the inventory once a month for leaking or uncapped containers.

15.3.2 Solvent Extraction Research

The workshop identified several pollution prevention options for solvent extraction research, including the following: modify the research design (this may not be feasible, since the yields may be too low); use non- or less toxic materials; avoid using methanol and other solvents for glassware cleaning unless absolutely necessary; check all operations to ensure that they are operating at maximum efficiency; determine whether diethyl ether can be recycled by using liquid nitrogen in the trap; consolidate similar waste streams in order to justify a small on-site recycling system; use better inventory procedures to eliminate waste generated from expired stocks; and check to ensure that all containers are tightly closed to prevent atmospheric releases.

15.3.3 Corrosion Research

Workshop group discussion generated the following pollution prevention suggestions for corrosion research: examine Greene cells for potential downsizing/scale; fill unused spaces with inert materials; reuse acids elsewhere; research alternative non-acid cleaning methods; extend bathlife through monitoring; implement pre-rinse or physical pre-cleaning before the bath; investigate electrowinning or other methods to recover metals; distill and reuse methanol in solvent extraction or cleaning.

15.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

More specific pollution prevention options could be generated from a complete PPOA conducted at this facility.

15.5 STATUS OF IMPLEMENTATION

As a result of the PPOA, seven performance goals have been established for the Albany Research Center:

- *Appoint a waste reduction team.* A team has been established and has performed several environmental audits for pollution prevention regarding chemicals used within each work group. Hazardous materials not required for research were moved to a storage warehouse. Each of the buildings at the center was assigned a hazard ranking according to the criteria set out by the fire department. NFPA ratings were assigned and each building was placarded on two sides with hazard profiles.

- *Limit purchases of drum quantities of materials.* A new policy requires a Research Supervisor to review any purchases of chemicals in 55-gallon drums. This should help avoid having excess hazardous materials requiring disposal when a project has been completed.

- *Order no more than a year's supply of chemicals.* Oversupplies of reagent grade chemicals have been purchased in the past in an effort to spend year-end funds before they are lost. This practice will be discouraged in the future.

- *Purchase no additional technical grade hydrochloric acid until supply is exhausted.* No technical grade HCL has been ordered since the program was implemented, and some of the overstock was sold to another firm.

- *Dispose of chemicals in an appropriate manner.* Employees have been instructed to contact the Environmental Manager for instructions on proper waste disposal procedures.

- *Store waste solvents and oils in an appropriate area.* The previously existing containment system failed during a solvent spill. The area was cleaned and contaminated soil evacuated. All waste chemical storage has been moved to a covered site with secure secondary containment. Decreases in the use of halogenated hydrocarbons have reduced the need for storage and disposal of these wastes.

- *Inform all employees of the new policies.* The policy has been distributed to all employees and has been discussed in each of the work divisions at a safety meeting. This has resulted in an increased awareness of the need to properly store and dispose of wastes.

SECTION 16

U.S. POSTAL SERVICE
BUFFALO GENERAL MAIL AND VEHICLE MAINTENANCE FACILITIES

A PPOA was conducted at two U.S. Postal Service (USPS) facilities in Buffalo, New York in 1992. The pollution prevention alternatives apply to commercial package-handling operations, as well as other government and commercial vehicle- servicing facilities. This project was funded by the USPS through an interagency agreement (IAG).

16.1 FACILITY DESCRIPTION

The USPS General Mail Facility (GMF) and a separate building housing the Vehicle Maintenance Facility (VMF) are located on approximately 25 acres in Buffalo, New York. The GMF consists of a three-story office building and a one-story 276,000 square foot mail processing floor. A one-story building several blocks away houses the Computerized Forwarding System and the Undeliverable Bulk Business Mail (UBBM) operation. Dock positions for more than 50 trucks are located on the east and west sides of the GMF building. The building is occupied 24 hours every day of the year and is occupied by anywhere from 688 to 1,515 full-time employees at a given time.

The Buffalo GMF receives nearly two million pieces of mail each day for processing; nearly 3 million pieces are sent out daily for delivery. The GMF serves as an area distribution center for several zip code areas, and also processes all mail from the eastern seaboard destined for Canada. As a major passageway between the U.S. and Canada, the Buffalo GMF provides space for the U.S. Customs and serves as a concentration center for mail transportation equipment.

The USPS operates the largest civilian vehicle fleet at its 350 VMF's nationwide. The Buffalo VMF is located in a one-story 121,061 square foot building. A staff of 32 automotive technicians maintain the fleet of 1,200 vehicles, which range from light delivery to 18-wheel tractor trailers. The major operations include vehicle repair, servicing, and painting. In one year, approximately 2,500 to 3,000 maintenance and repair jobs are performed and 500 vehicles completely painted with USPS colors at the VMF.

16.2 AREAS FOR POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

A pollution prevention opportunity assessment was conducted which addressed the feasibility of potential source reduction and recycling opportunities and resulted in a limited pollution prevention plan. The assessment focused on mail processing and vehicle maintenance operations.

16.2.1 Mail Processing

The GMF generates approximately 537 tons of waste per year, at an annual solid waste disposal cost of approximately $42,000. The wastes are comprised of 253 tons of old corrugated cardboard (OCC), two tons of computer paper, 46 tons of mixed office paper, 30 tons of metals, 13 tons of plastic film, 192 tons of "undetermined wastes," and an undetermined amount of machinery maintenance wastes (oil, grease and parts-cleaning solvent). The three areas responsible for generating the majority of the waste are the offices, the mail sorting floor, and the loading/unloading docks.

16.2.2 Vehicle Maintenance Facility

Operations performed at the VMF generate waste streams typical of a vehicle maintenance operation, including oil filters, spent lead acid batteries, brakes, cleaning solvent, waste paint containers, waste paint and thinner, soiled rags, buffing pads, cracked corn absorbent, used oil and fluid, used antifreeze, and radiators. Annual waste disposal costs are $21,645.

16.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

16.3.1 General Mail Facility

Several pollution prevention initiatives were already in place at the time of the PPOA. Recycling programs had been instituted at the GMF for corrugated cardboard, ferrous metal and aluminum, undelivered bulk business mail, office paper, and laser printer cartridges. Energy-efficient fluorescent lighting and interior storm windows were installed throughout the GMF to reduce lighting and energy requirements, and electric hand dryers were installed to replace disposable paper towels, potentially resulting in an annual savings of $50,000, before electricity and maintenance costs.

Additional pollution prevention options were developed for the GMF WHICH addressed the following items: (1) corrugated containers; (2) paper; (3) plastic film and strapping; (4) pallets; (5) rigid plastic containers; (6) oils, adhesives, and paints; and (7) cafeteria wastes.

16.3.1.1 Corrugated Containers--

This waste could be reduced by requiring vendors to provide products in the least possible amount of packaging, using corrugated plastic trays instead of cardboard cartons for internal mail distribution, and reusing cardboard boxes until unusable, then recycling them.

16.3.1.2 Paper--

Paper waste could be reduced by initiating a duplex copy policy, reducing the distribution of copies, and using reusable rigid plastic or metal cards instead of colored paper destination slips.

16.3.1.3 Plastic Film and Strapping--

Most plastic film (shrink wrap and stretch wrap) is removed from packaged incoming mail. This type of waste can be significantly reduced by converting to reusable cloth or net bags, wheeled bins, or metal cage containers for mail redistribution. Plastic film that is not eliminated can be recycled through the Mobil Chemical Company's Rochester manufacturing facility, which will pay $0.11 to $0.12 per pound. Using monochromatic, rather than multi-colored plastic strapping may assist in recycling the material.

16.3.1.4 Pallets--

Plastic pallets, while more expensive to purchase, are more durable than wood and result in a reduced cost per use. Plastic pallets made of high density polyethylene (HDPE) using twin sheet thermal forming are recyclable and when broken or no longer usable can be returned to the manufacturer as feedstock for new pallets.

16.3.1.5 Rigid Plastic Containers--

Waste plastic containers could be reduced by requiring bulk deliveries in refillable containers.

16.3.1.6 Oils, Adhesives, and Paints--

Strict inventory control and good housekeeping measures could reduce waste oils, adhesives, and paints caused by expired material, spills, and overstocking.

16.3.1.7 Cafeteria Wastes--

Cafeteria wastes can be reduced by instituting discounts for customers using their own mug for beverages, by allowing only reusable food service materials (e.g., plates and bowls), and by composting food wastes.

16.3.2 Vehicle Maintenance Facility

Employees have already initiated several pollution prevention measures in this area including the following: using separate paint cups for different color paints; painting lighter colors before darker colors to reduce solvent consumption; collecting unused paint prior to cleaning the equipment in the solvent sink; saving excess paint in one-gallon containers for use on the next appropriate job; and washing parts in a solvent sink.

Options for reducing wastes associated with painting operations include using low VOC paints (water-borne or high-solids coatings), using an HVLP paint application system, using a paint mixture system, installing a gun washer station, providing operator training, reducing and recycling paint cans, cleaning buffing pads, and on-site solvent distillation and recycling. Some of these options are described below.

16.3.2.1 Low VOC Paints--

There are several low VOC paints and coatings available. These include water-borne electrocoating, waterborne non-electrocoating, two-component high solids, single-component high solids, and isocyanate-free paint. Water borne coatings are formulated with water rather than organic solvents. While the average solvent-based coating contains 5 to 6 pounds of solvent per gallon, waterborne coatings contain 0.5 to 3.4 pounds per gallon, significantly reducing VOC emissions. Also, waterborne coatings can be cleaned with soap and water, eliminating use of cleaning solvents.

16.3.2.2 Paint Mixture System--

The amount of paint needed for a job and the necessary mixture of paint thinner is presently measured by the painter using best professional judgement. This can result in improperly formulated paint and/or leftover or surplus paint. Commercially available paint mixers accurately measure and weigh the necessary amount of paint according to manufacture specifications.

16.3.2.3 Paint Can Reduction and Recycling--

Paint is presently purchased in quart or gallon metal containers. Empty paint cans are drained and disposed of in the trash. It may be possible to order paint in five gallon reusable plastic containers which, when empty, would be picked up by the supplier. If a large quantity of limited colors is needed and the paint will be used before expiration dates, buying in bulk may also represent a viable option.

16.3.2.4 Buffing Pad Cleaner--

The buffing pad cleaner is an example of a low cost pollution prevention option. A simple device is commercially available for cleaning the buffing pads used to polish the newly painted vehicles. The buffing pad is strapped into place on top of a machine the size of a ten gallon drum. A rotating disk brushes off the paint dust contained in the pad, which can be reused rather than discarded.

16.3.2.5 Aqueous Cleaners--

Using aqueous cleaners is an example of a relatively simple pollution prevention option with significant benefits. The primary benefits of using an aqueous cleaning system are that it reduces the occupational hazards and waste management costs associated with solvents parts cleaning. These detergents, acids, and alkaline compounds displace the oil rather than dissolving it in organic solvent and should be of the type that readily releases the separated oil for collection. When no substitute is available for solvent cleaners, emphasis should be placed on minimizing waste generation by cleaning only as much as is necessary, minimizing losses associated with inappropriate uses (such as spills), and replacing solvents only when necessary.

Other possible pollution prevention options identified for the VMF include good operating practices for parts cleaning, on-site solvent distillation and recycling, on-site antifreeze recycling, inventory control and better housekeeping, improved waste management cost tracking, and employee participation in pollution prevention.

16.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Several of the identified options will be evaluated for incorporation into similar USPS facilities.

16.5 STATUS OF IMPLEMENTATION

Many of the recommendations made in the PPOA have been successfully implemented at the Buffalo facility. Waste management costs for FY93 were reduced by $62,333 from their 1992 values. Additional cost reductions are expected as further plans are implemented. Table 1 details the projected cost benefits from the PPOA and the actual benefits from FY93 (3).

Approximately 624 tons of solid waste were disposed of by the GMF in 1992, incurring disposal costs of $42,120. In fiscal year 1993, waste generation was reduced to approximately 244 tons. A new waste hauler was contracted, and waste disposal costs for fiscal 1993 were approximately $20,000, representing more than a 50 percent reduction from 1992 costs.

Recycling and pollution prevention programs have been implemented in several areas of the facility, with varying degrees of success. The following sections contain brief descriptions of notable program elements at the GMF and VMF.

TABLE 1. COMPARISON OF ESTIMATED AND ACTUAL RETURN FROM SOURCE REDUCTION AND RECYCLING AT THE BUFFALO GENERAL MAIL FACILITY[3]

Action	Potential Benefit Based on PPOA Study	Actual Benefit
Recycle Corrugated Cardboard	$17,228	$22,828
Recycle Computer Paper	529	399
Recycle Mixed Office Paper	5,035	5,035
Improve Division of Scrap Metals	2,334	5,168
Recycle Plastic film	3,927	0
Replace Paper Towels with Electric Air Dryers	21,681	28,525
Total Benefit	**$50,734**	**$61,955**

16.5.1 General Mail Facility

16.5.1.1 Corrugated cardboard recycling--

Approximately 312 tons of corrugated cardboard are collected annually by the GMF. Annual savings of approximately $22,878 result from eliminated collection and disposal fees. Current plans include the purchase of a baler, which will generate a net annual revenue from sales of baled corrugated cardboard.

16.5.1.2 Laser cartridges and printer ribbon recycling--

The GMF was recycling approximately 60 laser printer cartridges per year at the time of the original PPOA. As of FY93, that figure has been increased to 100 per year; additionally, 150 black printer ribbons are re-inked instead of being discarded.

16.5.1.3 Aluminum cans--

Approximately $75 to $80 per month in revenue is generated from recycling aluminum cans. The State of New York offers a five-cent deposit for each can. Approximately 1,500 to 1,700 cans per month are recycled by the GMF.

16.5.1.4 Scrap metal--

Approximately six tons of scrap metal are generated monthly between the GMF and the VMF. Seventy tons of scrap were recycled in FY93, including letter sorting machine carts, old conveyor parts, tubs and buckets, and vehicle doors, roofs, and axles. Annual savings in avoided disposal and collection fees were $5,168 for FY93.

16.5.1.5 Computer and mixed office paper--

Color-coded collection bins are used to separate computer paper from office paper. The GMF recycles 200 pounds per week of computer printouts, or 5.2 tons per year. Avoided disposal and collection costs resulted in savings of $5,434 for FY93. No specific data are available for mixed paper.

16.5.1.6 Plastic film--

Attempts to recycle the plastic film (stretch and shrink wrap) used to wrap pallets have been unsuccessful. The recycling company has stringent requirements for product cleanliness which are difficult to achieve. Because the recycler insists on delivery, the transportation costs outweigh any potential revenue from recycling the film. To date, no progress has been made on finding an alternative to shrink wrap.

16.5.1.7 Electric hand dryers--

The GMF spent approximately $30,100 per year on paper towels, including the purchase and disposal of 600 cases per year. Studies have shown that electric hand dryers are a possible means to avoid these costs. Funds have been approved to purchase 55 electric hand driers for the GMF, with an estimated payback period of six months or less.

16.5.2 <u>Vehicle Maintenance Facility</u>

16.5.2.1 Paint waste reduction--

Paint wastes comprise approximately 16 percent of all hazardous wastes generated by the VMF and are responsible for half of the hazardous waste management costs. The three primary PPOA recommendations for reduction of paint related wastes are described below.

