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ABSTRACTS

The Drake Hotel, Chicago, Illinois

July 9-11, 1996

Sponsored by the U.S. Department of Energy
Office of Environmental Management
Waste Minimization, EM-77

Cosponsored by DOE Chicago Operations Office
and Argonne National Laboratory

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FOREWORD

The 1996 DOE Pollution Prevention Conference XII incorporates a number of changes from previous conferences. The Technical Program Committee has attempted to present a more diversified program to address the many different perspectives of pollution prevention and waste minimization activities.

This year's conference features three forums with distinguished speakers from industry, regulators, and the government. The Industrial Forum focuses on industrial experience and why private industry has successfully embraced pollution prevention as a cost-saving, practical solution to production problems. The Regulatory Forum discusses recent developments in the permitting and enforcement areas that have incorporated pollution prevention requirements. The DOE forum features speakers from Environmental Management, Energy Research, Defense Programs who discuss returning the cost of waste management and pollution prevention to the generators.

An important component of this year's program is our attempt to reach out to private industry, regulators, and other federal agencies. The program reflects this effort, and conference attendees have the opportunity to learn from their expertise and experiences. A panel discussion features recent successes in the areas of materials exchange. This discussion should be valuable for federal agencies and private organizations. In addition, two poster sessions cover pollution prevention opportunity assessments and implementation of pollution prevention ideas.

The breakout sessions highlight such diverse topics as electric vehicles, chemical exchange in the public sector, and energy management. Sessions may present new ideas and concepts, or they may bring you up to date on a specific topic. What is old to some may be very new to others. The committee felt this diversity was important. In developing the program, we used our imagination and frequently asked questions. "How can this technology be adapted to a different waste stream?" "We have seen this technology, but why hasn't it been adapted for other uses? " "How can I use this?"

Abstracts received too late for publication in this document are included in your conference program. The Technical Program Committee welcomes you to DOE's Pollution Prevention Conference XII.

SESSION 1:

MODEL FACILITIES — 1
TUESDAY MORNING

IMPLEMENTATION OF A COMPREHENSIVE POLLUTION PREVENTION PROGRAM AT THE ICF KAISER HANFORD COMPANY

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In calendar year 1995, ICF Kaiser Hanford Company (ICF-KH) recycled 50,000 kg of hazardous waste; 3.9 million kg of solid, sanitary waste; and 230 m^3 of industrial wastewater. Through source reduction activities, 15,000 kg of hazardous waste; 1,100 kg of solid, sanitary waste; and 2,081 m^3 of industrial wastewater were eliminated. These quantitative successes are the result of a fundamental change in ICF-KH's approach to environmental management.

In 1994, ICF-KH restructured its Waste Minimization/Pollution Prevention (WMin/P2) program to integrate it with all aspects of environmental management, standardize WMin/P2 reporting requirements, coordinate the WMin/P2 efforts of diverse activities (e.g., engineering, construction, and base operations support), and fully integrate WMin/P2 into all levels of the company structure.

To achieve this restructuring, ICF-KH used a total quality approach to environmental management. Value engineering was used to baseline the ICF-KH WMin/P2 and environmental management programs and, through functional analysis, to develop a program integral to all business activities. Performance indicators were established and tracked to measure the success of implemented initiatives and focus on continually improving the program.

This paper discusses how value engineering and total quality tools were used to build a foundation for success to initiate a cultural change within ICF-KH. WMin/P2 is now a part of everyone's job and forms the cornerstone of the environmental management system.

PANTEX PLANT — A MODEL FACILITY FOR POLLUTION PREVENTION

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Pantex Plant is a model facility because of an aggressive, results-oriented Pollution Prevention Program. The plant has reduced its hazardous waste generation for seven consecutive years. Long-term commitment to the environment and responsible action have reduced hazardous waste generation by 98%, while the plant shifted the workload from new production to dismantlement. (Dismantlement generates more waste than new production.) These great strides have been accomplished by implementing many effective source-reduction and recycling programs. Thirty-three recycling programs are in operation, saving taxpayer money. Projects implemented in 1995 resulted in a savings of 5.7 million tax dollars.

