WASTE MINIMIZATION AT THE DEPARTMENT OF ENERGY'S HANFORD SITE

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ABSTRACT

This paper provides an overview of waste minimization activities at the Hanford Site. The paper briefly looks at the activities and types of wastes generated at the Hanford Site and provides a summary of the program to implement sitewide waste minimization. Several case histories are presented to highlight sources of the waste minimization successes at the Hanford Site to date. Also, recently initiated programs that hold promise for significantly reducing future waste generation are identified.

SITE OVERVIEW

The Hanford Site consists of 560 square miles of semiarid land along the Columbia River in southeastern Washington. The U.S. Department of Energy-Richland Operations Office (DOE-RL) facilities are located throughout the Site and the city of Richland. Operations at the Hanford Site are supported by more than 14,000 employees who work for the DOE-RL and four prime contractors. Westinghouse Hanford Company (Westinghouse Hanford) is the operating and engineering contractor and manages defense production, defense waste, advanced reactor operations, and environmental restoration, and provides site service support activities. Pacific Northwest Laboratory (PNL) is the research and development contractor with primary responsibility for technology development and environmental monitoring. Kaiser Engineers Hanford Company is the design engineering and construction contractor supporting new projects for the Hanford Site. The Hanford Environmental Health Foundation provides occupational and environmental health services for the Site.

The mission at the Hanford Site has changed in the last five years. The defense production focus of the Site in the 1980s has changed to waste management and environmental cleanup. As a result, N-Reactor has been placed in cold standby, the fuels fabrication activities have been curtailed, operations at the Plutonium-Uranium Extraction facility have been placed on hold, and the scrap recovery operation at the Plutonium Finishing Plant is in limited operation. Environmental issues have also influenced operations causing the temporary shutdown of the radioactive waste evaporator and the cleanout and removal of numerous product storage tanks. This change of mission at the Hanford Site and the influence of environmental regulations have changed the types and quantity of waste generated at the Site and changed the focus of waste minimization activities.

WASTE OVERVIEW

The Hanford Site generates a variety of nonregulated, hazardous, radioactive, and radioactive mixed wastes from the diverse activities performed onsite. Activities and operations generating wastes include administrative support, photo processing, duplicating and reproduction, blueprinting, painting, automotive and heavy equipment maintenance, laboratory analyses, tank cleanout, scrap recovery, fuel reprocessing, terminal plant cleanout, reactor operations, waste management, research and development activities, construction, decommissioning of retired facilities, and well drilling.

The types of hazardous wastes generated include rags, aerosol cans, solvents, paints, off-specification products, partially used or expired chemicals, acids, bases, and oils, to name a few.

Radioactive waste classifications found at the Hanford Site include low-level waste (LLW), transuranic (TRU) wastes, high-level wastes (HLW), and spent fuels. The activity level of each classification of waste also varies from contact-handled waste of less than 100 mrem to remote-handled waste with readings in the thousands of rem per hour range. Radioactive contaminated wastes include rags, aerosol cans, paper, wood, liquids from process operations, cooling water and evaporator condensate, spent ion exchange resin, contaminated process and support equipment, clothing, and masks.

Radioactive mixed waste results from process operations, maintenance, laboratory work, and decontamination efforts that use hazardous chemicals. Radioactive mixed waste is also generated when equipment or materials having hazardous characteristics become contaminated. The result is a waste with both radioactive and hazardous contaminants. Radioactive mixed waste has been generated in all radioactive waste classifications and at all activity levels. Many of the hazardous waste types previously described also are found under the radioactive mixed waste classification.

WASTE MINIMIZATION PROGRAM OVERVIEW

The Hanford Site waste minimization activities are guided by DOE orders, Environmental Protection Agency regulations and Washington State Department of Ecology regulations relating to waste management and minimization. The DOE-RL has incorporated these orders and regulations into program guidance in the DOE-RL Waste Minimization and Pollution Prevention Awareness Plan. The contractors have used this guidance to develop company waste minimization and pollution prevention plans. Westinghouse Hanford and PNL, because of the complexity of their operations, have created facility-specific plans and organization-specific plans, respectively. The recent completion of these implementing plans provides the structure to encourage waste minimization emphasis at all levels across the Hanford Site.