- *Investigate water-based or high-solids paints* - Investigations at the VMF indicate that water-based primers may be substituted for conventional ones without affecting performance. Water-based top coatings, however, have been shown to exhibit insufficient durability. One solution currently under evaluation at the VMF involves the use of a waterborne primer with an acrylic enamel top coat.

- *Conversion to HVLP paint application systems* - HVLP spray guns operate at a much lower pressure than conventional spray guns, resulting in considerably lower paint waste due to bounce-back. Two HVLP spray guns were purchased for the VMF and have resulted in improved-quality paint jobs and savings in paint usage. Because the equipment was installed only recently, the VMF has not been able to provide accurate data on the incurred savings. The VMF's conservative estimate is a twenty percent reduction in paint usage per vehicle, with an associated reduction in VOC emissions. These figures are based on a four-month test period.

- *Install a paint-gun washer station* - At present, paint guns are washed in an open solvent tank. The PPOA recommended using specially designed enclosed paint-gun washing stations which reduce VOC emissions by 75 to 90 percent. The VMF has plans to purchase a paint-gun washer station during FY94.

16.5.2.2 Aerosol chemicals--

Aerosol chemical use has been eliminated in all postal facilities in the western New York District. Portable sprayers are used to dispense maintenance products, which are purchased in bulk five gallon containers. As a result, significant reductions have been achieved in waste aerosol cans and packaging. In 1992, over 2,400 aerosol paint cans were used at the VMF.

16.5.2.3 Solvent cleaning waste reduction--

In the past, approximately 4,100 gallons of waste petroleum naphtha were generated annually during brake and engine parts cleaning operations at the VMF. This represented about one third of the total hazardous waste costs. The VMF has recently converted to an aqueous cleaner for cleaning brakes, which will eliminate over 2,000 pounds of hazardous waste annually. In addition, a longer- lasting solvent for cleaning automotive parts is in use which should also result in a substantial reduction in hazardous waste generation.

16.5.2.4 Antifreeze recycling--

Historically, the VMF has purchased about 750 gallons of antifreeze annually. Approximately 300 gallons per year of antifreeze must be disposed of as hazardous waste. Although there is no cost for antifreeze disposal at this time, the VMF has investigated recycling antifreeze to avoid possible future costs, and to reduce raw material expenditures. The VMF began recycling antifreeze through a private contractor in January 1994.

16.5.2.5 Oil filter recycling--

An oil filter crusher was installed at the VMF in 1993. Oil filters are drained, crushed, and sent to a local smelter for recycling as scrap metal.

16.5.3 Northeast Area Pollution Prevention Initiatives

The recommendations of the PPOA for the GMF and VMF were officially released in March 1993 to all 25 vehicle maintenance managers in the Postal Service Northeast Area. At the same time, the Northeast Area Environmental Compliance Office also made several other pollution prevention recommendations to VMF managers. The Northeastern Area VMF managers have committed to a strong program of waste reduction and pollution prevention with the following five priority goals.

- Substitute nonhazardous products for hazardous cleaning products to reduce hazardous waste generation.

- Eliminate the use of hazardous parts cleaning solvents.

- Adopt on-site antifreeze recycling.

- Install high-volume/low-pressure spray paint guns.

- Explore the use of water-based paints.

A comprehensive pollution prevention plan has been written for all VMFs in the Northeast Area and is being supplemented by site-specific plans for each of the 25 VMFs. By September 30, 1994, all 25 VMFs will have adopted site-specific pollution prevention plans consistent with the areawide plan. Table 2 shows the progress that the 25 VMFs have already made toward adopting these pollution prevention goals (3). The plans of the Northeast Area VMF managers are quite ambitious and include adoption of EPA's 33/50 program and a commitment to eliminate all hazardous materials by 1995.

TABLE 2. WASTE PREVENTION AND RECYCLING OPERATIONS IN PLACE AT USPS NORTHEAST AREA VEHICLE MAINTENANCE FACILITIES

Location	On-site Antifreeze	Re-refined Motor Oil	Oil Filter Crusher	Tire Retread or Recycle	Clean Separator with Microbe	Aqueous/ Low Hazard Cleaner	Aqueous Brake Cleaner	HVLP
Hartford, CT	*		*	*		*	*	*
New Haven, CT	*		*	*		*		*
Stamford, CT	*		*	*		*		*
Waterbury, CT	*		*	*		*		
Boston, MA	*		*	*		*		
Chelsea, MA	☐		*	*		*		
Fall River, MA	*			*		☐	x	
Lawrence, MA	*	*	*	*		☐	*	
Lowell, MA	*	*	*	*		☐	*	
Lynn, MA	*	*	*	*		☐	*	
Pittsfield, MA	*		*	*				
Springfield, MA	*	☐	*	*	*	☐		
Worcester, MA	*	*	☐	*		☐	*	
Portland, ME	*			*	*	*	*	
Manchester, NH			*	*		☐		
Albany, NY	*	*	*	*	*	*	*	*
Binghampton, NY	*		*	*		*		
Buffalo, NY	*	*	*	*	*	*	*	*
Elmira, NY	☐	*	*	*		☐		*
Rochester, NY	☐	*	*	*		☐		*
Syracuse, NY	*	*	*	*		*		*
Utica, NY	*		*	*		*		*
Providence, RI	*			*	*	☐	x	*
Framingham, MA	*	*		*		☐	*	
Brockton, MA	*	*	☐	*		☐	x	☐
Total in Place	21	11	19	25	5	12	11	10

Source: Northeast Area Vehicle Maintenance Managers, April 8, 1994
☐ = Planned for Fiscal Year 1994
x = These facilities use a HEPA filter unit for brake cleaning

SECTION 17

INTERAGENCY
THE WHITE HOUSE COMPLEX

At the invitation of President Clinton in 1993, staff from the U.S. EPA, the District of Columbia Environmental Regulations Administration of the Department of Consumer and Regulatory Affairs (DCRA), and technical experts conducted an environmental audit at the White House Complex. In addition to a preliminary assessment of pollution prevention and solid waste management opportunities discussed here, the audit also included compliance and environmental management systems. This project was performed through in-house EPA support.

17.1 FACILITY DESCRIPTION

The White House Complex is made up of the White House Residence and the Old Executive Office Building (OEOB). The White House Residence includes the Executive Residence structure and surrounding grounds. The facility employs 89 people, including maintenance staff, function activities staff, administrative staff, preservation staff, and grounds staff. The Residence organization is managed by the Chief Usher who is assisted by a staff of four assistant Ushers (for Maintenance, Activities, Administrative, and Preservation) and the Superintendent of Executive Grounds. The staff support the many inherent functions and roles of the Residence including serving as a public museum, offering Residence tours, and conducting official Presidential ceremonies and functions.

The OEOB has an estimated occupancy of 1,000 and primarily provides office space, meeting rooms and press facilities. Other portions of the building include restrooms, a cafeteria, service kitchens and dining areas, snack bar service rooms, maintenance rooms, and a loading dock.

17.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The environmental audit and preliminary assessment of pollution prevention and solid waste management opportunities evaluated activities associated with the paint shops; grounds maintenance; heating, ventilating and air conditioning (HVAC)/chiller operations; office operations; and general operations. Wastes generated by the paint shops include waste paints and solvents. Approximately 100 to 150 gallons of methylene chloride (dichloromethane) are used at the White House Complex each year to strip paint from steel trim and wood furniture, and other caustic chemicals are used to strip paint from older surfaces composed of horsehair plaster. Maintenance of the White House building exterior requires approximately 22 gallons of paint each week, generating atmospheric VOC emissions and cleanup wastes. Large amounts of water are used for the HVAC system and for groundskeeping activities, which also produce waste from the use of pesticides and herbicides for grounds maintenance. Office operations primarily produce paper waste, mostly in the form of photocopy and printer paper.

17.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

17.3.1 Paint shops

Three major pollution prevention options for the paint shops involve: (1) solvent use, (2) paint stripping, and (3) exterior coatings.

17.3.1.1 Solvent Use--

Solvent use can be reduced by replacing solvent only when it is completely saturated with paint or by using new technologies, such as paint guns. Solvent recycling is also an option. An on-site still can be used to recycle solvent. With a cost of $2,500, the still represents a payback period of less than six months. For solvents to be recycled, however, they must remain segregated.

17.3.1.2 Paint Stripping--

Approximately 100 to 150 gallons of methylene chloride are used at the White House Complex each year to strip paint from steel trim and wood furniture. Other caustic chemicals are used to strip paint from older surfaces that are made of horsehair plaster. Methylene chloride is a hazardous material, contains a high level of chemically defined VOC, and is an ozone-depleting compound and a suspected carcinogen. The primary pollution prevention option is to use a suitable substitute. One possibility is the use of non-chemical paint stripping methods, such as corn cob blasting, or the Sponge-Jet, which blasts sponge-coated garnet onto the substrate. Additional research and testing is needed to determine if these methods would be suitable for White House Complex applications.

17.3.1.3 Exterior Coatings--

Approximately 22 gallons of paint per week are needed for maintenance of the White House building exterior. Because there is a continual need for only one color, a paint coating alternative such as heat-applied thermal plastic paint (a type of solvent-free powder-coated paint) should be considered. Additional study is needed to determine if this type of coating would be appropriate for existing exterior wood finishes; however, if feasible, its use would represent a significant reduction in pollution.

17.3.2 Grounds Maintenance

Pollution prevention options include reducing water usage by installing a sensor/moisture analyzer to determine when watering of the lawn is needed, and providing astroturf or paved surfaces for heavily used areas, such as the helicopter landing area and the west side of the north lawn where reporters are permitted to deliver news reports.

17.3.3 HVAC/Chiller Operations

Currently, the OEOB chiller processes five gallons of water per minute or 2,628,000 gallons per year. A pollution prevention option that should be investigated is using a system that recycles the water in-process.

17.3.4 Office Operations

The primary pollution prevention options in this area relate to the reduction in paper use through source reduction and the use of recycled-content and source-reduced products and supplies.

17.3.4.1 Reduction in Paper Use--

As is true in most office settings, the White House Complex generates substantial amounts of paper, mostly in the form of photocopy and printer paper. Short term activities such as two-sided copying, eliminating facsimile cover sheets, routing documents instead of providing each reader a copy, and centralizing files can be accomplished by changing employee behavior through education. Longer range solutions such as microfiching essential duplicate files, and use of local area and other computer networks, may involve more costly investments, but can significantly reduce paper waste.

17.3.4.2 Use of Recycled-Content and Source-Reduced Products and Supplies--

The White House is in a unique position to serve as a model for other Federal agencies and the general public. It could, therefore, encourage recycling of existing paper by purchasing recycled-content and source-reduced products and supplies.

17.3.5 General Operations

Pollution prevention recommendations in this area include pollution prevention planning, awareness, and education; consolidating maintenance functions now performed separately by the White House Residence and OEOB staffs; restoring and upgrading the OEOB to reduce maintenance; practicing water conservation; and establishing pollution prevention policies. An example is labeling White House functions "green." Suggestions for accomplishing this include the following: sending invitations on recycled paper using vegetable-based inks; printing on both sides of menus and function programs; eliminating or reducing the amount of disposable items used by substituting durable napkins, utensils, drinking cups, etc.; donating unused food to a local charity; and publicizing the function as being an environmentally sensitive one.

17.4 RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Several areas could be researched, demonstrated and evaluated for use at the White House Complex, including a less hazardous paint solvent alternative, alterative paint stripping methods, an exterior paint coating alternative, and using a system to recycle water in-process for the OEOB chiller.

17.5 STATUS OF IMPLEMENTATION

The White House Environmental Audit Report was not released until February 1994. However, because of a Presidential commitment to "greening" the White House, several pollution prevention projects are ongoing, while many others are planned. Some of the ongoing projects are described below (4).

17.5.1 Water conservation

Water-saving fixtures are currently being installed in restrooms, kitchens, and other areas. Water conservation is also a consideration in landscaping. Sprinkler heads are being replaced or adjusted to minimize water consumption. Future plans call for "cascading" uses for water; for example, old drinking water is used to water lawns.

17.5.2 Pest Management

A grounds maintenance plan is currently being developed which will reduce fertilizer and pesticide use, change mowing practices, improve irrigation and reduce runoff.

17.5.3 Eliminating Chlorofluorocarbons (CFCs)

HVAC systems should be renovated to eliminate CFCs and to operate more efficiently. A comprehensive HVAC system upgrade will require Congressional approval and may take several years.

17.5.4 Energy-efficient appliances

White house refrigerators and lighting fixtures have been replaced with energy-efficient models offering substantial reductions in energy consumption.

SECTION 18

INTERAGENCY
TIDEWATER INTERAGENCY POLLUTION PREVENTION PROGRAM (TIPPP)

The Tidewater Interagency Pollution Prevention Program (TIPPP) is a cooperative effort among the U.S. Environmental Protection Agency (EPA), the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA) to develop and implement multi-media pollution prevention plans for each participating installation, outlining short- and long-term projects that are readily transferrable to other communities and/or settings. The TIPPP was initiated in 1991.

18.1 FACILITY DESCRIPTION

The TIPPP host facilities are located at Fort Eustis (Army), Langley Air Force Base, NASA Langley Research Center, and Naval Base Norfolk. Community activities/facilities represented at these installations include administrative offices, materials distribution, housing/food services, new construction, land management activities, procurement/acquisition, maintenance operations, vehicle storage and fueling areas, and manufacturing processes.

18.1.1 Fort Eustis

Fort Eustis and Fort Story, a sub-installation of Ft. Eustis since 1962, are the home of the U.S. Army Transportation Center located in eastern Virginia. One of 16 Training and Doctrine Command (TRADOC) installations, Fort Eustis covers 9,000 acres of land which ranges from tidal wetland to bottomland forest. The U.S. Army Transportation Center at Fort Eustis has two major missions: (1) train Army transportation personnel in various tasks, including the maintenance and operation of helicopters, oceangoing vessels, and land-based transportation equipment; and (2) provide field support and equipment during a conflict, such as Operation Desert Storm. Several active-duty commands are located at Fort Eustis. Fort Eustis also supports a number of U.S. Army schools and tenant activities.

18.1.2 Langley Air Force Base (LAFB)

Langley Air Force Base is located in Hampton, Virginia and comprises approximately 2,900 acres. More than 9,000 military and 3,000 civilian employees work and/or live at the base. The host unit at LAFB, the 1st Fighter Wing, is charged with the mission of maintaining combat capability for rapid global deployment to conduct air superiority operations. The 1st Fighter Wing flies UH-1N helicopters and F-15 and C-21 aircraft.

18.1.3 NASA Langley Research Center (LaRC)

Nasa Langley Research Center is an 807-acre research center in Hampton, Virginia dedicated to aeronautical and space research. At this facility, which employs about 6,000 people, LaRC conducts research programs to advance aircraft design, and to develop advanced transportation systems and space station technologies. Activities include large-scale physics and chemistry research, engineering and design testing programs, and routine equipment maintenance. These activities involve the use of approximately 6,000 different chemicals and materials, and yield approximately 280 tons of hazardous waste and 780 tons of municipal waste each year.