CREATING BETTER WAYS TO COMMUNICATE POLLUTION PREVENTION TO EMPLOYEES — THE P2 WEB SITE AT OAK RIDGE NATIONAL LABORATORY

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In September 1995, Oak Ridge National Laboratory's (ORNL's) Pollution Prevention Office unveiled its Web site. The Web site was created to fill a need for better communication with ORNL's 5,000 employees and to disseminate information more easily. Information on the Web site is organized in a easy-to-use menu format and includes (1) news, announcements, and ORNL's quarterly pollution prevention (P2) newsletter; (2) a description of pollution prevention and ORNL's P2 program goals; (3) information on the sanitary waste recycling program; (4) pollution prevention opportunity assessment information; (5) funding opportunities for P2 projects; (6) information on various P2 awards programs; (7) affirmative procurement information; (8) links to other sources of P2 information; (9) a telephone directory of P2 contacts at ORNL; and (10) a suggestion form.

The Web site has been extremely useful in distributing electronic versions of forms that employees can fill out on their own computers and return without using paper. The Web site was purposely placed on an external server so that anyone around the world can learn from our P2 program. The address for the ORNL P2 Web page is http://www.ornl.gov/ornlp2/p2main.htm.

WASTE MINIMIZATION/POLLUTION PREVENTION ACTIVITIES AT THE WESTERN AREA POWER ADMINISTRATION

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In accordance with U.S. Department of Energy directives and U.S. Environmental Protection Agency regulations, the Western Area Power Administration (Western) has reduced the amount of contaminants, wastes, and other regulated materials that require disposal through source reduction and recycling programs. Since 1977, Western has reduced its use of polychlorinated biphenyls (PCBs) and minimized waste generation by retrofitting equipment and processing and reusing PCB-contaminated oil. Eliminating approximately 40 million pounds of PCBs reduced their possible future threat to human health and release into the environment. Western also has established recycling programs throughout its service area. Such programs include the recycling of paper, aluminum, computer tapes, used oil, and steel circuit breakers.

Western has developed a Waste Minimization/Pollution Prevention Awareness Plan (hereafter referred to as the Plan) to guide the development and implementation of a facilitywide, multimedia, pollution prevention (P2) program within the agency. The four main objectives of the Plan are (1) pollution prevention opportunity assessments, (2) affirmative procurement of recycled materials, (3) P2 ethics and awareness in the workplace, and (4) annual reporting and evaluation of progress toward the Plan's goal. Western uses these specific activities to meet its goal of reducing or eliminating the generation of solid waste and the associated adverse environmental impacts. Western employees contribute individually to the waste minimization P2 effort by participating in these activities.

SAVANNAH RIVER SITE WASTE MINIMIZATION: PUTTING THE MONKEY BACK ON THE GENERATOR

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The Savannah River Site (SRS), and other U.S. Department of Energy (DOE) facilities, have been forced to develop administrative controls to drive waste minimization (WMin) in the absence of true economic incentives that motivate aggressive performance in commercial industry. Compartmentalization of DOE programs and budgets disconnects waste generators from the financial impacts of waste treatment, storage, and disposal. Waste management costs typically accrue outside of the generating organization, and the generator sees little financial feedback — positive or negative — from the quantity of waste produced. DOE waste-generating organizations are not sufficiently motivated to seek and implement WMin improvements when another organization realizes the cost savings.

The SRS has instituted a variety of compensatory administrative drivers that have proved to be positive WMin incentives. Successful strategies and initiatives, such as generator disposal space allocations, use of waste acceptance criteria, approval of waste forecasts, generator waste taxes, and pass-through of low-level waste (LLW) treatment costs, are placing waste ownership where it belongs — with the generator.

The results have been impressive. Since 1990, SRS WMin initiatives have prevented the generation and disposal of more than 350,000 ft^3 of solid radioactive (LLW, low-level mixed, and transuranic) waste. More significantly, these improvements have saved more than $17 million in life-cycle waste costs. This paper outlines SRS WMin incentive strategies and relates generator implementation success stories. These tactics could be applied throughout federal government operations and could strengthen aggressive WMin practices in commercial industry.