Facility-specific plans were completed in March 1990 at all Westinghouse Hanford plants. The facility-specific plans are designed to provide structure and standardization to waste minimization activities. These plans define how waste minimization is managed by each organization. The plans also establish a process to prioritize waste streams for waste assessments based on minimization potential, degree of hazard, storage and disposal costs, and quantity generated. Finally, the plans provide a methodology for setting goals for minimization and for reporting both successes and failures.

As the Hanford Site has changed from production to environmental restoration, the emphasis on waste minimization similarly has changed. Much of the plant-specific actions in the past four to five years have concentrated on process optimization. With the shutdown of plants, focus has changed to improved conduct of operations and improved maintenance to reduce waste generation. With cleanup of the site as a primary mission, future waste minimization efforts will focus on the development of new techniques to reduce the volume of wastes associated with the cleanup.

CASE HISTORIES

The following case histories highlight some of the waste minimization success stories at the Hanford Site. These case histories, for the most part, demonstrate the work minimization initiatives taken at various plants by plant management and operators. However, the first two case histories, the Surplus Chemical Exchange Program and the Double-Shell Tank Space Management, reflect formal programs that have been initiated to address specific problems experienced at the Hanford Site.

Surplus Chemical Exchange Program

In 1989, it was discovered that excess chemical products being disposed of as hazardous waste by one organization were still being ordered and used by other organizations at the Hanford Site. To address this problem, the Surplus Chemical Exchange (SCE) Program was developed for advertising surplus chemical products. The SCE uses the local area computer network to bring persons who have surplus chemicals together with persons who need the chemicals. The result, since implementation in March 1990, has been the avoidance of approximately 2,700 kg of waste from across the Site and numerous savings on both chemical purchase costs and waste disposal costs. The program has also spawned efforts to exchange chemicals with schools and universities. The program will be further expanded to formally coordinate with purchasing the review of the surplus chemicals listing before purchase of new products. This required review is expected to enhance the effectiveness of the program across the Site.

Double-Shell Tank Space Management

The temporary shutdown of the radioactive liquid waste evaporator because of environmental issues resulted in a projected tank space shortage. The historical volume of dilute waste generated by the various operating facilities indicated that available tank space would be depleted by December 1990, before the projected restart of the evaporator.

Total Quality task teams were established at each plant to explore waste reduction and minimization options. Each stream at each plant that generates radioactive liquid waste was evaluated for minimization potential or elimination. The task teams established maximum waste generation limits at each plant. These limits extended the availability of tank space through June 1991. Westinghouse Hanford management created a set of even more restrictive limits that further challenged plants to reduce waste. In addition, a multi-function Tank Space Management Board consisting of plant managers was established to review efforts to reduce wastes generated and to provide review and approval of activities that would cause a plant to exceed management's established volume. The result has been the further reduction of waste generation rates. The volume of liquid waste avoided to date is in excess of 11 million liters.

Examples of waste minimization efforts that have been implemented are discussed below. The volume of line flushes to reduce the buildup of solids has been reevaluated and in some cases reduced by one third. Solids accumulations are monitored. The reduced flush volume continues to have a similar effectiveness for solids removal; for one plant alone, this represents a 680,000-liter reduction in waste. The frequency of transfers has been reduced by allowing catch tanks to operate at higher levels. The reduced number of transfers further reduces flush volumes. The frequency of many operations that create waste (equipment cleanout, ion exchange column regeneration, etc.) have been challenged and reduced as appropriate. Maintenance on leaking valves and equipment has been expedited to reduce waste sources. Generally, plants have been optimizing operations and reducing waste volumes. Separately, most of these activities do not result in significant volume reduction, but together they have reduced the dilute volume shipped to Tank Farms. (See Fig. 1.)