18.1.4 Naval Base Norfolk

Located in the Tidewater, Virginia area, Commander, Naval Base (COMNAVBASE) Norfolk covers approximately 5,400 acres of land, hosts approximately 200 tenant commands, docks more than 100 ships, and employs more than 100,000 military and civilian personnel, qualifying it as the largest naval base in the U.S. Navy. The mission of the Base is to provide quality support to the tenant commands. Base personnel conduct a variety of operations, including paint stripping, painting, engine maintenance, cleaning, and other operational and repair work. These activities consume large quantities of chemicals and materials and generate many different types of hazardous and non-hazardous waste streams.

18.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

As a cooperative demonstration program, the TIPPP was designed to support pollution prevention efforts to: (1) reduce solid and manufacturing wastes generated at the participating facilities; (2) improve energy efficiency at the installations; (3) test the use of alternative, environmentally protective materials that still meet research and military specifications; (4) improve procurement practices and inventory controls; and (5) reduce non-point source environmental problems.

18.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

WREAFS Program support to TIPPP has been undertaken in a base-by-base approach. Early work in the program resulted in the development of several pollution prevention recommendations. These include actions related to the following: chemical material management; land management practices; municipal solid wastes; laboratory wastes; electroplating; painting operations; metal working (surface preparation and shaping); halogenated and non-halogenated solvents; and depainting operations. Recommended options for each are given below.

18.3.1 Chemical Material Management

Chemical material management consists of a series of tools for controlling the procurement, distribution, and use of chemicals. Examples of the various activities that can become an integral part of chemical material management are described in the following sections.

18.3.1.1 Procurement--

Some of the procurement practices that generate excessive waste and that should be avoided include: allowing customers to reject usable chemicals that have been recertified with extended shelf-lives; requiring that the supply element maintain stockpiles of materials that expire; and ordering chemicals without previous use rates and without verifying the appropriateness of the materials for the specified activity. Automatic ordering can reduce the amount of expired materials while meeting all supply demands of the facility.

18.3.1.2 Employee Training--

Train employees in the safe use of chemicals, spill procedures, and proper recycling or disposition of chemicals.

18.3.1.3 Inventory Control--

Practice first-in first-out inventory control, whereby older materials are used first. When possible, assign control of hazardous material supplies to a limited number of individuals trained to handle the materials. Finally, limiting access to supplies also helps employees conserve raw materials.

18.3.1.4 Chemical Storage--

Routinely check the chemical storage areas for leaking containers, rusted or damaged containers, or containers that have the potential to leak. Store chemical containers off the floor for improved leak detection. Store chemicals to preserve their chemical integrity. For example, solvents should be stored to avoid temperature extremes. Assign one person the responsibility of checking for leaks and maintaining the storage area.

18.3.1.5 Proper Labels--

Assure that containers are properly labeled and dated. Replace labels before they deteriorate. Unlabeled chemicals are often disposed of unnecessarily, increasing disposal and replacement costs.

18.3.1.6 Return Empty Containers--

Empty containers often contain hazardous residue and should be returned to the supplier for recycling whenever possible. Out-of-date material returned to the supply center may qualify for recertification, enabling continued use or recycling. Some suppliers give credit toward the next purchase for returned material.

18.3.1.7 Chemical Use Tracking--

Comprehensive chemical use tracking involves the use of a computer system to track the procurement, storage, distribution, use and disposal or recycling of every chemical used. The requestor must justify the need and qualifications for handling the chemical being requested. Instructions are issued with the chemical for proper use, recycling or disposal. A bar code system for hazardous material containers should also be considered. The code would contain information on the chemical content, the recipient, the date issued, the chemical's intended use, and the chemical's expiration date.

18.3.2 Land Management

Land management can significantly influence non-point source pollution and stormwater runoff, which are major sources of nutrients and significant sources of sediment and toxic pollutants from urban runoff (e.g. metals, pesticides, oil and grease). Existing pollution prevention options relate to: (1) flightline and runway management; (2) erosion and sediment control; (3) nutrient management planning; (4) pesticide management; (5) forestry management practices; (6) road construction and maintenance; (7) urban runoff in developing areas; (8) housing; and (9) wetland and riparian area protection.

18.3.2.1 Flightline and Runway Management--

The largest potential sources of contaminants to stormwater from flightlines and runways are fueling operations, vehicle maintenance/washing, and deicing practices. Best management practices strive to prevent fuel from coming into direct contact with rain and stormwater runoff. Examples of methods to accomplish this aim include: fuel-spill management; covering chemical storage areas; use of low phosphorous content cleaning agents; and use of a less environmentally disruptive deicing agent.

18.3.2.2 Erosion and Sediment Control--

Best management practices include: maintaining perennial vegetative cover on vacant land, slopes, and around wetlands and other waterbodies; leaving undisturbed vegetative buffer strips adjacent to streams, wetlands and waterbodies; and constructing sediment retention structures.

18.3.2.3 Nutrient Management Planning--

Applying the minimum required amount of fertilizer would limit nutrient runoff. This would require such practices as optimum timing and methods of fertilization to limit loss to runoff, investigating organic alternatives to chemical fertilizers, such as compost, and determining the proper rate of fertilizer application based on the vegetation's actual nutrient requirements.

18.3.2.4 Pesticide Management--

The best method to reduce the environmental impacts of pesticides is to use fewer pesticides and lower quantities. Pesticides should only be used when there is an economic gain. In such cases, an effort should be made to select the pesticide with the least toxicity, leachability, persistence, and volatility that will still be effective in the desired application. Pesticides should be applied in such a way as to minimize their movement into water and exposure of workers and nontarget wildlife or vegetation. Since many pesticides bind to soil and clay particles, practices that reduce soil erosion are also effective in retaining pesticides on the treated area.

18.3.2.5 Forestry Management Practices--

The goal of best management practices in forestry is to plan, design, and operate logging and silvicultural practices to minimize erosion, pesticide use, and hydrologic disruption to streams, wetland and waterbodies.

18.3.2.6 Road Construction and Maintenance--

Roads should be located away from wetlands, critical habitat areas, and drainage areas. Cut and fill should be minimized and road culverts should be sized at waterbody crossings to minimize hydrologic disturbances. Sweeping and vacuuming road surfaces will remove accumulated dust, debris and pollutants, while more frequent mowing may replace large scale herbicide application.

18.3.2.7 Urban Runoff in Developing Areas--

Recommendations include minimizing impervious surface areas and certain natural drainageways. Development should be located away from critical areas, such as steep slopes, highly erodible soils, and wetlands. Where possible, vegetation buffer areas should be retained.

18.3.2.8 Housing Areas--

Lawn care nutrient and pesticide use should be reduced, and pet wastes should be managed. Alternatives to commercial fertilizers, such as compost, can often be used. Commercial fertilizers, when used, should never be used in amounts which exceed the recommended application rates. Mechanical weeding should be used whenever possible, rather than wide spread pesticide use. Pesticides, when needed, should be organic rather than chemical, and used in spots instead of broad application.

18.3.2.9 Wetland and Riparian Area Protection--

Wetlands function as a natural filter and regulator of nutrients and sediments. The best way to protect wetlands is to leave them undisturbed. Riparian areas (uplands or floodplain areas immediately adjacent to wetlands, streams, rivers or other waterbodies) perform similar functions as wetlands and should be protected from disturbance, as well.

18.3.3 Municipal Solid Waste

Almost 43 tons of solid waste, (including, but not limited to, scrap metal, paper, wood, and aluminum cans) are generated each year by the four facilities participating in the TIPPP program. Pollution prevention options include one or a combination of the following: (1) source reduction; (2) recycling; (3) composting; and (4) waste-to-energy/incineration.

18.3.3.1 Source Reduction--

Source reduction falls into five basic categories: product reuse, reduced material volume, reduced toxicity of products, increased product lifetime, and decreased consumption. These activities can be accomplished by: buying in bulk; avoiding the use of disposable items (razors, cameras); reusing common items (plastic bags); repairing items; buying concentrates (drinks, laundry soaps); using two-sided copies; and using longer-life tires and light bulbs.

18.3.3.2 Recycling--

Recycling is the process by which materials otherwise destined for disposal are collected, reprocessed or remanufactured for subsequent use. Commonly recyclable items in the waste stream include paper, aluminum cans, glass, ferrous metals, plastics, batteries, used oil, and tires.

18.3.3.3 Composting--

Composting is the controlled biological decomposition of organic solid waste under aerobic conditions. Degradable organics, such as yard waste and food, are easily composted. High quality compost can then be used by greenhouses, golf courses, landscaping, public parks, military installation grounds, and cemeteries.

18.3.3.4 Waste-to-Energy/Incineration--

This is the process of burning solid waste and capturing steam to generate power, usually electricity. The primary use of this energy is for industrial heating and cooling systems.

18.3.4 Laboratory Wastes

Due to the potential for variability, laboratory wastes present unique challenges for protective and environmentally sound management. In addition, laboratories may generate small quantities of numerous types of wastes, or a specific experiment may generate wastes on a one-time basis. Existing pollution prevention options include: (1) inventory management; (2) product substitution; (3) changes in experimental design; (4) recycling/reuse/recovery; (5) volume reduction; (6) energy recovery; and (7) waste segregation.

18.3.4.1 Inventory Management--

Optimize the use of supplies on hand; control dispensed chemicals and check for outdated solvents and other chemicals.

18.3.4.2 Product Substitution--

Replace hazardous materials with less toxic or hazardous substances whenever possible.

18.3.4.3 Experiment Design--

Improve current research practices to increase the efficiency of experiments, thereby decreasing waste generation. For example, lab experiments conducted on a smaller scale will use smaller quantities of raw materials.

18.3.4.4 Recycling/Reuse/Recovery--

Promote reuse of materials, such as by solvent recovery through distillation and/or metals extraction (particularly silver and mercury).

18.3.4.5 Volume Reduction--

Reduce hazardous waste volumes with methods such as neutralization, precipitation, and inactivation.

18.3.4.6 Energy Recovery--

Recover energy, primarily from waste solvents, in the form of fuel supplements.

18.3.4.7 Waste Segregation--

Separate waste streams to facilitate treatment, disposal or reuse.

18.3.5 Electroplating

In electroplating, metal ions supplied by the dissolution of metal from anodes or similar pieces are reduced onto the workpieces (cathodes). Depending on the metals involved, electroplating cells may use acidic, alkaline, or neutral solutions. The majority of metals and cyanide discharged into the Nation's waterways originates primarily from electroplating activities. Centralized wastewater treatment systems are common and result in the generation of solid-phase sludges. In addition, spent process solutions and quench baths are discarded when contaminant concentration inhibits proper function of the solution or bath. When discarded, process baths usually consist of solid- and liquid-phase wastes that may contain high concentrations of cyanide and other harmful constituents.

Existing pollution prevention options related to electroplating and associated processes include: (1) training and supervision; (2) production planning and sequencing; (3) process or equipment modifications; (4) substitutions; (5) waste generation and separation; and (6) recycling.

18.3.5.1 Training and Supervision--

Educate plating shop personnel in the conservation of water during processing and material segregation.

18.3.5.2 Production Planning and Sequencing--

Pre-inspect parts to prevent processing of obvious rejects.

18.3.5.3 Process or Equipment Modifications--

Several process or equipment modifications can be used to prevent pollution: greatly reduce rinse water usage through counter current rinsing; increase drain time to allow parts to drain 10 seconds or more after removal from the bath; add wetting agents to the plating baths to reduce solution adhesion to the parts; increase bath temperature to reduce viscosity and improve drainage; spray rinse to increase rinsing efficiency for non-complex part configurations; use air agitation in rinse tanks to improve rinsing efficiency.

Changing continuous treatment to a batch system would account for upsets in effluent levels. Bath evaporation can be reduced by covering the surface with non-reactive gases or materials. For example, a blanket of polypropylene balls can significantly reduce losses through evaporation. Processes baths can be continuously filtered to extend their life. If etching is used only to put a shine on the parts, some customers may agree to buy them unetched, thus reducing etch bath wastes. Use of low concentration plating solutions rather than mid-point concentrations will reduce the total mass of chemicals being dragged out.

18.3.5.4 Substitutions--

Examples of less toxic substitutes that can be used include zinc instead of cadmium in alkali/saline environments; nitric or hydrochloric acid instead of cyanide in certain plating baths; zinc chloride instead of zinc cyanide; non-chlorinated stripper instead of methylene chloride; trivalent chromium instead of hexavalent plating systems; and non-cyanide instead of cyanide plating baths.

18.3.5.5 Waste Generation and Separation--

Wastewaters containing recoverable metals should be segregated from other wastewater streams.

18.3.5.6 Recycling--

Any combination of the following techniques can be used to recycle materials: evaporation; ion exchange; chemical reaction; reverse osmosis; electrolysis; and reclamation. Specific recycling opportunities include: process chemicals; regeneration of caustic etching solutions; use of acid copper in the electroplating of plastics; recovery of spent chromatic acid from anodizing; and filtration and reconstitution of plating baths instead of disposing of the baths when strength has decreased.

18.3.6 Painting Operations

An estimated total of 250 tons of waste paint, paint and sludge, and 68,000 gallons of thinner are disposed of annually by the four facilities participating in TIPPP. Paints may contain highly toxic levels of lead, cadmium, mercury, copper and titanium. Chlorinated solvents used in painting operations create solvent and paint-bearing sludge, and release VOCs into the air. Pollution prevention options include: (1) use of air-assisted airless spray equipment; (2) use of HVLP spray painting; (3) electrostatics use; (4) dip tanks use; (5) use of cyclone separator and paint detackifying compounds; (6) *UNICARB*™ use; (7) product substitution; (8) recycling; (9) incineration; (10) process redesign/equipment modification; (11) segregation; (12) heat recovery; and (13) housekeeping changes/process control.

18.3.6.1 Air-Assisted Airless Spray Equipment--

This equipment delivers paint to a spray gun under very high pressure. Air is not required because the pressure at which the coating is delivered to the nozzle is sufficient to atomize the coating.

18.3.6.2 High Volume/Low Pressure Spray Painting--

This is a compressed air paint spraying system utilized to reduce overspray.

18.3.6.3 Electrostatics--

In this process, an electrostatic charge is applied to the workpiece while the surface to be painted receives an opposite charge. The spray is attracted to the work surface to such an extent that some of the overspray curves back and coats the reverse side of the item.

18.3.6.4 Dip Tanks--

When painting with dip tanks, the workpiece is inserted into a tank of coating, removed, and allowed to drain back into the tank. Excess paint may be removed electrostatically or with a doctor blade or squeegee.

18.3.6.5 Cyclone Separator and Paint Detackifying Compound--

These options reduce paint sludge generation. The cyclone separator and paint detackifying compound are used to dewater and concentrate solids in the paint sludge.

18.3.6.6 UNICARB™--

This coating technique applies coating by using supercritical carbon dioxide, which produces vigorous atomization and allows for high quality coating without the use of volatile organic solvents.

18.3.6.7 Product Substitution--

Substituting water-based paints for solvent-based products reduces environmental and worker exposure to solvent vapors and allows cleanup with soap and water.

18.3.6.8 Recycling--

Recycling channels hazardous wastes back into the production process. Organic solvents which become contaminated through industrial use without being consumed in the manufacturing process may be recovered, reused and recycled.