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* Westinghouse Savannah River Company.

SESSION 2:

FEDERAL/NEPA/STAKEHOLDERS
TUESDAY MORNING

INCORPORATING WASTE MINIMIZATION AND POLLUTION PREVENTION INTO THE NEPA PROCESS

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Methods and procedures are recommended for ensuring that all U.S. Department of Energy (DOE) projects and programs incorporate waste minimization (WMin) techniques into project planning. The primary tool for ensuring this is the National Environmental Policy Association (NEPA) process, which looks at a proposed action, considers alternatives and environmental impacts, and recommends a preferred alternative.

Specific recommendations are made to amend DOE's NEPA regulations (10 CFR 1021), DOE orders, and a DOE guidance document (*Recommendations for Preparation of EAs and EISs*). Recommendations focus on incorporating WMin/pollution prevention (P2) goals consistent with the Pollution Prevention Act of 1990 and ensuing Executive Orders, regulations, and guidance. It also incorporates the goals of the Energy Policy Act of 1992 concerning water and energy conservation. Incorporating WMin/P2 into the NEPA process would also ensure carrying NEPA values into the Comprehensive Environmental Response, Compensation, and Liability Act process, as required by the Secretary of Energy's policy on NEPA. Because the goals of NEPA and WMin/P2 are consistent (environmental protection), it is logical to integrate the regulatory and statutory requirements.

DOE AND DOD POLLUTION PREVENTION PROGRAM IMPLEMENTATION: HOW CAN WE HELP EACH OTHER?

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The U.S. Department of Energy (DOE) and the U.S. Department of Defense (DOD) have been solidly in step with the national policy on pollution prevention (P2) as stated in the Pollution Prevention Act of 1990. Both departments have issued policies, plans, and guides for initiating and maintaining an aggressive, results-oriented program at each site or installation. Similarities exist in many approaches within the two programs, including aggressive goal setting, accurate process baseline information, tracking and reporting requirements, ongoing pollution prevention opportunity assessments, and project implementation. Both departments are also involved in environmental restoration activities and are wrestling with the dilemma of effectively integrating pollution prevention into these nonroutine projects.

"Cross-cutting" is a new buzzword being used to bring attention to common issues, such as P2 waste management (WM) and its integration into every activity within an organization. A key opportunity exists between DOE and DOD to "cross-cut" WM/P2 opportunities and successes to combine resources for the good of each department. This paper addresses both similarities and differences between the two programs. Only by understanding the core programs and implementation strategies and contrasting the differences will a pathway be forged that blends the WM/P2 knowledge and experiences of the two departments. This unity can bring together successful programs and projects that have a common thread between the two departments and create an arena for technical and programmatic exchanges.

In 1991, DOE and the U.S. Air Force (USAF) formed a Memorandum of Understanding Program designed to combine forces to reduce or eliminate hazardous waste generation in areas common to both agencies. The projects and activities composing this program supported the WM/P2 objectives of both DOE and USAF complexes. Participants also included DOD, private industry, and universities. The results and status of this program are discussed, along with ways to rejuvenate support and involvement from all areas of the two departments and expand this program to include current issues, such as recycling, decommissioning, and restoration.

Collaboration between the two departments is both financially and developmentally advantageous. Saving time and money by minimizing duplication of effort and maximizing the use of resources is

essential in an era of budget cuts and downsizing. This paper discusses several WM/P2 case studies and other issues of common interest to both departments and identifies the similarities and differences between the planning and implementation of projects.

STAKEHOLDERS AND POLLUTION PREVENTION: THE TECHNICAL MANAGER'S GUIDE TO BUILDING PUBLIC SUPPORT FOR POLLUTION PREVENTION PROGRAMS

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Public involvement should be a critical component of the pollution prevention (P2) strategy at every federal agency. Executive Order 12856 outlines the need to keep the public informed of progress being made by agencies involved in pollution prevention. Technical managers who do not work with external stakeholders on a daily basis may find public involvement a challenging task. "Where do I start?" "Who are the stakeholders near my facility?" "How do I get my message out?"