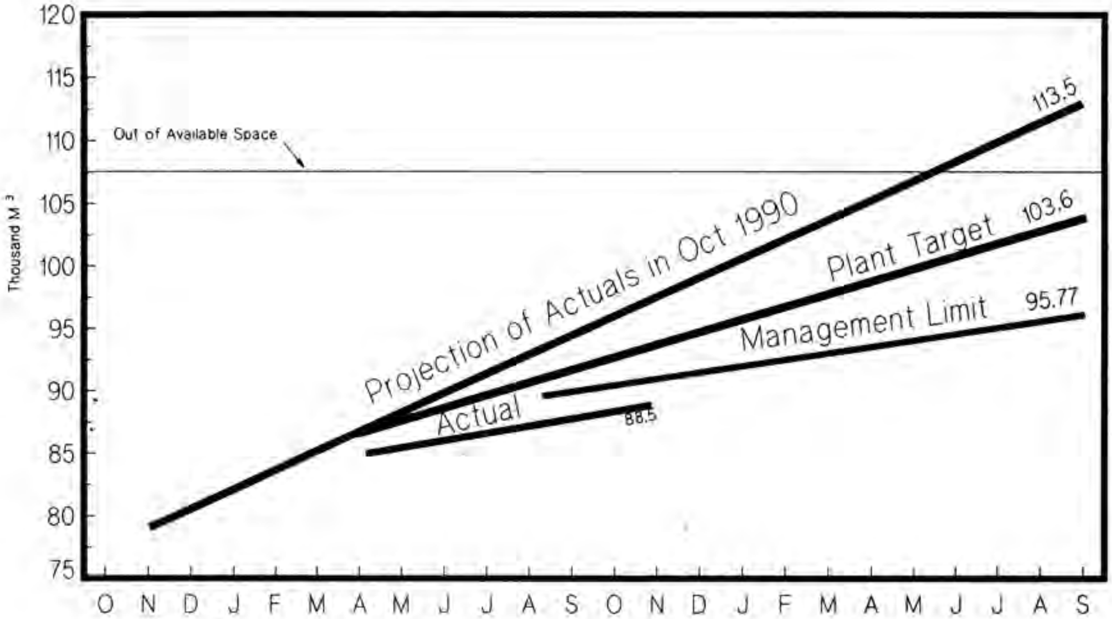

Fig. 1. Double-shell tank space.

Waste Sorting (segregation) at N-Reactor

In late 1987 a sorting system was initiated at the N-Reactor to separate compactable from non-compactable wastes. This waste volume reduction exercise also identified waste minimization opportunities. All low-level operations waste packaged for disposal was opened and sorted. The compactable waste was placed in a drum compactor for volume reduction. Hazardous materials that should not have been in the package were recovered and disposed of correctly. In addition, many reusable items, some of which could be salvaged, were found in the packages.

In 1988, the low-level radioactive waste stream was reduced from 440 m^3 to 115 m^3 by recovering salvageable items and using compaction. Salvageable items recovered include protective clothing, fresh air hoods, masks and filters, face-shields, tools, and miscellaneous supply items. Reusing the salvageable items saved $98,350 in new product costs.

Since the sorting process was initiated, the number of hazardous and useable items found in the low-level waste stream has been significantly reduced. Salvageable items recovered have dropped to an estimated $15,000. Employees are now more careful with what they throw away and the way they segregate the waste. In the near future, an assay table will be added to sort nonradioactively contaminated items from contaminated items. The facility will contain two physical sorting tables, an assay sorting table, and a compactor. The waste sorting system will be available to sort low-level solid waste generated at other facilities.

Solvent recycling at Westinghouse Hanford paint shop

A Westinghouse Hanford paint shop operates a small solvent recycling unit to minimize solvent waste from paint cleanup operations. The unit was purchased commercially from Dowmar and has a 38-liter capacity. The unit consists of a metal bucket completely housed by another container. Below the metal bucket is an electrical heating element which is controlled by a thermostat. The metal bucket is lined with a plastic "oven" bag before each use. The solvent is placed in a bucket and the temperature is set to the boiling point of the solvent. This prevents the evaporation of contaminants and provides for an automatic shutoff at the end of the cycle. The solvents are collected and condensed using an ambient air cooling coil located below the bucket. The operation is slow and requires no extra cooling for condensation. The condensed solvent is then reused for paint cleanup.

This is a small system treating a small waste stream. Approximately 10 gallons of waste is processed through this system each month, reducing the waste stream by approximately 90%. The remaining sludge is disposed of as hazardous waste.

Antifreeze (ethylene glycol) recycling

In 1988, the Fleet Operations, Transportation, and Maintenance Services group of Westinghouse Hanford was using 5,470 L of antifreeze per year to support vehicle maintenance. Several attempts were made to reduce the quantity of waste through source reduction methods such as the use of antifreeze extenders, and procedural changes to extend the lifetime of the antifreeze. (See Fig. 2.) These changes reduced the amount of antifreeze used but did not significantly minimize waste. An antifreeze recycling unit was purchased from FPPF Chemical Company in an attempt to further reduce antifreeze use. Antifreeze recycling has reduced antifreeze waste to 380 L per year.