18.3.6.9 Incineration--

Combustion can be used to dispose of still bottom wastes resulting from the use of organic solvents.

18.3.6.10 Process Redesign/Equipment Modification--

This includes alteration of the existing process design to include new equipment, and implementation of new technologies or changes in operating practices to reduce waste generation (i.e. housekeeping or maintenance).

18.3.6.11 Segregation--

Solvent waste streams should be separated from other solvent and non-solvent waste streams. Utilization of water can aid in future recovery efforts.

18.3.6.12 Heat Recovery--

Spent solvents may be used as supplementary fuels, particularly in high-temperature industrial processes.

18.3.6.13 Housekeeping Changes/Process Control--

Modifications in procurement procedures can optimize the use of raw materials, thereby reducing wastes. An example would be to purchase only the amount needed to complete the task, avoiding the accumulation of excess paints that may expire and require disposal.

18.3.7 Metal Working

Metal working operations include metal shaping (*e.g.*, casting, drilling, machining, polishing, shaping, milling, etc.) and surface preparation (*e.g.*, acid cleaning, paint stripping, ultrasonic degreasing, mechanical treatment, etc.). Such operations typically result in scrap metal and metal working fluids/oils as waste. Related pollution prevention options involve: (1) training and supervision; (2) process modification; (3) waste segregation; (4) recycling and reuse; (5) loss prevention and housekeeping controls; (6) metal recovery; and (7) materials handling and storage.

18.3.7.1 Training and Supervision--

Instruct operators in water conservation, materials segregation techniques and process monitoring.

18.3.7.2 Planning and Sequencing--

Pre-inspect parts to identify reject workpieces prior to processing.

18.3.7.3 Process Modification--

Possible process changes may reduce atmospheric emissions by using such techniques as increased free board height, installation of refrigeration coils to condense vapors, rotation of workpieces before removal to drip solvents back into the reservoir, reduced drag-out techniques, increased drainage, proper racking, and use of counter-current cleaning to maximize the use of cleaning solvent prior to disposal or recycling.

18.3.7.4 Raw Material Modification--

Identify and use less toxic materials, including alternatives for chlorinated hydrocarbon cleaning solvents such as aliphatic hydrocarbons, dibasic acid esters, N-methyl-2-pyrrolidone and terpenes.

18.3.7.5 Waste Segregation--

Separate waste streams to recover and recycle metals and to avoid contamination of other wastes with potentially toxic constituents.

18.3.7.6 Recycling and Reuse--

Devise methods to maximize use of rinse waters and other materials, such as solvents. Such methods include the use of activated carbon or condensers to capture solvents for reuse, acid recovery from wastewaters using evaporation techniques, and on-site recycling of solvents by distillation, filtration, and gravity separation.

18.3.7.7 Loss Prevention and Housekeeping Controls--

Preventative maintenance on equipment will minimize leaks and spills. Establishing solvent check-out procedures through the shop leader will also assist in minimizing losses.

18.3.7.8 Metal Recovery--

Precious metals and metal salts can be recovered from sludges and spent process baths through such procedures as evaporation, reverse osmosis, ion exchange, electrolytic recovery, and electrolysis.

18.3.7.9 Materials Handling and Storage--

Control inventory, pre-inspect materials, and properly store chemicals to prevent degradation.

18.3.8 Solvents

Over 75,000 gallons of solvents, both halogenated and non-halogenated, are estimated to be disposed of each year by the four TIPPP facilities. These organic solvents and solvent mixtures contain such toxic constituents as benzene, toluene, methyl ethyl ketone, isobutyl ketone, perchloroethylene, methylene chloride, 1,1,1-trichloroethane, and others. Pollution prevention options include: (1) substitution; (2) reformulation; (3) process redesign/equipment modification; (4) housekeeping changes/process control; (5) segregation; (6) minimization; (7) heat recovery; and (8) recycling/reuse/recovery.

18.3.8.1 Substitution--

Substitute a substance which is either less hazardous or produces a less hazardous waste, but does not jeopardize product quality. An example is the replacement of benzene with aliphatic naphthas.

18.3.8.2 Reformulation--

Certain products may be reformulated to reduce the volume or toxicity of the waste produced. This can be accomplished by altering or lowering certain product specifications (i.e. concentration), changing the chemical composition, or changing the physical state.

18.3.8.3 Process Redesign/Equipment Modification--

This includes alteration of the existing process design to include new equipment and implementation of new technologies or changes in operating practices to reduce waste generation (i.e. use of condensers to capture solvent emissions).

18.3.8.4 Housekeeping Changes/Process Control--

Solvent use can be reduced through careful monitoring of solvent consumption during product manufacturing and through evaluating current spill-avoidance procedures.

18.3.8.5 Segregation--

Separating solvent waste streams from other solvent and non-solvent waste streams is particularly important for halogenated solvent wastes.

18.3.8.6 Minimization--

Standardization and consolidation of solvent use can minimize wastes. As examples, many solvents can be used for more than one application, or solvents may be reused in the same application or in other applications, resulting in less solvent consumption.

18.3.8.7 Heat Recovery--

Non-halogenated spent solvents may be used as supplementary fuels, particularly in high-temperature industrial processes such as industrial boilers, rotary kilns and blast furnaces.

18.3.8.8 Recycling/Reuse/Recovery--

Regularly used solvents may be recovered from waste streams using techniques such as distillation, evaporation or steam stripping.

18.3.9 Depainting Operations

Almost 420 tons of blasting grit, sand blast residue, and paint stripper, and over 1,000 gallons of thinner, solvent, paint remover, and associated liquids are cumulatively generated by the four TIPPP facilities each year. Options for pollution prevention in this area include: (1) using a fluidized bed unit; (2) substituting less toxic cleaning media; (3) using aqueous cleaners; (4) using emulsion cleaners; and (5) employing mechanical thermal methods.

18.3.9.1 Fluidized Bed Unit--

A heated bed of fluidized aluminum oxide can be used instead of chemical stripping to remove paint, thus increasing solution life.

18.3.9.2 Less Toxic Cleaning Media--

An example of substituting less toxic cleaning media includes the conversion from vapor degreasing to cold tank cleaning.

18.3.9.3 Aqueous Cleaners--

This cleaning method uses water in conjunction with mechanical or ultrasonic agitation and relies mainly on the displacement of soils.

18.3.9.4 Emulsion Cleaners--

When solvent and aqueous cleaning are combined, the solvent is dispersed in the aqueous phase with the aid of emulsifiers, surfactants, and coupling agents.

18.3.9.5 Mechanical Thermal Methods--

These methods eliminate the need for solvents and include such techniques as air blast systems, abrasive blast cleaning, and dry stripping.

18.4 STATUS OF IMPLEMENTATION

Initiatives for pollution prevention have been implemented to varying degrees at the four TIPPP sites. Pollution prevention recommendations developed for each facility do not necessarily reflect actions related to all of the areas described above, because of differences in the nature of operations conducted at the different facilities. The status of implementation of pollution prevention initiatives at each of the facilities is described below.

18.4.1 Fort Eustis

Fort Eustis has conducted several pollution prevention activities through TIPPP. Fort Eustis held its first environmental fair, Ecologic '93, on April 23, 1993. The fair supported the Army's environmental strategy and provided an opportunity to present environmental information to military and civilian personnel at Fort Eustis and in the surrounding communities. In addition, a quarterly publication called *Environmental Watch* has been developed for distribution post-wide to keep everyone informed on pollution prevention and other environmental issues.

As part of its pollution prevention efforts, Fort Eustis has established an ongoing environmental awareness program. The program has sponsored many activities, including the following:

- Various demonstrations of parts washers and non-hazardous solvents and lubricants, material substitutes, and other equipment to reduce hazardous wastes.

- A training program in pollution prevention that incorporates the Transportation Officers' Basic Course, Warrant Officers' Advanced Course, Officer Development Courses, and Pre-Command Courses. As of July 1994, over 1,500 personnel on post had participated in this training. An annual pollution prevention workshop is currently being developed. The three-day workshop anticipates training 80 personnel stationed at the installation.

- An Environmental Day in October 1992 sponsored by the 24th Battalion.

- A Household Hazardous Waste Forum, co-sponsored by the city of Newport News.

Additional pollution prevention initiatives are described below.

18.4.1.1 Chemical Material Management--

A Pilot Program is in the preliminary stages of development. The first phase will consist of a centralized hazardous material issue and storage facility. Components of the program will include: central issue and storage of hazardous materials, reuse of opened materials, development of an Authorized Use List, development of environmentally friendly substitutes, and appointment of inventory control personnel to track and extend the shelf life of materials. This program is scheduled to be evaluated in January 1995.

18.4.1.2 Land Management--

A Storm Water Pollution Prevention Plan is scheduled to be finalized by November 1994. Results from a sludge characterization study will be available in August 1995. The study will focus on the beneficial reuse of sludge generated at the facility, thereby avoiding the need for sludge disposal. A second study has been designed to set up a pilot project to clean, recycle, and reuse soils currently contaminated with petroleum hydrocarbons which otherwise require disposal as hazardous waste. The soils will be composted with organic debris and biosolids obtained from the facility's wastewater treatment plant.

For the past two years, an environmental fair called "EcoLogic" has been held during Earth Week at Fort Eustis. As part of the fair, field trips are conducted to the wetlands on the installation and to the Recycling Center.

18.4.1.3 Municipal Solid Waste--

A recycling program has been established at Fort Eustis. From March 1990 to November 1992 the following materials were recycled:

- More than 2 million pounds of paper
- More than 3 million pounds of metal
- More than 925,000 pounds of cardboard
- More than 316,000 pounds of glass
- More than 147,000 pounds of aluminum cans

In 1992, 22 percent of the solid waste generated at Fort Eustis was recycled. In recognition of its success, the recycling program was presented the 1992 TRADOC Pollution Prevention and Recycling Award and was nominated for the Army Pollution Prevention and Recycling Award. The Recycling Center is expanding to approximately double its current size. A policy memorandum making recycling mandatory at Fort Eustis is scheduled for release in November 1994.

The installation Commissary has implemented a program to highlight the use of environmentally friendly products, provide extensive pollution prevention training for the employees, and post bulletin boards highlighting "Reduce, Reuse, Recycle." The program includes a storm drain labeling effort, which would reduce the inadvertent disposal of wastes and trash into the storm sewer. A waste characterization project is also ongoing at the Commissary, which entails the identification of recyclable materials. The project has been in progress since December 1993 and will continue through the end of November 1994. Based on the results of the characterization, recommendations will be made on the commissary's internal solid waste management program.

18.4.1.4 Painting and Depainting Operations--

Several procedural changes have been implemented based on PPOAs at Fort Eustis. Paint shops at Fort Eustis began using HVLP spray paint guns to apply Chemical Agent Resistant Coating (CARC). The CARC paint is solvent-based and is extremely hazardous in liquid form, but is non-hazardous when dry. Overspray has been reduced by 60 percent, which has in turn reduced paint usage by 40 percent, for an annual savings of approximately 200 gallons at $6,700.

Use of a lower VOC CARC paint was considered, but was eliminated in favor of a single-step application of CARC. The low VOC CARC is only available in a two-step application. A filter system was added to the paint booth water curtain, which has improved the efficiency of the paint booth operation. A study is underway to eliminate the water curtain altogether. This would eliminate wastewater production and would rely on filters to capture paint particles.

An indoor sandblasting facility was completed in June 1992, which has reduced the air emissions incurred from outdoor sandblasting. Recyclable blast media are currently used at the sandblasting facility.

18.4.2 Langley Air Force Base (LAFB)

Langley Air Force Base conducts a number of activities on base and in the surrounding communities as part of an ongoing environmental awareness program. The base sponsors an Earth-Week program each year, which includes educational and training programs and poster and art contests to promote environmental and pollution prevention awareness. LAFB attempts to educate the base community on environmental issues by using various types of information sources such as federal and state EPA information publications, *Air Force Times*, the base newspaper, and closed-circuit television.

A computer-based reporting system has been developed at LAFB to track hazardous waste disposal. The system identifies wastes associated with each operation, tracks waste disposal, and provides other information required to make management decisions. Langley Air Force Base has conducted a variety of other pollution prevention activities through TIPPP, as described below.

18.4.2.1 Chemical Material Management--

Household chemicals are used for cleaning purposes throughout the base and resident housing. Facilities and residents often have excess household chemicals that may inadvertently become part of the municipal solid waste stream. LAFB recently established a program allowing facilities and residents to contribute excess household chemicals so that they may be re-issued for use, thereby avoiding disposal.

An antifreeze recycling system which enables the reuse of antifreeze has been installed at LAFB. The system removes metals, colloid silica, and other harmful particulates in used antifreeze and restores corrosion inhibitors to the reprocessed antifreeze. It is anticipated that this recycling system will significantly reduce the amount of hazardous materials entering and therefore leaving the installation.

The process of powering down an aircraft generates about one quart of JP-5 fuel, which is collected in a sump on the aircraft. The fuel is removed from the sump and deposited into specially designed 125- or 660-gallon containers called bowsers. Recovered fuel is tested for contamination and moisture content. If results indicate that the fuel conforms to the required specifications, the fuel is returned to the main fuel storage tank and is mixed through the bulk storage filter banks prior to being used to refuel aircraft. Approximately 2,400 gallons of JP-5 aircraft fuel are recycled annually by this process. Cost savings associated with the fuel recovery program are estimated at $1,848 in raw materials and $432 in avoided disposal costs.

18.4.2.2 Municipal Solid Waste--

The recycling program at LAFB is divided into areas that target different parts of the installation. The 1st Moral Welfare Recreation and Services Squadron recycles aluminum cans, office paper, and corrugated cardboard boxes for administrative and industrial areas. The residential communities' curbside recycling program recycles newspaper, corrugated cardboard boxes, brown paper grocery bags, glass, metal food and beverage cans, aluminum foil and foil products, metal aerosol cans, metal paint cans, and number 1- and 2-type plastic bottles.

18.4.2.3 Painting Operations--

A plural component paint system has recently been installed at the LaRC. This system allows paint to be mixed in the exact quantities and packaged in units for a specific task. The painting system is cleaned with thinners which are collected for recycling in separate containers. An HVLP spray gun is scheduled to be installed at the facility. The new system will increase the efficiency of paint use, and will reduce the amount of VOC emitted from the facility. Due to the increased efficiency of paint use, it is anticipated that there will be a reduction in the amount of hazardous materials entering and therefore leaving the facility.

18.4.3 NASA Langley Research Center (LaRC)

Activities at LARC with potential to adversely impact the environment and generate wastes include large-scale physics and chemistry research, engineering and design testing programs and the upkeep, operation, and maintenance of the Center's equipment and facilities. Activities involve the use of approximately 6,000 different chemicals. Accumulated chemical and hazardous wastes generated during 1992 totaled 180,000 pounds; atmospheric emissions for 1992, including Total Hazardous Air Pollutants, VOC, Ozone Depleting Compounds (ODC), carbon monoxide, lead, nitrogen oxides, sulfur oxides, ozone, and PM_{10}, totaled 175 tons.