Meaningful public involvement can be achieved at minimal cost and time to the technical manager. This paper introduces the tools and techniques needed to involve the public and increase visibility of a P2 program. Electronic on-line and print media sources of publicity enable technical professionals to achieve visibility and recognition for "good news" accomplishments in pollution prevention. Internet home pages offer stakeholders an understanding of program successes. Professional contacts in the agency's public affairs organization assist technical managers in disseminating P2 information. National publications solicit articles about environmental management activities, including P2 successes. Public meetings and workshops are mechanisms to gain public involvement and feedback regarding activities to prevent pollution at a federal facility. This paper aims to help technical professionals who are addressing pollution prevention issues develop a working knowledge of public involvement resources that can be used immediately within their organization.

THE VALUE AND GOOD SENSE OF COMMUNITY OUTREACH

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Times have changed: people are more environmentally savvy than they used to be. They demand to know how a facility's operations can affect their families, neighborhoods, and the environment. In short, they care about what goes on behind the company fence. Most businesses want to develop good relationships with their communities but are unsure of how or where to begin. This presentation defines community outreach and the types of techniques that can help communities develop positive relationships with companies.

Government and industry are sometimes presented with the unique challenge of providing the general public with information about what they do. This information is often very technical, unfamiliar, and intimidating. Most people fear what they do not know or understand, and that fear or misunderstanding can lead to denial of environmental permits, public outrage that stops projects, and lawsuits. By instituting an outreach program, companies can establish trust, credibility, and confidence within the community.

SESSION 3:

MICROCHEMISTRY
TUESDAY MORNING

ANALYTICAL CHEMISTRY IN CONJUNCTION WITH THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY OFFICE OF POLLUTION PREVENTION GRADUATE INTERNSHIP PROGRAM

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The goals of the Illinois Environmental Protection Agency's (IEPA's) Office of Pollution Prevention (OPP) Graduate Internship Program are to provide fresh perspectives and new ideas in pollution prevention (P2) techniques to interested Illinois facilities and to give graduate students the opportunity to apply new knowledge and skills in the workplace. The program's benefits include (1) short-term expertise in P2 applications at little cost to Illinois companies (the intern's stipend is provided by IEPA); (2) long-term savings because of reduced disposal and the cost of raw materials; and (3) summary results to promote technology transfer and greater participation in voluntary P2 programs by Illinois industries.

The IEPA's OPP assists Illinois industries that choose to protect the environment through pollution prevention. This assistance is provided through a variety of voluntary programs, such as the Graduate Internship Program.

The Graduate Internship Program places a graduate-level student with participating Illinois facilities to work on P2 projects. Graduate students have expertise in engineering, science, and occupational health and safety. The IEPA has placed interns during the summer since 1989 and recently began a fall intern program. IEPA pays the intern's stipend, and the host facility provides supervision and workers' compensation coverage for the length of the intern's stay.

Over the years, the program has helped numerous Illinois companies save millions of dollars. Savings have included reduced disposal costs, improved process efficiency, conservation of raw materials, reduced energy usage, and less pollution from power generation.

Each interested company fills out and submits an initial application. OPP then requests a brief summary of the company's proposed project objectives. Priority is given to true P2 projects rather than to off-site recycling and end-of-pipe controls. A 1995 graduate intern project dealing with analytical chemistry is described. The case study is presented in the following paper by Mitch Erickson and colleagues.

POLLUTION PREVENTION IN THE ANALYTICAL LABORATORY — MICROSCALE AND OTHER TECHNIQUES *DO* ADD UP

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Pollution prevention (P2) has not been sufficiently addressed in the analytical laboratory. Although the amount of reagent used per sample is often only a few milliliters, the aggregate of many routine tests each day in thousands of laboratories becomes significant. Effective P2 will require operational or even fundamental changes in the methods employed. "End-of-pipe" recycling is not practical with small streams.

Routine analytical methods for environmental samples and waste are quite prescriptive and often do not include the principles of waste minimization and P2. Many methods require preparation of 100-fold or more excess samples for an instrumental determination and use reagents that are not now considered "green."