A 1,300-liter holding tank is used to accumulate used antifreeze. The holding tank allows the oil to separate from the antifreeze and large impurities to settle. Antifreeze from this tank is poured, in 350-liter batches, into the feed tank of the recycling unit. The operator watches for signs of oil as the 1,300-liter tank is emptied. Oil indicates that the 1,300-liter tank must be emptied. The residual 3 to 7 L of oil and solids are disposed of as hazardous waste.

Each 350-liter batch is circulated through two sets of water purification filters. The 25-micron and 5-micron filters remove suspended particulate matter and any remaining oil. The pH is adjusted to 10.0 using an FPPF additive. Fresh ethylene glycol, as needed, is added to adjust the freezing point to -35 °C. Each batch takes about 1 h to complete. Antifreeze waste has been reduced by 93%.

Road Striping Paint Wastes

Approximately 14,000 L of paint are used annually to stripe roads on the Hanford Site. Paint was previously purchased in 19-liter non-returnable paint cans. Cleanup material and empty cans translated into 660 kg of hazardous waste. Through arrangements with the supplying company, paint is now purchased in 1,300-liter returnable containers. This has eliminated an estimated 500 kg of waste. The paint company also accepts all liquid wastes associated with the cleanup of the paint and allows the waste to be returned in the reusable containers. This translates to reduced waste generation and disposal costs.

Hydraulic Oil Recycling and Motor Oil Minimization

Formerly, hydraulic oil was replaced at routine intervals on cranes and other hydraulic units. The routine change-out of oils has been replaced with oil recycling. A portable hydraulic oil filtering unit is taken to the job site along with three to five clean empty drums. The oil is pumped directly from the crane hydraulic oil reservoir

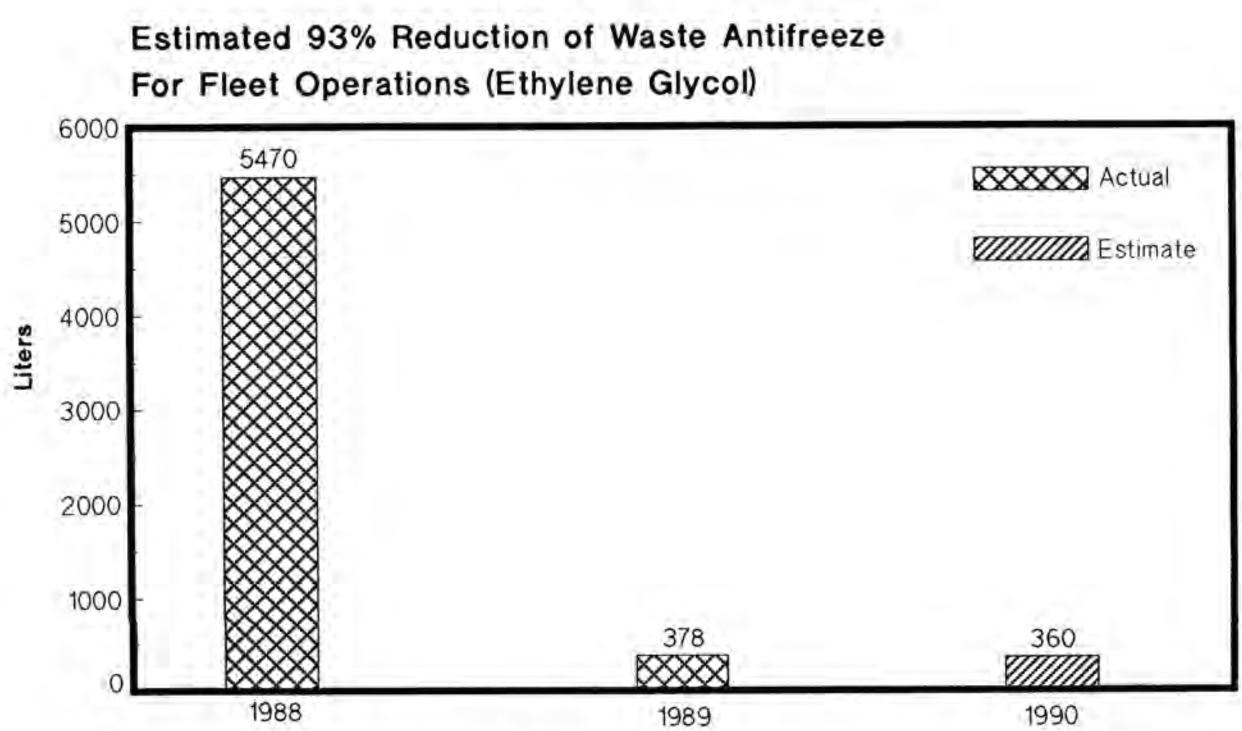

Fig. 2. Reduction of antifreeze.