LaRC's pollution prevention program emphasizes source reduction and recycling, and recognizes that eliminating pollutants at the source is generally less risky and less costly than waste treatment and disposal. Recycling activities and use of conservation measures at LaRC have reduced the use of chlorofluorocarbon by 44 percent, or 19,305 pounds, in 1992 compared with 1989 figures. Total hazardous waste, excluding abrasive blasting debris generated by specific projects, has been reduced by 45 percent, or 120,605 pounds, in 1992 compared to 1990. A natural gas-fired boiler is being installed to reduce air emissions by reducing the use of inefficient oil-fired units. Oil, when used, will be substituted by a low-sulfur fuel (at or below 5 percent sulfur) to reduce SO_2 emissions.

The focus of pollution prevention activities at LaRC since September 1992 has been the Center-wide Pollution Prevention Program. The Program is comprised of a Program Plan implemented through individual projects and support initiatives under the direction of the Office of Environmental Engineering of the Safety, Environment and Mission Assurance Office. Specific Program Goals are as follows:

- Systematically reduce and eliminate the use of hazardous materials, and the discharge of hazardous and solid waste and other emissions to the environment.
- Adopt a comprehensive approach to environmental management that collectively considers all environmental media.
- Integrate pollution prevention into environmental compliance programs.
- Develop pollution prevention partnerships with other Federal facilities and organizations.

- Instill a pollution prevention ethic throughout the entire Center community and all mission areas.

- Acquire world-class pollution prevention technologies for distribution throughout NASA.

LaRC developed a comprehensive pollution prevention plan in 1992 as a first step toward meeting the overall goals. The Program Plan covers three general sectors: (1) energy production and use; (2) industrial and commercial processes or operations; and (3) natural resource conservation/land management. The Program Plan provides the framework within which to identify, plan, implement, monitor and evaluate specific pollution prevention projects or initiatives. The Plan will be updated periodically to identify new pollution prevention opportunities and to assess the performance of existing pollution prevention techniques.

The LaRC Pollution Prevention Program consists of a collection of short- and long-term projects and initiatives designed to accomplish the Program Plan goals. Foundation projects have been initiated to help build the organizational and physical infrastructure required to support a pollution prevention program. Four foundation projects underway include developing a chemical materials tracking system, constructing a pollution prevention building, conducting training, and outreach and communication. In addition, action projects, ranging from recycling municipal solid waste and eliminating the use of organic solvents to filtering and reusing antifreeze, are currently being conducted at LaRC. These individual pollution prevention activities conducted under the Program Plan are described in the following sections.

18.4.3.1 Materials Tracking System/Chemical Material Management/Laboratory Wastes--

Reduction of laboratory waste presents a challenge due to the small amount of specific waste material generated by each laboratory. However, combined laboratory wastes represent about 10 percent of the total waste stream generated in 1992. Recycling is often impractical due to the chemical mixture and/or the small amount of material generated, and the need for certifiable chemical grades. The nature of research and development work requires specific chemicals, thus making chemical substitution impossible in many cases.

As part of a pollution prevention foundation project, LaRC staff chose to implement a center-wide material tracking system to improve chemical utilization. The chemical material tracking system allows LaRC to track the types and quantities of chemicals entering the Center and determine where they are used. It is estimated that approximately 75 percent of the benefits identified in the PPOA with respect to laboratory wastes can be achieved simply by accounting for the types and quantities of chemicals entering LaRC. The remaining 25 percent can be achieved by tracking the materials present at the facility and recognizing their movement within LaRC. The tracking system is expected to be operational in early 1995.

18.4.3.2 Pollution Prevention Support Building--

An additional pollution prevention foundation project involves the design and construction of a support building to house pollution prevention related equipment and materials. The building will house an electrolytic silver recovery unit for centralized silver recovery from photoprocessing wastes, used oil management equipment and a drum crusher.

18.4.3.3 Pollution Prevention and Environmental Awareness Training--

The objective of environmental awareness training, the third pollution prevention foundation project being conducted at LaRC, is to strengthen the pollution prevention program by enlisting the support of staff throughout the Center. Training sessions are being developed for environmental coordinators which are intended to familiarize coordinators with pollution prevention concepts and techniques and encourage them to implement pollution prevention at their job sites. Continuing briefings for senior management are also being conducted, to introduce top management to the concepts of pollution prevention with the hope of institutionalizing the commitment for the Pollution Prevention Program.

18.4.3.4 Communications and Outreach--

The fourth foundation project at LaRC involves pollution prevention communication and outreach. Environmental education, communication, and outreach is considered to be a crucial element of the Pollution Prevention Program. This aspect of the Program will present the role of pollution prevention and will publicize accomplishments, both internally at LaRC and externally. Through publicizing pollution prevention accomplishments, it is anticipated that the staff will begin to understand prevention concepts, including the need for and the benefits of pollution prevention. This increased awareness should expand interest in the program. External publications will enable transfer of pollution prevention awareness to other facilities, including those participating in the TIPPP.

Through a Communications and Outreach Strategy developed in early 1994, informal focus groups were developed to solicit input on how best to maximize employee participation in and external awareness of the Pollution Prevention Program. The LaRC Pollution Prevention Program is described in posters which have been displayed, and a series of fact-sheets has been distributed to employees and reproduced in the LaRC newsletter. Additional activities planned for FY 95 include flyers, educational presentations, and seminars.

18.4.3.5 Oil Analysis to Reduce Waste Oil Generation--

The amount of waste oil generated during equipment repair or scheduled equipment maintenance has been reduced by analyzing equipment oil to determine whether or not it needs to be changed, rather than requiring oil replacement on a schedule. A sample of used oil is collected semi-annually and sent to an outside laboratory for analysis. Based on the results, the oil is either changed or left in the system. Savings achieved through this program include the cost of replacement oil, the labor required to change the oil, and the avoided disposal cost of $100 per 55-gallon drum of contaminated oil. The cost for off-site laboratory analysis is approximately $23,328 per year, based on 54 samples per month at $36 per sample.

The program is currently used for volumes of lubricating oil greater than 100 gallons. LaRC is considering expanding the program to include equipment with capacities of less than 100 gallons. The oil is currently changed every 12 months for such equipment. The oil analysis program may also be applied in the future to the LaRC vehicle fleet. A portable oil analyzer designed for in-shop use by maintenance staff will be purchased in the near future. At a cost of $8,635, the system will be used to determine which oil samples require off-site analysis.

18.4.3.6 Used Oil Filter Recycling--

LaRC's Vehicle Maintenance Shop began collecting used oil filters for recycling in May 1993. The shop routinely changes oil for approximately 700 government vehicles annually. The shop would previously drain the excess oil from the filters into a 55-gallon waste oil drum before disposing of the filters in the trash. Three drums of used oil filters are recycled annually under the new program. LaRC incurs a net cost from sending oil filters out to be recycled. Shipping a 55-gallon drum of drained oil filters costs $88; drained used oil filters would otherwise be included with NASA's solid waste, at no additional cost.

18.4.3.7 Substitute Reusable Absorbent Pads for Single-Use Materials--

LaRC has implemented a program using reusable absorbent pads in place of single-use absorbent pads and speedi-dry absorbent material at the National Transonic Facility (NTF) and the Vehicle Maintenance Shop. Two wringers sit atop disposal drums which collect oil squeezed from the pads. According to the manufacturer, up to 90 percent of the oil can be wrung out of the absorbent pads when they become saturated; the pads can be reused up to ten times.

Before implementation of this initiative, the two facilities purchased approximately 3,200 pounds of speedi-dry per year, at a cost of $286, and 863 single-use absorbent pads, socks, and pillows per year, at a cost of $1,374. LaRC disposed of 18 drums of used absorbents at a cost of $2,040 annually; an unquantified amount of soiled absorbent material was disposed of as solid waste and incinerated in LaRC's waste-to-energy facility.

This action project was implemented in January 1994 and is anticipated to reduce the amount of absorbent pads purchased and disposed of at the facility. The reduced volume of waste absorbent materials should decrease disposal costs. Additionally, the oils removed from the absorbent pads may be collected for energy recovery. Cost savings associated with the reusable pads are estimated at $2,281 per year at these two facilities. The capital investment for the wringer units will be recovered in about six months. LaRC staff report that reusable pads are better suited for large spills where the pads can be wrung out and immediately reused to soak up the spill.

Wringer units and reusable pads have been in use at the Vehicle Maintenance Shop and the National Transonic Facility since January, 1994. Vehicle Maintenance Shop staff have not used the reusable pads, because the large reusable pads are ill-suited for the small leaks and drips typical of Vehicle Maintenance Shop operations. The wringer and reusable pads will be removed from the Vehicle Maintenance Shop and transferred to the Operations Support Division for a trial basis.

18.4.3.8 Electroplating Waste Reduction--

Printed circuit board manufacturing is one of the major waste-generating operations at LaRC. Current circuit board manufacturing involves processing copper-clad glass laminate material through a series of chemical tanks to clean and prepare the laminate for electroplating and etching. The rinsewater pretreatment facility, which handles all rinsewater generated from circuit board fabrication processes, pretreats an average of 5,000 gallons of rinsewater a week and generates one cubic yard of metal hydroxide sludge.

A deionization/water recycling system was purchased and installed at LaRC as part of a pollution prevention action project. The system allows treated wastewater to be reused as rinsewater, and is anticipated to reduce the amount of wastewater treatment sludge generated by approximately 75 percent in addition to reducing water consumption. The capital cost for the system is $20,000. It has been estimated that the avoided costs based on reduced sludge generation and seed material costs will be $19,868, excluding cost savings from water reuse. Testing of the system is currently in progress. The system was installed in January 1994, and should reach maximum efficiency by January 1996, at which point water recycling will be considered.

The size of the electroplating tanks was reduced in 1991. The size reductions are variable, ranging from 19 to 50 percent. This initiative has reduced chemical supply costs, waste generation, and labor costs associated with waste processing activities. Chemical cost savings associated with the tank reductions are $652 per year. Reduced waste generation and reduced labor costs have not been quantified.

18.4.3.9 Centralized Silver Recovery Unit--

Photoprocessing and x-ray operations are located at eleven facilities throughout LaRC in addition to the main photo lab. Wastes generated by these operations include silver-bearing liquid wastes, which are hazardous because of the high silver content. Improved silver recovery procedures reduced the amount of photographic laboratory waste by 28 percent, or 6,141 pounds, during 1992.

A centralized silver recovery unit is scheduled to begin operation in late 1994. The unit will be used to recover silver from all silver-bearing waste generating operations at LaRC, except for the main photo lab. Disposal of silver-bearing liquids will be reduced by approximately 1,200 gallons, reducing disposal costs by approximately $3,000.

18.4.3.10 Termination and Restriction of Ozone Depleting Substances--

Chlorofluorocarbons (CFCs) have traditionally been used at NASA to clean wind tunnel components and oxygen systems. NASA has established a goal of eliminating non-essential uses of chlorofluorocarbons and methyl chloroform (1-1-1 trichloroethane, TCA). LaRC has begun terminating from the supply system Class 1- Ozone Depleting Compounds (ODCs) and TCA. LaRC has also restricted the use of CFC-22, CFC-11, CFC-113, and CFC-12 to refrigerant applications only.

Approximately 825 gallons of CFC-113 were previously used annually at LaRC to clean oxygen systems. LaRC staff laboratory-tested a number of alkaline detergents in conjunction with an ultrasonic cleaner to determine the detergent with the best cleaning performance. Aqueous cleaning has replaced the use of CFC-113 in 99 percent of the cleaning operations. Annual savings from using alkaline detergents in place of CFCs were approximately $15,000 in raw material costs as of 1993. Projected cost savings are anticipated to be greater due to the increase in price of CFC-113 because of declining commercial availability in response to statutory mandates.

Aqueous cleaning replaced the use of CFC-113 to clean small metal parts used in the NTF wind tunnel, eliminating the annual consumption of 70 to 130 gallons of CFC-113 at an annual cost of approximately $18,000 in 1991. Although the alkaline detergents reduce use and subsequent disposal of CFC's, conversion to aqueous cleaning generates a new waste stream. The wastewater from the parts cleaner is collected, tested, and discharged to the sanitary sewer.

The LaRC continues to use CFC-113 to clean flight hardware, removing particles by ultrasonification and organic contamination by dissolution. Projects designed to test the cleaning efficiencies of alternative aqueous solvents demonstrated that these solvents left a residue on the cleaned part. Isopropyl alcohol, which was also tested, cleaned better than the other aqueous solvents. One ultrasonic tank has been converted to allow the use of isopropyl alcohol and a deionized water rinse. CFC-113 will be used in the remaining tanks until the phase-out date. A deionized water blanket in the CFC-113 tank has significantly reduced the evaporative losses of CFC-113.

18.4.3.11 Aqueous Parts Washing--

Thirty-two facilities were identified which use solvent-based cleaners such as xylene, methylene chloride, or petroleum naphtha. These organic degreasers not only produce VOC emissions, but also must be managed as hazardous materials because of their flammability and/or toxicity.

Aqueous cleaning agents have replaced solvent cleaning at the compressor building, the machine shop, the Aircraft Landing Dynamics Facility, and the Vehicle Maintenance Shop. Two aqueous parts washer machines were installed at the Vehicle Maintenance Shop. These changes have eliminated approximately 3,500 pounds of hazardous waste and 2,000 pounds of VOC emissions annually, and have avoided approximately $1,000 annually in direct waste disposal costs. Raw material costs have been reduced since solvents are typically more expensive than aqueous cleaners. The cleaning solutions can be reused with the addition of makeup water and fresh detergent as needed, and thus do not require disposal. Sludge collects in the tank bottom and will eventually require disposal. The material will have to be tested to determine the proper disposal method.

18.4.3.12 Electronic Document Transfer to Eliminate Paper Use--

The NASA LaRC library uses an estimated 20 reams of paper each week to photocopy articles, journals, and other publications requested by researchers. The library is investigating electronic transfer to replace paper copies thereby reducing paper use and waste. With the electronic transfer system, documents will be scanned and sent electronically via LaRC Net (the local network) to the researcher. Currently only one page at a time can be scanned, processed, transferred to diskette, or sent across the Local Area Network. The software is being upgraded to increase processing capacity.

The electronic system may not be appropriate for transferring documents containing technical or engineering drawings. These types of documents may require traditional paper photocopying.

18.4.3.13 Gas Cylinder Management and Recycling--

Several hundred compressed gas cylinders are maintained at LaRC for use in research and related activities. The cylinders fall under three ownership categories: (1) stock cylinders; (2) rental cylinders; and (3) government-owned cylinders. Stock cylinders are government-owned, issued by supply to LaRC personnel. Empty stock cylinders are returned to supply, and then transported off-site to be refilled by a vendor. Rental cylinders are owned by a vendor. The contents are purchased by NASA, and vendors charge a daily fee for use of the cylinder on-site. Government-owned cylinders are variable in size and are purchased from vendors. Many of these cylinders are disposable and are designed for one-time use.

Cylinders often remain on-site for many years, and personnel lose track of their origin. As tags fade, knowledge of their contents and purpose is often lost. Unidentifiable cylinders must be disposed of as hazardous waste at an average cost of $300. In contrast, returning a cylinder to a vendor costs about $27, while shipping a cylinder to the Defense Reutilization and Marketing Organization (DRMO) for sale as scrap metal costs $75. Approximately 200 cylinders were disposed of or returned to vendors between 1993 and 1994, at a combined cost of $28,000.