Microscale chemistry is loosely defined as the application of chemical principles and apparatus at a scale much smaller than that currently employed by most bench chemists, reducing the volume of reagents and product by several orders of magnitude. Green chemistry is an umbrella term addressing waste minimization, P2, solvent substitution, environmentally conscious manufacturing, maximum atom utilization, technologies for a sustainable future, environmental security, and industrial ecology. The primary focus of green chemistry over the past decade has been within the chemical industry; adoption by routine environmental laboratories has been slow because "regulatory methods must be followed." Green and microscale methods are increasingly necessary for the environmental analytical community as regulations tighten, the cost of waste disposal escalates, and public scrutiny increases.

Argonne staff have adapted the principles of microscale chemistry, along with other modern analytical approaches, to develop routine analytical methods that significantly reduce waste generation, while they maintain acceptable analytical figures of merit and achieve cost savings through reduced reagent consumption *and* labor costs.

- The principles of P2 and waste minimization were used to develop and test microscale adaptations to regulatory approved analytical procedures for the analysis of Resource Conservation and Recovery Act elements in soil.

- In a separate effort, new procedures were developed for preventing or minimizing primary and secondary waste generation in chemical laboratory operations for the analysis of polychlorinated biphenyls.

- In a third example, an integrated thermal desorption/gas chromatography/mass spectrometer (TD/GC/MS) system was investigated as an alternative to the customary solvent extraction, cleanup, and solvent elimination followed by GC/MS. Because solvents are *eliminated* from the analytical method, only the analytes of interest are extracted, other reagents are eliminated, and the process can be integrated into a single flow-through system.

Results are reported, and the general significance of P2 in the analytical laboratory is discussed. The analytical applications are illustrative of potential changes achieved by incorporating P2 principles into research laboratories.

IN-PROCESS CLEANING ANALYSIS

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Cleaning parts and equipment used in U.S. industrial activities constitutes one of the largest sources of hazardous waste and air emissions. Surface cleaning is integral to operations (such as metal machining and electroplating), electronic fabrication activities (such as printed circuit board manufacture/assembly and composites molding/machining), and many other activities. In some activities, cleaning processes generate most of the waste volume.

Monitoring contamination levels on parts during cleaning operations can make such processes more efficient and provide useful feedback for reducing waste generation and air emissions caused by overcleaning or undercleaning and subsequent rework of the parts. Such real-time process controls could reduce reject rates and raise profitability in a variety of high- and low-technology industries.

In response to this need, Lawrence Livermore National Laboratory is developing a sensor system that can provide real-time cleaning verification feedback in an industrial production-line environment. The sensor system, termed a "contamination analysis unit," or CAU, is robust enough to be used in a range of industrial and governmental applications. The CAU is portable so that it can quickly be moved from one part of an assembly line to another. It generates highly precise data. In testing of the sensor prototype, hydrocarbon contamination layer thicknesses of the order of 1 nm were routinely measured. This measurement corresponds to contamination only a few monolayers thick. The sensor also identifies the type of contamination. It can distinguish between different hydrocarbon species and detect other common contaminants, such as silicone oils. Finally, the sensor components are inexpensive; it is envisioned that once commercialized, the CAU will be affordable to medium- and small-sized shops and to larger plants.

The CAU uses off-the-shelf mass spectrometry technology and a probe designed to interface with parts surfaces and desorb traces of contamination from the surface, using a combination of vacuum plus heat. The CAU contains data processing capabilities and a contaminant library for identifying the amount and type of surface contamination. It reads out in standard metrics (micrograms of contamination per square centimeter of part surface).