through a 25-micron and then a 5-micron hydraulic oil filter into the empty drums. Once the reservoir has been emptied the hoses are reversed and the oil is pumped through the filters again and back into the crane's reservoir. Normally, two to three cycles are sufficient to remove water and particulate matter. This operation saves the cost of purchasing 600 to 800 L of new hydraulic oil per crane, and disposal costs are avoided.

Motor oil wastes have also been reduced. The average interval between oil changes has been increased by using better grades of motor oil and performing wear analysis on the oil rather than changing the oil at a predetermined time or mileage interval.

The combination of hydraulic oil recycling and motor oil use reduction has reduced oil wastes by 54.6% from 76,200 L in 1986 to 41,600 L in 1989. (See Figs. 3, and 4.)

Recently Initiated Waste Minimization Activities

Paper recycling - A pilot paper recycling program has been initiated at one office facility. If the program is successful and can be implemented at other facilities it will result in the recycling of much of the paper currently placed in landfills at the Hanford Site.

Procurement Control - Efforts are ongoing to implement a required review of all hazardous products purchased. The review will require an evaluation of alternatives and substitutes for hazardous products used.

Aerosol Can Elimination - Reusable compressed air applicators or pump spray applicators are being used in conjunction with bulk quantities of pesticides, solvents, paints, etc. in an effort to eliminate aerosol cans. Aerosol cans continue to present disposal problems as well as hazardous waste sources.

Waste Waters - Cooling water, steam condensate, and miscellaneous waste waters are being evaluated for elimination. Single-pass cooling water streams are being evaluated for replacement by closed loop systems. Clean water sources such as steam condensate are being segregated from potentially contaminated streams to eliminate radioactive wastes disposed to cribs.