The Center has instituted a new policy for gas cylinder management, which includes tracking the movement of cylinders at the facility. All "returnable" cylinders, both rentals and government-owned, should be returned to vendors instead of being disposed of as hazardous waste. Non-returnable government-owned and stock cylinders with expired service lives are prepared and shipped to DRMO.

The new management system will reduce the number of cylinders disposed of as hazardous waste. Tracking cylinders and cylinder contents at LaRC will reduce the need for testing to identify tank contents, and may also increase the material usage rates of cylinder gases.

18.4.4 Naval Base Norfolk

As part of its pollution prevention program, Naval Base Norfolk established a PPOA training program in FY 1992. Approximately 25 personnel have been trained in the opportunity assessment process. This training is believed essential to successful implementation of the PPOA recommendations.

A major objective for the environmental program at Naval Base Norfolk is moving beyond environmental compliance to incorporate pollution prevention practices into everyday activities. Numerous pollution prevention initiatives have been implemented at the base. These initiatives, described below, encompass a wide range of operations and are not limited to the recommendations made as part of the PPOA.

18.4.4.1 Air Pollution Control--

Three boilers at the PWC Norfolk P-1 Power Plant were converted to enable fueling by natural gas or oil. Two were converted in 1992, and the third in 1993. The use of natural gas at the Power Plant has reduced carbon emissions by approximately one third of the preconversion value. Nitrogen oxides (NO_x) emitted in pounds per hour were reduced by approximately 40 percent, lowering the annual NO_x emissions by an estimated 30 tons. The converted boilers are currently maximizing the use of natural gas by burning all the natural gas that Virginia Natural Gas Company can supply through existing pipelines. Plans are underway to build an additional pipeline to provide for the expanded use of natural gas.

Three additional boilers are being installed at building Z-312 which will burn natural gas and low sulfur #2 fuel oil, and will act as the main power backup during times of peak power demand on base. The boilers should be fully operational by Spring 1995.

18.4.4.2 Water Conservation--

Two projects at Naval Base Norfolk address water conservation. The first project provided a replacement for the demineralizer at the P-1 Steam Plant, which came on line in the Fall of 1992. The Steam Plant had previously experienced a continuous seven percent blowdown. With the addition of the demineralizer, blowdown percentages have dropped to between 0.5 and 1.0 percent, resulting in a water savings of well over 18.5 million gallons per year.

The second project involves the installation of flushometers in Navy Housing toilets. The flushometers are able to save water by raising toilet tank levels while dropping toilet bowl levels, effectively reducing water use while maintaining adequate flush velocity. Water savings are expected to be 10 million gallons per year, once full installation is complete.

18.4.4.3 Chemical Material Management--

COMNAVBASE has produced a Hazardous Materials/Hazardous Waste Minimization, Reutilization and Disposal Guide that details procedures for minimizing and reutilizing hazardous materials and identifying, accumulating, and disposing of hazardous waste. The document is distributed base-wide, including homeported ships as well as hazardous waste accumulation area custodians during the hazardous waste accumulation area training course. Standardized training to custodians is conducted bimonthly by the Environmental Programs Department.

Every ship homeported at the Naval Station receives training and a Hazardous Materials/Hazardous Waste Minimization, Reutilization and Disposal Guide, produced by Naval Base Norfolk. A prototype effort began in August 1992 to manage hazardous material off-loads in the Hampton Roads area. COMNAVBASE serves as the single point of contact for ship offloads of four or more pallets of hazardous materials/hazardous waste. Through the effort, the quantity of hazardous waste disposed of was reduced by 6 percent from 330,595 gallons in FY 92 to 312,315 gallons in FY 93. A significant amount of stock fund material has also been diverted from the disposal system.

A hazardous pollution prevention program focusing on training, education, and single point hazardous material issuance has been implemented at the Naval Air Supply Station Supply Department and the Naval Supply Center Norfolk Paint Mart and Reutilization Store. Hazardous materials are collected for reutilization and placed in the Reutilization Store. The store provides used hazardous materials, at no cost, as well as a crossdecking service. The Fleet and Industrial Supply Center (FISC) Flash Bulletin and Streamlined Alternative Logistics Transmission System (SALTS) advertises available hazardous materials every 2 weeks. This program reduced hazardous waste disposal from 408,000 gallons in FY90 to 253,000 gallons in FY92. During only eight months of operation, from March to December 1993, the Norfolk Reutilization Store avoided $1M in hazardous materials purchase and disposal costs.

During 1992 and 1993, the Hazardous Waste Minimization Program at Naval Base Norfolk accomplished the following.

- Training for every homeported ship at the Naval Air Station Norfolk regarding proper processing of hazardous materials and hazardous wastes

- Development and distribution of standardized procedures for turn-in of hazardous materials and hazardous wastes, for ships and shore commands, shelf life extension and ship offloads

- Redirection of $666K in medical items for use in lieu of disposal. These items were given to the State Department Humanitarian Assistance Program

- Establishment of a Household Chemical Reuse Program in March 1993. Families that live in government housing can donate partially used household chemicals to the Navy Family Housing Office, Self Help stores for reuse by other residents or new arrivals

- Maintenance of an authorized hazardous materials user list and inventory, which entails annual reviews of products and procedures used by tenants and subordinates

- Installation of six prefabricated storage buildings with spill containment at Hazardous Waste Accumulation Areas to provide secure storage and minimize hazardous waste generated by spillage and cleanup materials

- Establishment of an independent Naval Air Station Norfolk fluid recovery contract to dispose of contaminated oil and hydraulic fluid with a cost savings of $66,600

COMNAVBASE Norfolk has been working to phase out the use of Oil Disposal Rafts (ODRs) for ship bilge water disposal. A Military Construction project was developed to provide pier piping for bilge water collection at the submarine piers. This project will also provide piping to the two drydocks at Naval Station (NAVSTA) Norfolk. Piping for the two remaining NAVSTA piers will be provided during a follow-on project, which is currently being developed. These two projects are anticipated to provide both environmental and cost savings benefits for the base.

18.4.4.4 Municipal Solid Waste--

A recycling program has been in effect since the mid-1980s at Naval Base Norfolk. The Resource Recovery and Recycling Program (RRRP) services all tenant and subordinate commands on the Naval Base and encompasses a multitude of separate revenue-generating operations that, combined, make it the most effective and profitable recycling program in the Department of the Navy. The COMNAVBASE RRRP is ranked third in revenue-generating recycling programs in the Department of Defense. Operations include the following.

- An on-base waste transfer station for recovery of recyclables

- A thriving scrap metals recovery program

- An aluminum can recovery facility

- Two materials recovery facilities (primarily for office and computer paper and corrugated cardboard)

- Recycle Saturdays (at the Naval Air Station Norfolk on the last Saturday of each month)

- Curbside collection of recyclables in the Willoughby housing area

- Aerosol can puncturing and recycling
- Empty drum crushing and recycling

Over 8,000 tons of recyclables were processed, sold, and credited to the RRRP in FY 93, equalling 25 percent of the total waste stream at the Naval Base complex at a cost avoidance and revenue generation of $5.16M. The ultimate goal of the RRRP is to eliminate marketable recyclable materials from the Naval Base waste stream. Near-term goals include increasing the percentage of recyclable materials removed from the waste stream to 33 percent by the end of calendar year 1994; decreasing the number of refuse dumpsters on the Naval Base complex by 5 percent; decreasing the size of at least 20 percent of the remaining refuse containers to smaller, less costly containers; decreasing the pick-up frequency of at least 30 percent of the refuse containers in fiscal year 1994; and, by the end of calendar year 1995, recycling 15,000 tons of material.

18.4.4.5 Electroplating--

Several provisions for pollution prevention had been successfully implemented at the Naval Base Norfolk electroplating facility at the time that the PPOA was conducted. Rinsewater had been reduced by 75 percent, from 80,000 to 20,000 gallons per day, by installing flow restrictors on all water inlets which feed rinse tanks, and by training platers to close water valves on idle plating lines. Water use is assessed through at least two periodic inspections per day. Water meter readings are recorded on a daily basis to track water use and to identify unusual conditions. Process solutions are rarely discarded, due primarily to the exclusive use of deionized water for evaporative makeup in the process tanks. Also, the facility performs some bath maintenance including filtering, sludge removal, carbonate control, dummying, and carbon filtering. Electrolytic metal recovery has been installed for the recovery of cadmium; the recovered cadmium is reused as anode material. A non-cyanide nickel strip solution was substituted for the conventional cyanide bath. Finally, the shop contains a mist eliminator system to recover chromic acid from hard chromium plating tank emissions.

A recently implemented pollution prevention project has significantly reduced the generation of heavy metal sludge-bearing wastes containing chromium, cadmium, silver, and nickel during hard chromium and nickel sulfamate electroplating operations. Using commonly available equipment, the quantity and toxicity of rinsewaters generated during the plating, stripping, and cleaning processes have been significantly reduced, thereby reducing waste disposal costs associated with plating activities.

18.4.4.6 Painting and Depainting Operations--

Painting facilities at Naval Base Norfolk are currently being converted from wet to dry booths. This effort is anticipated to reduce the quantity and toxicity of paint wastes, reduce VOC emissions, and increase the efficiency of paint use. Conversion from wet to dry booth operations at the Naval Aviation Depot (NADEP) alone eliminated more than 25 large electric motors needed to operate the wet systems, significantly reducing power consumption in addition to the improved paint process reliability and paint recovery efficiency. High volume/low pressure paint guns have also reduced overspray solids at NADEP.

Efforts have been made to minimize blast grit in the paint shops, thereby reducing waste generation. Best Management Practices (BMPs) were developed for the Norfolk Barge Repair Facility that address sand blasting, painting and welding operations. The BMPs are designed to eliminate violations for Total Suspended Solids, which have been characteristic for this facility. The BMPs require containment of spent blast grit and debris, daily cleaning and removal of spent blast grit, spray painting only under calm weather conditions, shrouding of surfaces to be blasted, and proper storage of materials in use.

COMNAVBASE Norfolk has drafted a BMP that requires use of paint floats and roller pans to minimize paint discharges. In addition, COMNAVBASE Norfolk is evaluating the feasibility of alternative painting equipment, such as HVLP spray guns and continuous-feed rollers, for pier-side hull painting operations.

18.4.4.7 Solvents--

To reduce solvent use in the parts cleaning process, aqueous parts washers were installed aboard the *U.S.S. Theodore Roosevelt* and at the Shore Intermediate Maintenance Activity (SIMA) Norfolk. These parts washers use high-pressure water and water-based cleaners, rather than chemical solvents. The installation of the parts washer at SIMA resulted in the cancellation of the base's single largest cleaning contract. Procurement of solvents and procurement and disposal of cleaning rags have been eliminated, resulting in an immediate savings of $24,000 a year. More than $100,000 can be saved in labor costs the first year. Many other commands at the base and surrounding area have been provided demonstrations of this technology and have procured or are in the process of procuring additional parts washers. The parts washers aboard the *U.S.S. Theodore Roosevelt* represent the first such systems aboard ship; Naval base Norfolk is working with other ships to install additional systems.

From 1991 to 1993, the Naval Aviation Depot (NADEP) Norfolk undertook the following actions to reduce emissions: vapor degreasers were replaced with water parts washers, freon and ethyl acetate wipe cleaning of aircraft was replaced with water based cleaning, and replacements for freon spray cleaners and freon dip tanks were investigated. Through a thorough review of line processes, NADEP was able to eliminate all but a few of the solvent-containing process tanks, thereby eliminating virtually all VOC emissions. The generation of hazardous waste was reduced, since these solvents previously required disposal as hazardous waste.

Refrigerant recovery equipment was procured during 1992 and 1993 for several facilities at Naval Base Norfolk. This equipment is used to recover and contain ozone depleting substances during maintenance of refrigeration units, thereby reducing emission to the atmosphere.

SECTION 19

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NASA LANGLEY RESEARCH CENTER
PHOTO LABS

As part of the TIPPP program, a pollution prevention opportunity assessment was conducted at the NASA Langley Research Center (LaRC) photo labs in 1991. This project was jointly funded by EPA Risk Reduction Engineering Laboratory and NASA.

19.1 FACILITY DESCRIPTION

Photoprocessing and x-ray operations are located at twelve facilities throughout LaRC; however, the majority of activity takes place at the main photo lab, Building 1155. Photoprocessing facilities are used to develop photos used in LaRC publications and for special events. X-ray processing is used for various research projects and for medical diagnosis. Operations include batch mixing of photographic chemicals, plate-making, and negative and x-ray development.

19.2 AREAS OF POLLUTION PREVENTION OPPORTUNITY EVALUATIONS

The LaRC photo labs generate approximately 16 percent of LaRC's hazardous and chemical wastes. These wastes include spent developers, fixers, and bleaches which amounted to 7,582 gallons of waste shipped off site at a cost of $14,372. The main photo lab, building 1155, accounts for 66 percent of the total hazardous wastes generated by photo operations. Liquid wastes generated by photo developing activities are hazardous because of the high silver content. Additional wastes generated include scrap film and scrap photographic paper. Building 1155 collects scrap film for off-site silver recovery; scrap photographic paper is disposed of as solid waste.

19.3 POLLUTION PREVENTION OPTIONS AND RECOMMENDATIONS

The two areas with the greatest potential for savings per year are: (1) general processing procedures; and (2) silver recovery.

19.3.1 General Processing

Photo technicians currently print several photographs from each negative regardless of the number of photos requested. Assuming two prints were made of each negative, a potential savings of 50 percent could be realized from printing only one. However, occasionally, a reprint is needed for quality; therefore, a conservative estimate of the amount of photographic paper saved by printing only one photo is 33 percent, which would still result in an annual savings of $35,000.

The PPOA additionally recommended several other pollution prevention options to improve photo lab operations.

- Modify quality assurance operations to reduce waste generation.
- Install a water meter in order to monitor water usage to establish baseline information.
- Minimize water usage and reuse rinsewater when possible.
- Return packaging materials to manufacturer.
- Install solution-level alarms on waste photographic solution storage containers to prevent waste solution from overflowing and draining into the floor drain.
- Minimize evaporation losses of photographic solutions.

19.3.2 Silver Recovery

The main photo lab at LaRC is a major generator of silver-bearing wastewater. LaRC will generate silver-bearing photoprocessing wastes whenever typical photographic reproductions of images on film are produced. In several areas, electrolytic silver recovery units were discontinued and the metal cartridges were used for silver recovery, then disposed of. After extensive testing to ensure that silver in the effluent from the canisters would meet discharge permit levels, the used canisters are shipped to Defense Reutilization and Marketing Organization for sale to metal-recovery companies. To minimize the waste, it was recommended that the photo labs reinstate the use of electrolytic silver recovery units in conjunction with silver recovery cartridges. The reduced purchase and disposal of cartridges would result in an annual savings of $1,800 per year.

19.4 STATUS OF IMPLEMENTATION

19.4.1 General Processing

As recommended, the photo lab has installed a water meter to establish baseline water usage. Additional recommendations regarding water usage will be implemented after applicable information has been available for one year.