SESSION 4:

SOURCE 4 SOLVENTS AND REDUCTION — 1
TUESDAY AFTERNOON

PRODUCTION TESTING OF AQUEOUS CLEANING SYSTEMS

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The National Defense Center for Environmental Excellence (NDCEE) was tasked by the U.S. Army Environmental Research, Development, and Engineering Center to identify, test, and evaluate the most environmentally compliant, technically and economically feasible, nonhalogenated metal parts cleaning system for the widest range of Department of Defense (DOD) applications. As part of the task, production testing was performed in NDCEE's Environmental Technology Facility to demonstrate the viability of nonhalogenated cleaning systems. During testing, qualitative and quantitative cleanliness results and process information were collected for material compatibility and economic and environmental analyses. This testing consisted of the following elements:

- Selecting metal parts representative of parts currently cleaned at DOD facilities;
- Operating the high-pressure spray and ultrasonic cleaning system for 30 trials at various combinations of pressure, chemical concentration, wash time, and wash temperature settings;
- Determining cleanliness levels;
- Performing a statistical analysis of cleanliness test results;
- Evaluating material compatibility data;
- Collecting process information for material and energy balances; and

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* Westinghouse Savannah River Company.

- Evaluating waste minimization methods.

Cleanliness testing consisted of both qualitative and quantitative methods, such as visual examinations, tape lifts, wipe tests, surface tension tests, nonvolatile residue tests, and particulate residue tests. A comparison of the cleanliness results from production testing and cleanliness baseline testing performed at DOD facilities showed that with appropriate variable settings and part fixturing, the levels of cleanliness achieved during nonhalogenated production testing were equal to or better than the levels of cleanliness obtained by using current halogenated cleaning processes.

By means of statistical analysis techniques, the optimal operating conditions were identified and verified for both cleaning systems. Projected annual material and utility usage was calculated from the production trial testing material and energy balances. This information will be used as the basis for economic analyses and environmental assessments.

Both cleaning systems and the results of the production and cleanliness baseline testing are applicable to the cleaning of radioactively contaminated materials from nuclear processes. Technologies that optimize waste minimization and cleaner reuse must be tested and evaluated to reduce waste disposal costs.

ELIMINATION OF PHOTO-CHEMICAL WASTES THROUGH DIGITAL IMAGING TECHNOLOGY

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In October 1994, the Photographic Services Group shut down six photo-chemical processors and began providing photographic support through digital imaging technology. This action totally eliminated the annual generation of 500 gal of developers, 1,000 gal of fixers, and 90 gal of system cleaners. It reduced Ernest Orlando Lawrence Berkeley National Laboratory's annual waste by approximately 6,000 kg and decreased the acid waste stream by 12%.

SOLVENT USAGE AND RECOVERY IN A RESEARCH AND DEVELOPMENT SETTING

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In general, Argonne National Laboratory's wastes can be characterized as coming from three focus areas:

- Laboratory operations generate approximately 50% of all waste disposed. Operational waste is relatively less hazardous, reasonably consistent in nature, and generally in larger quantities.

- Restoration- and decommissioning-associated wastes generate larger quantities of waste on a one-time basis. These wastes can be nonhazardous to highly toxic, and the quantities can vary from small to very large.

- The final waste stream is ongoing research and development waste. This material is typically small quantities that come from many different waste streams.

This last waste stream is at the center of Argonne's pollution prevention program. Although the individual generator does not produce a significant amount of waste, the total aggregate of each individual project contributes to the volume. Argonne initiated a study to quantify solvent usage, characterize the waste solvent, and match the purity requirements, while exploring all opportunities to substitute and recycle.

The first phase of the study determined what solvents and which research processes could yield the best results. A list of potential solvents was generated, and the Waste Management Database was queried for quantities disposed of and numbers of users. This phase allowed Argonne to reduce the list of solvents from more than 50 to less than 25. Solvents that had low annual usage or a corresponding large number of generators with small individual usage were eliminated from further study because the likelihood of achieving successful results was not cost-effective at the time.

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* Environment and Waste Management Programs.

† Energy Systems Division.

The second phase of the study ranked individual solvents, from large users to small users; an arbitrary cutoff of 5 L per year was established. For solvents that met the screening criteria, detailed characterization data were obtained (e.g., name of generator, generation history, contaminants, and concentration). The information was compiled into a questionnaire for each of the solvents and waste generators in question.

The third phase involved discussions with the individual solvent users to verify the accuracy of the data and collect missing information. The users were also asked about potential barriers to recycling opportunities. Could they recycle directly, or did they have to filter or purify their material? Under what circumstances could they use recycled materials? Could their material be recycled? Could they substitute a different, less toxic solvent?