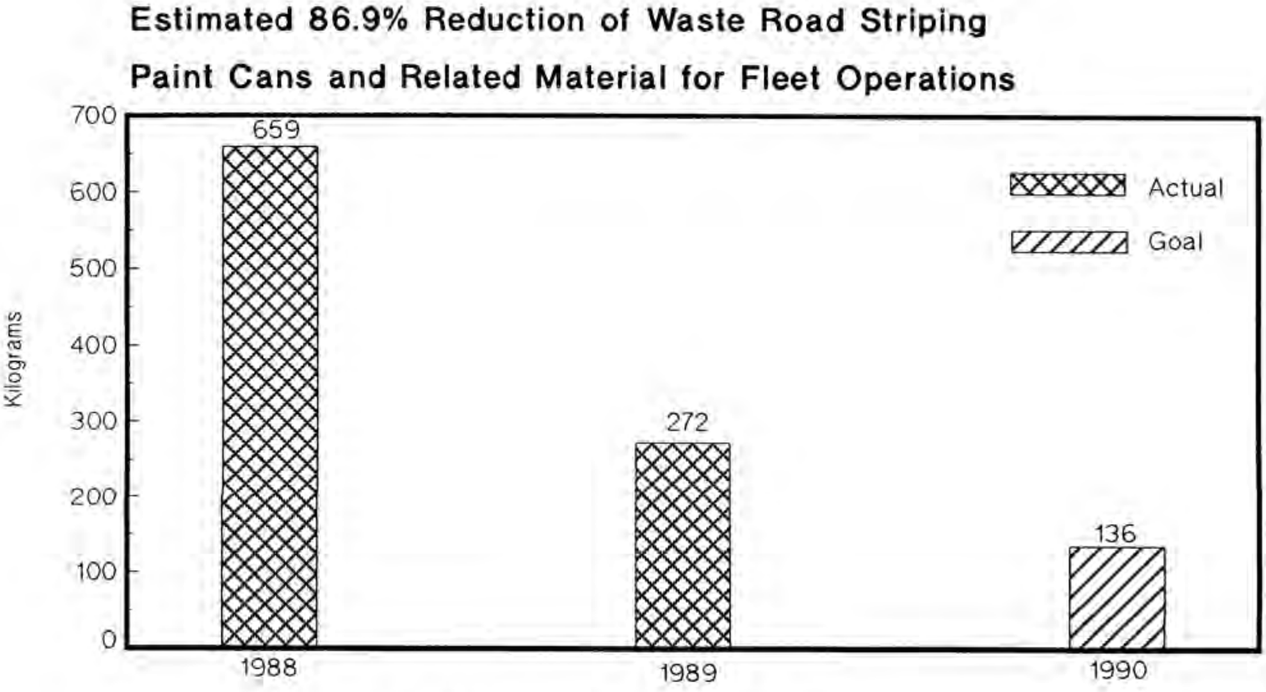

Fig. 3. Reduction of paint striping paint wastes.

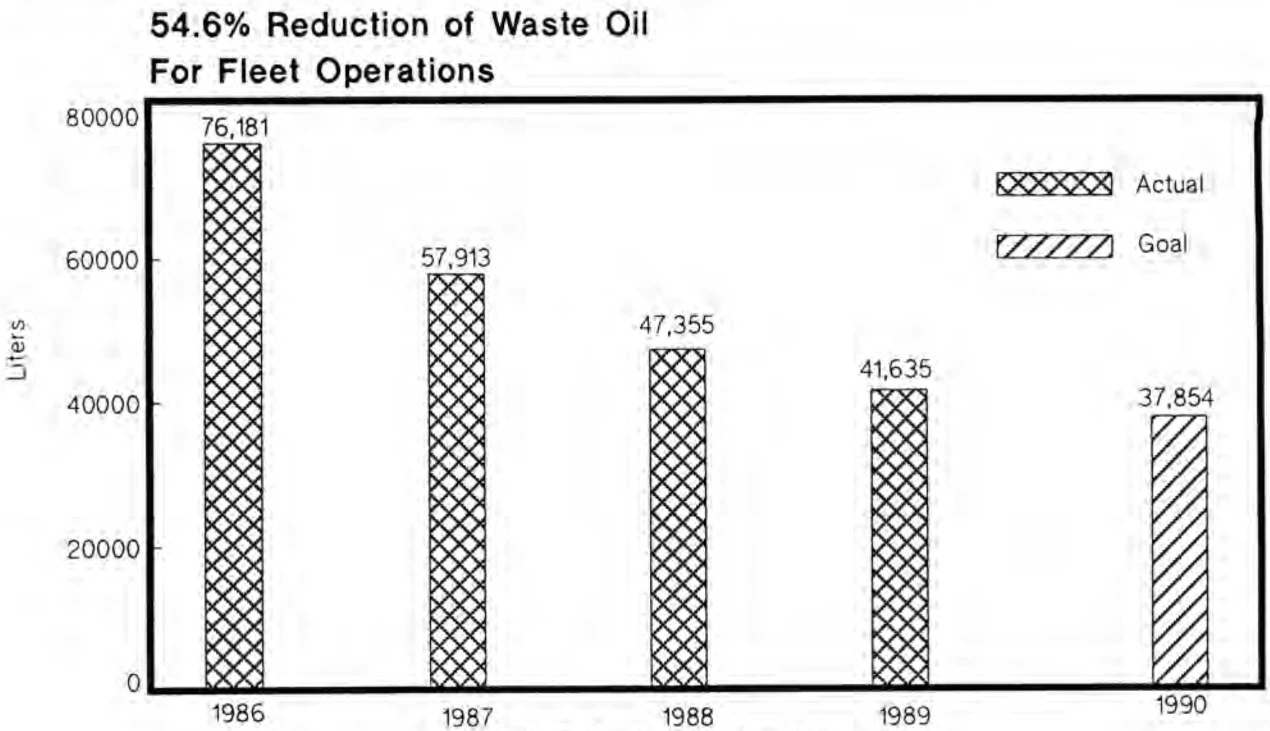

Fig. 4. Reduction of waste oil.

SUMMARY

Multiple waste minimization techniques are being implemented across the Hanford Site. Some ideas have resulted in large reductions in waste volumes while others represent a smaller decrease in waste produced. All minimization efforts are significant. Together these techniques have prevented the generation of 369,000 kg of hazardous waste and 208,000 kg of radioactive mixed wastes in 1989. Fourteen thousand kg of hazardous waste have been recycled. The numbers for 1990 are still being compiled, but further reduction of wastes is predicted.