The photo lab has modified General Processing Procedures and Quality Assurance Procedures used by the lab. These two initiatives are anticipated to reduce the amount of waste paper due to decreasing the number of unused photographic prints produced by the lab and reducing the number of poor quality prints that are disposed of as solid waste. Savings associated with these two initiatives are estimated at $35,000 per year.

19.4.2 Silver Recovery

A centralized silver recovery unit will be in operation in late 1994 for all silver-bearing waste generating operations except for the main photo lab, which has its own recovery system. The centralized unit will be located in the new pollution prevention support building at LaRC. Implementation is expected to ensure uniform management of all silver recovery activities. Silver flake will be recovered from the waste solutions.

The recovery of silver from photoprocessing and x-ray equipment liquid waste is anticipated to reduce disposal costs by eliminating the off-site hazardous waste shipment of silver-bearing liquids, reducing the amount of liquid waste by approximately 1,200 gallons, resulting in an anticipated annual savings of $3,000 in disposal costs. Although additional revenue can be expected from the silver flake which is recovered from the waste stream, this revenue has not been included in the analysis due to fluctuating silver prices and will vary depending on the efficiency of the electrolytic silver unit.

SECTION 20

WREAFS PROJECTS ONGOING OR COMPLETED AFTER SEPTEMBER 1994

In addition to the completed WREAFS projects, several new projects are ongoing or completed after September 1994. Unless otherwise noted, a published report of each project has or will be published and available through NTIS and a project summary has or will be published and available through EPA-CERI (see attached list and ordering blank). A summary of each project follows.

20.1 U.S. DEPARTMENT OF DEFENSE

20.1.1 Naval Ophthalmic Support and Training Activity (NOSTRA)

EPA, with technical support from NOSTRA, worked with the Optical Laboratories Association (OLA) and its member companies to reduce or eliminate process wastes such as MEK, acetone, methanol, toluene, xylene, TCE and TCA. The technical evaluation was funded by the EPA Risk Reduction Engineering Laboratory. The results of the evaluation will be published in a journal article.

20.1.2 Naval Station Mayport

Through the Naval Facilities Engineering Services Center (NFESC), implementation of fluid filtration, recovery, and reuse technologies and rag-use reduction techniques were evaluated for application to the Public Works Operations at Naval Station Mayport in Florida.

20.1.3 U.S. Air Force Center for Environmental Excellence

Using the data from the PPOAs conducted at the OC-ALC, a lessons learned document has been developed for aircraft repair pollution prevention assessments and demonstrations. The project was funded under SERDP.

20.1.4 U.S. Army Corps of Engineers (USACE)

PPOAs were conducted at four USACE facilities as models for future assessments at similar types of Corps facilities. The facilities included in the assessment were: a hydropower plant, a repair station, an operational lock and dam, with ongoing major maintenance occurring within the lock chamber, and a flood control project. The project was funded under SERDP.

20.1.5 Fort Eustis Army Transportation Center

Under the TIPPP program, Fort Eustis has completed a base-wide pollution prevention program plan, which identified a need to evaluate and upgrade painting, depainting and corrosion control operations. Several improvements have been implemented. A Life Cycle Assessment (LCA) of painting and depainting operations is being conducted, beginning with an inventory analysis of improved CARC painting and depainting operations to determine the resources used and environmental releases. An impact analysis will determine the environmental consequences associated with CARC operations, including corrosion control techniques. By evaluating the environmental consequences, the improvement analysis will identify opportunities which will be implemented and evaluated on-site. The project is being funded under SERDP.

20.2 U.S. DEPARTMENT OF TRANSPORTATION

20.2.1 U.S. Coast Guard Air Training Center

Joint assessments were conducted for pollution prevention options in aircraft maintenance, aircraft fueling, flight simulators, and aircraft cleaning at the Air Training Center in Mobile, Alabama. This project was funded by EPA-RREL.

20.2.2 U.S. Coast Guard Technology Assessments

A study was conducted to provide guidance for the USCG in choosing cost-effective parts cleaning chemicals that have minimum environmental and safety impacts. The three bases chosen for this study were: Aviation Training Center (ATC) Mobile, AL; Air Station Cape Cod (ASCC), Falmouth, MA; and Support Center NY (SCNY), Governors Island, NY. The project was jointly funded by USCG and EPA-RREL.

20.3 U.S. DEPARTMENT OF ENERGY

20.3.1 LCA Research and Development Demonstration

As a follow-on to the joint Life Cycle Assessment Research and Development (LCA RD&D), cross-cutting pollution prevention technologies and methodologies at DOE laboratories are being developed and demonstrated. The project is jointly funded by SERDP and DOE.

20.3.2 Complex-wide LCA Design Case Studies

This will build on current DOE/EPA LCA work which is developing a technical framework, Life Cycle Cost Assessment (LCCA) to be included within a life cycle assessment. This project will take the framework to the next phase of demonstration allowing for further development and refinement of DOE products and processes. The project will be jointly funded by SERDP and EPA-RREL.

20.4 U.S. DEPARTMENT OF INTERIOR

20.4.1 Bureau of Indian Affairs

Based in part on the work being done by tribal pueblos, a pollution prevention Resource Guide is being developed to provide technical assistance on source reduction to Indian tribes and business operating on Indian lands. The Guide addresses creation of a pollution prevention program that consists of five elements, including a multi-media pollution prevention effort for Indian tribes that fosters close coordination with State and Federal programs. A training program and workshop on source reduction will also be included as part of the project. The project is funded by EPA-RREL.

20.5 U.S. POSTAL SERVICE

20.5.1 Pollution Prevention Opportunity Assessments

PPOAs are being conducted at six types of postal facilities, including an Engineering and Research Development Laboratory; a Stamp Distribution Center; a Bulk Mail Facility; an Area Supply Depot; a Forensics Laboratory; and customer service centers (small, medium, and large post offices). The recommendations should have applicability to other similar postal facilities throughout the United States. Also, an evaluation was conducted for recycling opportunities between the USPS and Federal Prison Industries. The project is jointly funded by USPS and EPA-RREL. Technology transfer will be in the form of project reports and an implementation workshop.

20.6 U.S. ENVIRONMENTAL PROTECTION AGENCY

20.6.1 Federal Facility Enforcement Office (FFEO) - F2P2 Manual

To assist Federal managers in reducing waste generation and emission rates in order to meet compliance objectives by using pollution prevention tools, a manual was produced by the WREAFS program titled, "Federal Facilities Pollution Prevention--Tools for Compliance." The project was jointly funded by EPA-RREL and EPA-FFEO.

20.6.2 Federal Facility Enforcement Office - FMECI Support

In a project jointly funded by FFEO and RREL, RREL is providing support to EPA Regions in developing Pollution Prevention Supplemental Environmental Projects (SEPS) under the Federal Facilities Multi-Media Enforcement/Compliance Initiative (FMECI). As requested, RREL will provide pollution prevention solutions for violations and other identified areas of noncompliance at Federal sites. The first P2 SEP developed under this program was at Eielson Air Force Base.

20.7 NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

20.7.1 NASA Langley Research Center - Dry Powder Towpreg

In performing its mission, LaRC develops composite materials for use in subsonic and supersonic aircraft applications. LaRC developed a new dry powder towpreg process to manufacture these composite materials. The process is a less hazardous way to impregnate carbon fibers with dry powder resin (towpreg) by using powdered polymers to coat fibers. The TIPPP project is demonstrating this innovative pollution prevention technology and conducting a life-cycle analysis of its energy and environmental impacts. Final products are being compared with commercially produced products to determine comparable performance characteristics. The project is jointly funded by EPA and NASA.

20.7.2 NASA Langley Research Center - Pollution Prevention Program Implementation

Under TIPPP, a base-wide assessment of NASA-LaRC operations was conducted and a Pollution Prevention Program Plan for the facility was developed under the WREAFS program. WREAFS continues to support the implementation of selected projects from the Pollution Prevention Program Plan.

20.8 OTHER POLLUTION PREVENTION RESEARCH INVOLVING FEDERAL AGENCIES

Other pollution prevention research projects involving federal agencies, but not under the WREAFS program per se, were completed or underway at the Newark Air Force Base, the Naval Aviation Depot in Jacksonville, Florida, Tooele Army Depot, and the U.S. Department of Agriculture Forest Products Laboratory.

20.8.1 Newark Air Force Base

EPA in cooperation with Vortec Corporation (equipment supplier) completed a study at the Newark Air Force Base to revaluate compressed air and nitrogen as replacements for spray cans of refrigerants (CFC-12 and HCFC-22). The application was for trouble-shooting thermally intermittent circuit board components.

20.8.2 Naval Aviation Depot

EPA in cooperation with Honeywell-Space Systems Group (Clearwater, FL) and Naval Aviation Deport (Jacksonville, FL) conducted a project to evaluate the effectiveness of using CO_2 at supercritical conditions for cleaning precision parts, such as gyroscope bearings. This method will replace the use of CFCs or other toxic solvents.

20.8.3 Tooele Army Depot

EPA in cooperation with Tooele Army Depot (Tooele, UT) evaluated N-methyl-2-pyrrolidone (NMP) as a substitute paint remover in an automated conveyer paint stripping system used to depaint the High Mobility Multipurpose Wheeled Vehicle (HMMWV) and other Army vehicles.

20.8.4 U.S. Department of Agriculture, Forest Products Laboratory

Two projects funded under interagency agreements between the U.S. Department of Agriculture and EPA are: (1) Reclaiming Fiber from Newsprint (investigating the potential for newsprint reclamation through a dry fiberizing process); and (2) Developing composites from Recycled Plastics, Wood and Recycled Wood Fiber (investigating and developing wood/plastic composites).

20.9 SUMMARY AND CONCLUSIONS

The WREAFS Program takes on many facets in its endeavor to support the Federal community with pollution prevention research. There have been a number of RD&D products completed and a number of on-going efforts, but perhaps the most important impact will come from any resulting cultural change brought about by conducing a PPOA or reading an RD&D report. It is necessary for all Federal agencies to take an active role in pollution prevention and set examples for others. The SERDP/WREAFS combination is an excellent illustration of the opportunities available for Federal agencies to wisely use funding and manpower to attain the goal of pollution prevention.

SECTION 21

REFERENCES

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4. U.S. Environmental Protection Agency, Greening the White House, *U.S. EPA Pollution Prevention News*, EPA-742-N-94-003, June-July 1994.

SECTION 22

POLLUTION PREVENTION
PUBLICATIONS AND ORDERING FORM

The following list of current publications and ordering form include pollution prevention topics in addition to those related to the WREAFS program. WREAFS program products are indicated with an asterisk. For additional information, contact the Pollution Prevention Research Branch at (513) 569-7215, FAX: (513) 569-7111.

P2 PUBLICATIONS

January 6, 1995

PLEASE PLACE A CHECK NEXT TO THE GUIDES YOU WISH TO ORDER AND MAIL TO:

CERI PUBLICATIONS UNIT, US EPA
26 W. MARTIN LUTHER KING DRIVE
CINCINNATI, OH 45268
(513) 569-7562

GUIDES TO POLLUTION PREVENTION:

____	THE PESTICIDE FORMULATING INDUSTRY	EPA/625/7-90/004
____	THE PAINT MANUFACTURING INDUSTRY	EPA/625/7-90/005
____	THE FABRICATED METAL PRODUCTS INDUSTRY	EPA/625/7-90/006
____	THE PRINTED CIRCUIT BOARD MANUFACTURING INDUSTRY	EPA/625/7-90/007
____	THE COMMERCIAL PRINTING INDUSTRY	EPA/625/7-90/008
____	SELECTED HOSPITAL WASTE STREAMS	EPA/625/7-90/009
____	RESEARCH AND EDUCATION INSTITUTIONS	EPA/625/7-90/010
____	THE PHOTOPROCESSING INDUSTRY	EPA/625/7-91/012
____	THE AUTO REPAIR INDUSTRY	EPA/625/7-91/013
____	THE FIBERGLASS REINFORCED AND COMPOSITE PLASTICS INDUSTRIES	EPA/625/7-91/014
____	MARINE MAINTENANCE AND REPAIR INDUSTRY	EPA/625/7-91/015
____	THE AUTOMOTIVE REFINISHING INDUSTRY	EPA/625/7-91/016
____	THE PHARMACEUTICAL INDUSTRY	EPA/625/7-91/017
____	MECHANICAL EQUIPMENT REPAIR	EPA/625/R-92/008
____	METAL CASTING AND HEAT TREATING INDUSTRY	EPA/625/R-92/009
____	METAL FINISHING INDUSTRY	EPA/625/R-92/011
____	MUNICIPAL PRETREATMEMT PROGRAMS	EPA/625/R-93/006
____	NON-AGRICULTURAL PESTICIDE USERS	EPA/625/R-93/009
____	WOOD PRESERVING INDUSTRY	EPA/625/R-93/014

GUIDES TO CLEANER TECHNOLOGIES

____	ORGANIC COATING REMOVAL	EPA/625/R-93/015
____	ALTERNATIVES TO CHLORINATED SOLVENTS FOR CLEANING & DEGREASING	EPA/625/R-93/016
____	CLEANING AND DEGREASING PROCESS CHANGES	EPA/625/R-93/017
____	ORGANIC COATING REPLACEMENTS	EPA/625/R-94/006
____	ALTERNATIVE METAL FINISHES	EPA/625/R-94/007

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OTHER MANUALS:

	Title	Number
____	FACILITY POLLUTION PREVENTION GUIDE	EPA/600/R-92/088
____	OPPORTUNITIES FOR P2 RESEARCH TO SUPPORT THE 33/50 PROGRAM	EPA/600/R-92/175
____	LIFE CYCLE DESIGN GUIDANCE MANUAL	EPA/600/R-92/226
____	LIFE CYCLE ASSESSMENT: INVENTORY GUIDELINES & PRINCIPLES	EPA/600/R-92/245
____	POLLUTION PREVENTION CASE STUDIES COMPENDIUM	EPA/600/R-92/046
____	ACHIEVEMENTS IN SOURCE REDUCTION & RECYCLING FOR TEN INDUSTRIES IN THE UNITED STATES	EPA/600/2-91/051
____	INDUSTRIAL P2 OPPORTUNITIES FOR THE 1990'S	EPA/600/8-91/052
____	BACKGROUND DOCUMENT ON CLEAN PRODUCTS RESEARCH & IMPLEMENTATION	EPA/600/2-90/048
____	A PRIMER FOR FINANCIAL ANALYSIS OF P2 PROJECTS	EPA/600/R-93/059
____	MEASURING POLLUTION PREVENTION PROGRESS PROCEEDINGS	EPA/600/R-93/151
____	WASTE MINIMIZATION PRACTICES AT TWO CCA WOOD-TREATMENT PLANTS	EPA/600/R-93/168
____	INNOVATIVE CLEAN TECHNOLOGIES CASE STUDIES	EPA/600/R-93/175
____	DUPONT CHAMBERS WORKS WASTE MINIMIZATION PROJECT	EPA/600/R-93/203
____	MERCURY USAGE AND ALTERNATIVES IN THE ELECTRICAL AND ELECTRONICS INDUSTRIES	EPA/600/R-94/047
____	A REVIEW OF COMPUTER PROCESS SIMULATION IN INDUSTRIAL POLLUTION PREVENTION	EPA/600/R-94/128
____	FEDERAL FACILITY POLLUTION PREVENTION TOOLS FOR COMPLIANCE	EPA/600/R-94/154
____	POLLUTION PREVENTION OPPORTUNITY ASSESSMENT: US COAST GUARD AVIATION TRAINING CENTER MOBIL, ALABAMA	EPA/600/R-94/156
____	DEVELOPMENT OF A POLLUTION PREVENTION FACTORS METHODOLOGY BASED ON LIFE-CYCLE ASSESSMENT: LITHOGRAPHIC PRINTING CASE STUDY	EPA/600/R-94/157
____	INNOVATIVE CLEAN TECHNOLOGIES CASE STUDIES SECOND YEAR PROJECT REPORT	EPA/600/R-94/169
____	NASA LANGLEY RESEARCH CENTER & THE TIDEWATER INTERAGENCY POLLUTION PREVENTION PROGRAM	EPA/600/R-94/171
____	CHEMICAL HAZARD EVALUATION FOR MANAGEMENT STRATEGIES (CHEMS 1): A METHOD FOR RANKING & SCORING CHEMICALS BY POTENTIAL HUMAN HEALTH & ENVIRONMENTAL IMPACTS	EPA/600/R-94/177
____	THE PRODUCT SIDE OF POLLUTION PREVENTION: EVALUATING THE POTENTIAL FOR SAFE SUBSTITUTES	EPA/600/R-94/178
____	GERMANY, GARBAGE, & THE GREEN DOT: CHALLENGING THE THROWAWAY SOCIETY	EPA/600/R-94/179