The study indicated that an excellent opportunity existed to recycle solvents from "high end users," such as analytical chemistry where purity is a given, to middle end users that can use a clean solvent for a process, and finally to low end users who likely use the material for cleaning.

From data obtained by Environmental Management Operations at Argonne, six solvents were identified as preliminary targets for recovery and reuse: ethanol, methanol, carbon tetrachloride, 1,1,1-trichloroethane (TCA), propanol, and acetone. A review of the technical literature indicated that the following treatment technologies offered promise for recovery and reuse of solvents: adsorption, absorption, membrane separation (e.g., reverse osmosis, centrifugation, direct solvent reuse, filtration/ultrafiltration, and distillation). Waste samples were obtained from a number of researchers around the Laboratory for use in preliminary treatability studies. The solvents used for these studies included ethanol, methanol, and TCA. The waste solvents were subjected to a number of treatment techniques, primarily distillation and filtration. As an example of the results obtained, the ethanol waste was readily distilled from a 12% ethanol waste, yielding a distillate of about 92% quality.

WASTE MINIMIZATION AT THE OAK RIDGE SITE PAINT SHOP

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The Oak Ridge K-25 Site Paint Shop has significantly reduced its hazardous waste generation through several projects initiated in the past year. These projects include substituting latex paint for oil-based paint whenever feasible and participating in waste exchange programs.

In a joint effort between Lockheed Martin Energy Systems, Inc., and private industry, the K-25 Paint Shop worked with Kurfee's Coatings, Inc., to develop and procure a 99.6% solvent-free interior paint. The Paint Shop arranged to recycle 5,000 gal of its oil-based paint, which would have been disposed of as waste under the Resource Conservation and Recovery Act. The Paint Shop sent 2,000 gal of the paint to the K-25 Site Swap Shop and 3,000 gal to the U.S. Forest Service in Kentucky. This recycling effort reduced the K-25 Site's paint inventory by 90% and saved $211,750 in disposal costs. The Paint Shop minimized its waste even further by limiting the site color selection to four interior and four exterior colors and by buying a base color and adding tints required for specific jobs. Excess tinted paints are now combined and used as a base coat. The shelf life of the paint is no longer exceeded because only a two days' supply of paint is stored on site. The Paint Shop also continues to use its paint thinner reclamation center (developed in 1992) with great success.

In calendar year 1994, the Paint Shop purchased a sandblast and vacuum recovery unit to prepare surfaces for painting. This equipment segregates and collects removed surface material, which may contain lead, chromium, or other toxic materials, from the used sandblast grit. This process prevents the release of contaminants and minimizes hazardous waste cost-effectively.

POLLUTION PREVENTION IN THE CHROMIUM ELECTROPLATING INDUSTRY

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Recently issued U.S. Environmental Protection Agency air quality regulations require reductions in air toxic emissions from chromium electroplating and anodizing operations. Specifically, the National Emission Standard for Hazardous Air Pollutants states that chromium electroplating and anodizing sources must comply with technology-based emission limits, work practice standards, performance testing, recordkeeping/reporting requirements, and monitoring requirements.

Pollution prevention options, including alternative formulations that electroplaters can consider for reducing chromium emissions, are discussed. Case studies are presented from two North Carolina electroplating facilities that demonstrate the use of high-efficiency dry scrubbing emissions recovery technology and alternative nonchromium plating bath formulations. The advantages, disadvantages, and mode of operation of pollution prevention options, such as fume suppressants, wetting agents, dry scrubbing systems, and polypropylene balls, are discussed in detail.

Although no alternatives to chromium electroplating can replace the functional properties of chromium, existing alternatives can provide an effective substitute to certain chromium properties and characteristics. The use of alternative electroplating operations to eliminate chromium emissions is presented through the use of North Carolina industrial case studies.