TO CERI PUBLICATIONS UNIT:

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PROJECT SUMMARIES / PROJECT REPORTS

December 14, 1994

PLEASE PLACE A CHECK NEXT TO THE REPORTS YOU WISH TO ORDER AND MAIL TO:

CERI PUBLICATIONS UNIT, US EPA
26 W. MARTIN LUTHER KING DRIVE
CINCINNATI, OH 45268
(513) 569-7562

		EPA Document #
____	WMOA Report and Project Summary - Fort Riley, Kansas	EPA/600/S2-90/031
____	Recovery of Metals Using Aluminum Displacement	EPA/600/S2-90/032
____	Machine Coolant Waste Reduction by Optimizing Coolant Life	EPA/600/S2-90/033
____	Metal Recovery/Removal Using Non-Electrolytic Metal Recovery	EPA/600/S2-90/035
____	WMOA Project Summary- Philadelphia Naval Shipyard	EPA/600/S2-90/046
____	WMOA Project Summary- Coast Guard/ Governor's Island	EPA/600/S2-90/062
____	Diaper Industry Workshop Report	EPA/600/S2-91/018
____	Hospital Pollution Prevention Case Study	EPA/600/S2-91/024
____	WMOA Project Summary - Naval Undersea Warfare Engineering Station, Keyport, WA	EPA/600/S2-91/030
____	WMOA Project Summary - Optical Fabrication Laboratory, Fitzsimmons Army Medical Center, Denver, CO	EPA/600/S2-91/031
____	WMOA Project Summary - A Truck Assembly Plant	EPA/600/S2-91/038
____	WMOA Project Summary - A Photofinishing Facility	EPA/600/S2-91/039
____	Industrial Pollution Prevention Opportunities for the 1990s	EPA/600/S8-91/052
____	WMOA Project Summary - Scott Air Force Base	EPA/600/S2-91/054
____	Automotive and Heavy-Duty Engine Coolant Recycling by Filtration	EPA/600/S2-91/066
____	Evaluation of Five Waste Minimization Technologies at the General Dynamics Pomona Division Plant	EPA/600/S2-91/067
____	Automotive and Heavy-Duty Engine Coolant Recycling by Distillation	EPA/600/SR-92/024
____	PPOA: Histology Laboratory Xylene Use, Fort Carson, CO	EPA/600/SR-92/187
____	An Automated Aqueous Rotary Washer for the Metal Finishing Industry	EPA/600/SR-92/188
____	Onsite Waste Ink Recycling	EPA/600/SR-92/251
____	PPOA: USDA Beltsville Agricultural Research Center, Beltsville, Maryland	EPA/600/SR-93/008
____	PPOA for Two Laboratories at Sandia National Laboratories	EPA/600/SR-93/015
____	Ink and Cleaner Waste Reduction Evaluation for Flexographic Printers	EPA/600/SR-93/086

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____	Mobile Onsite Recycling of Metalworking Fluids	EPA/600/SR-93/114
____	Evaluation of Ultrafiltration to Recover Aqueous Iron Phosphating/ Degreasing Bath	EPA/600/SR-93/144
____	Replacement of Hazardous Material in Wide Web Flexographic Printing Process	EPA/600/SR-93/149
____	Watts Nickel & Rinse Water Recovery via an Advanced Reverse Osmosis System	EPA/600/SR-93/150
____	A Fluid Sorbent Recycling Device for Industrial Fluid Users	EPA/600/SR-93/154
____	Recycling Nickel Electroplating Rinse Waters by Low Temperature Evaporation and Reverse Osmosis	EPA/600/SR-93/160
____	Carbon-Black Dispersion Preplating Technology for Printed Wire Board Manufacturing	EPA/600/SR-93/201
____	Ultrasonic Cleaning as a Replacement for a Chlorofluorocarbon-Based System	EPA/600/SR-93/223
____	Onsite Solvent Recovery	EPA/600/SR-94/026
____	Evaluating ACQ as an Alternative Wood Preservative System	EPA/600/SR-94/036
____	Evaluation of Supercritical Carbon Dioxide Technology to Reduce Solvent in Spray Coating Applications	EPA/600/SR-94/043
____	Cadmium and Chromium Recovery from Electroplating Rinsewaters	EPA/600/SR-94/050
____	Wash Solvent Reuse in Paint Production	EPA/600/SR-94/063
____	Evaluation of an Electrodialytic Process for Purification of Hexavalent Chromium Solutions	EPA/600/SR-94/071
____	Removal and Containment of Lead-Based Paint via Needle Scalers	EPA/600/SR-94/114
____	Waste Reduction Evaluation of Soy-Based Ink at a Sheet-Fed Offset Printer	EPA/600/SR-94/144
____	Alkaline Noncyanide Zinc Plating & Reuse of Recovered Chemicals	EPA/600/SR-94/148
____	PPOA: US Coast Guard Aviation Training Center, Mobile, AL	EPA/600/SR-94/156
____	Innovative Clean Technologies Case Studies, Second Year Project Report	EPA/600/SR-94/169
____	Electronic component Cooling Alternatives: Compressed Air & Liquid Nitrogen	EPA/600/SR-94/170
____	Evaluation of Propylene Carbonate in ALC Depainting Operations	EPA/600/SR-94/176

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NEW JERSEY RESEARCH BRIEFS

December 14, 1994

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CINCINNATI, OH 45268
(513) 569-7562

Waste Reduction Activities and Options for a:

_____	Printer of Forms and Supplies for the Legal Profession	EPA/600/S-92/003
_____	Nuclear Powered Electrical Generating Station	EPA/600/S-92/025
_____	State DOT Maintenance Facility	EPA/600/S-92/026
_____	Local Board of Education in New Jersey	EPA/600/S-92/027
_____	Manufacturer of Finished Leather	EPA/600/S-92/039
_____	Manufacturer of Paints Primarily for Metal Finishing	EPA/600/S-92/040
_____	Manufacturer of Writing Instruments	EPA/600/S-92/041
_____	Manufacturer of Room Air Conditioning Units and Humidifiers	EPA/600/S-92/042
_____	Autobody Repair Facility	EPA/600/S-92/043
_____	Fabricator and Finisher of Steel Computer Cabinets	EPA/600/S-92/044
_____	Manufacturer of Artists' Supply Paints	EPA/600/S-92/045
_____	Manufacturer of Wire Stock Used for Production of Metal Items	EPA/600/S-92/046
_____	Manufacturer of Commercial Refrigeration Units	EPA/600/S-92/047
_____	Transporter of Bulk Plastic Pellets	EPA/600/S-92/048
_____	Manufacturer of Electroplated Wire	EPA/600/S-92/049
_____	Manufacturer of Systems to Produce Semiconductors	EPA/600/S-92/050
_____	Remanufacturer of Automobile Radiators	EPA/600/S-92/051
_____	Manufacturer of Fire Retardant Plastic Pellets and Hot Melt Adhesives	EPA/600/S-92/052
_____	Printing Plate Preparation Section of a Newspaper	EPA/600/S-92/053
_____	Manufacturer of General Purpose Paints and Painting Supplies	EPA/600/S-92/054
_____	Manufacturer of Fine Chemicals Using Batch Processes	EPA/600/S-92/055
_____	Laminator of Paper and Cardboard Packages	EPA/600/S-92/056
_____	Manufacturer of Hardened Steel Gears	EPA/600/S-92/057

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____	Scrap Metal Recovery Facility	EPA/600/S-92/058
____	Manufacturer of Electroplating Chemical Products	EPA/600/S-92/059
____	Manufacturer of Plastic Containers by Injection Molding	EPA/600/S-92/060
____	Fossil Fuel-Fired Electrical Generating Station	EPA/600/S-92/061
____	Manufacturer of Commercial Dry Cleaning Equipment	EPA/600/S-92/062
____	Electrical Utility Transmission System Monitoring and Maintenance Facility	EPA/600/S-92/063
____	Manufacturer of Orthopedic Implants	EPA/600/S-92/064

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ENVIRONMENTAL RESEARCH BRIEFS

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CINCINNATI, OH 45268
(513) 569-7562

Waste Minimization Assessment for a:

_____	Manufacturer of Printed Plastic Bags	EPA/600/M-90/017
_____	Metal Parts Coating Plant	EPA/600/M-91/015
_____	Manufacturer of Outdoor Illuminated Signs	EPA/600/M-91/016
_____	Manufacturer of Rebuilt Railway Cars and Components	EPA/600/M-91/017
_____	Manufacturer of Brazed Aluminum Oil Coolers	EPA/600/M-91/018
_____	Manufacturer of Heating, Ventilating, and Air Conditioning Equipment	EPA/600/M-91/019
_____	Bumper Refinishing Plant	EPA/600/M-91/020
_____	Multilayered Printed Circuit Board Manufacturing	EPA/600/M-91/021
_____	Manufacturer of Printed Circuit Boards	EPA/600/M-91/022
_____	Paint Manufacturing Plant	EPA/600/M-91/023
_____	Manufacturer of Compressed Air Equipment Components	EPA/600/M-91/024
_____	Manufacturer of Aluminum Cans	EPA/600/M-91/025
_____	Manufacturer of Refurbished Railcar Bearing Assemblies	EPA/600/M-91/044
_____	Manufacturer of Prototype Printed Circuit Boards	EPA/600/M-91/045
_____	Manufacturer of Speed Reduction Equipment	EPA/600/M-91/046
_____	Manufacturer of Printed Labels	EPA/600/M-91/047
_____	Manufacturer of Chemicals	EPA/600/S-92/004
_____	A Dairy	EPA/600/S-92/005
_____	Manufacturer of Metal-Cutting Wheels and Components	EPA/600/S-92/006
_____	Manufacturer of Automotive Air Conditioning Condensers and Evaporators	EPA/600/S-92/007
_____	Printed Circuit Board Manufacturer	EPA/600/S-92/008
_____	Manufacturer of Components for Automobile Air Conditioners	EPA/600/S-92/009
_____	Manufacturer of Aluminum Extrusions	EPA/600/S-92/010
_____	Manufacturer Producing Galvanized Steel Parts	EPA/600/S-92/011
_____	Manufacturer of Commercial Ice Machines and Ice Storage Bins	EPA/600/S-92/012
_____	Manufacturer of Water Analysis Instrumentation	EPA/600/S-92/013

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____	Manufacturer of Can-Manufacturing Equipment	EPA/600/S-92/014
____	Manufacturer of Metal Bands, Clamps, Retainers, and Tooling	EPA/600/S-92/015
____	Manufacturer of Permanent-Magnet DC Electric Motors	EPA/600/S-92/016
____	Manufacturer of Military Furniture	EPA/600/S-92/017
____	Aluminum Extrusions Manufacturer	EPA/600/S-92/018
____	Manufacturer of Metal-Plated Display Racks	EPA/600/S-92/019
____	Manufacturer of Motor Vehicle Exterior Mirrors	EPA/600/S-92/020
____	Manufacturer of Sheet Metal Cabinets and Precision Metal Parts	EPA/600/S-92/021
____	Manufacturer Producing Treated Wood Products	EPA/600/S-92/022
____	Manufacturer of Industrial Coatings	EPA/600/S-92/028
____	Manufacturer of Cutting and Welding Equipment	EPA/600/S-92/029
____	Manufacturer of Finished Metal Components	EPA/600/S-92/030
____	Manufacturer of Machined Parts	EPA/600/S-92/031
____	Manufacturer of Injection-Molded Car and Truck Mirrors	EPA/600/S-92/032
____	Manufacturer Producing Printed Circuit Boards	EPA/600/S-92/033
____	Manufacturer of Custom Molded Plastic Products	EPA/600/S-92/034
____	Manufacturer of Sheet Metal Components	EPA/600/S-92/035
____	Manufacturer of Silicon-Controlled Rectifiers and Schottky Rectifiers	EPA/600/S-92/036
____	Manufacturer of Penny Blanks and Zinc Products	EPA/600/S-92/037
____	Manufacturer of Baseball Bats and Golf Clubs	EPA/600/S-93/007
____	Manufacturer of Product Carriers and Printed Labels	EPA/600/S-93/008
____	Manufacturer of Rotogravure Printing Cylinders	EPA/600/S-93/009
____	Manufacturer of Screwdrivers	EPA/600/S-94/003
____	Manufacturer of Pliers and Wrenches	EPA/600/S-94/004
____	Manufacturer of Finished Metal & Plastic Parts	EPA/600/S-94/005
____	Manufacturer of Prewashed Jeans	EPA/600/S-94/006
____	Manufacturer of Paints and Lacquers	EPA/600/S-94/007
____	Manufacturer of Gravure-Coated Metalized Paper & Metalized Film	EPA/600/S-94/008
____	Manufacturer of Surgical Implants	EPA/600/S-94/009
____	Manufacturer of Aluminum and Steel Parts	EPA/600/S-94/010
____	Manufacturer of Aerial Lifts	EPA/600/S-94/011
____	Manufacturer of Mountings for Electronic Circuit Components	EPA/600/S-94/012

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____	Manufacturer of Felt Tip Markers, Stamp Pads, & Rubber Cement	EPA/600/S-94/013
____	Manufacturer of Coated Parts	EPA/600/S-94/014
____	Manufacturer of Microelectronic Components	EPA/600/S-94/015
____	Manufacturer of Corn Syrup and Corn Starch	EPA/600/S-94/016
____	Manufacturer of Caulk	EPA/600/S-94/017
____	Manufacturer of Electrical Rotating Devices	EPA/600/S-94/018
____	Manufacturer of Parts for Truck Engines	EPA/600/S-94/019

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