DESTRUCTION OF ORGANIC WASTE BY UV/H_2O_2 AND ACID RECYCLING

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In aqueous plutonium or uranium processings, there are acids contaminated with organic compounds, such as HCl or HNO_3 solutions with oxalic acid and HNO_3 with kerosene and tributyl phosphate (TBP). The acids containing oxalate came from the precipitation of plutonium species as oxalates. The excess oxalic acid can be destroyed by the ultraviolet (UV)/H_2O_2 process. The process

is clean, simple, and safe. The excess H_2O_2 decomposes to water and oxygen. After the destruction of oxalate, the acid can be recycled without further processing. The UV/H_2O_2 process can also mineralize kerosene and TBP in nitric acid solutions used in the solvent extraction processes. The detailed procedure is presented.

NOTES:

SESSION 5:

EDUCATION AND OUTREACH PLANNING
TUESDAY AFTERNOON

AIRLIE HOUSE POLLUTION PREVENTION TECHNOLOGY TRANSFER PILOT INITIATIVES

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The Airlie House Pollution Prevention Projects were a series of pilot projects developed for the U.S. Department of Energy to transfer pollution prevention technology to private industry. The concept was to develop small technology transfer initiatives in partnership with the private sector. Argonne developed three projects: microscale chemistry in education, microscale cost-benefit study, and the Bethel New Life recycling trainee program. The two microscale chemistry projects focused on brining microscale chemistry to secondary and college education. The two programs were inexpensive to develop and received excellent results from participants and regulators. The recycling trainee program was successful in training two participants and identifying recycling and source reduction opportunities in Argonne National Laboratory's solid waste stream.

The pilot programs demonstrated that technology transfer initiatives can be developed and implemented with a small budget and within a short time. The essential components of the program were identifying available target technologies, identifying target audiences, and focusing the effort to achieve a limited, but defined, objective.

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* Wilkes University.

PARTNERING BETWEEN DOE SITES AND COMMERCIAL UTILITIES TO REDUCE COSTS

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Westinghouse Savannah River Company (WSRC) is partnering with a number of commercial nuclear power plants to directly implement utilities' best practices as a means for improving treatment, storage, and disposal of low-level radioactive waste. The initial focus has been on developing and implementing an aggressive pollution prevention/waste minimization program. Through a series of benchmarking visits and technical exchanges, WSRC has identified and begun implementing a series of changes to work practices and material/product specifications. These changes are expected to result in substantial cost savings and to extend the life of on-site disposal facilities. The utility participants in this partnership have been exposed to technologies with significant applicability to current and planned operations at commercial nuclear power plants. This partnership is consistent with the U.S. Department of Energy's initiative to increase use of commercial technologies/practices and to follow the U.S. electrical industry's continuing practice of cost reduction and economic competitiveness.

WASTE REDUCTION INFORMATION EXCHANGE

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On August 30, 1995, the Pollution Prevention Technical Team hosted a conference to facilitate the exchange of information with the Panhandle industrial and agricultural communities regarding

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* Pennsylvania Power & Light Company.

† Washington Public Power Supply System.

recycling and reduction of waste. The "Waste Reduction Information Exchange," held at the Amarillo Civic Center, was attended by approximately 200 individuals. The conference provided a forum for the transfer of technology and exchange of information resources. Internet resources, such as E-Source, EPIC, Enviroene, and P2Info, and information ranging from small business incentive programs to partnering endeavors were provided. Many speakers; approximately 30 exhibitors; and a variety of agencies, including TNRCC, Battelle Columbus, and Argonne National Laboratory, provided information on waste minimization and pollution prevention topics.

POLLUTION PREVENTION EDUCATION IN CHEMICAL ENGINEERING AT MICHIGAN TECHNOLOGICAL UNIVERSITY

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Pollution prevention (P2) is a strategy for environmental protection that emphasizes reductions in pollutant generation and emissions at the source and incorporates a wider perspective on the impacts of engineering activities and decisions that extend well beyond traditional system boundaries. Industry, academia, and regulatory agencies are investigating new technologies for manufacturing materials and products that generate either less pollutant mass or pollutants that have lower toxicity toward human and environmental receptors. Engineering graduates from universities are often involved in projects early in their careers that rely on P2 concepts and approaches. The concepts of responsible care and product stewardship are being incorporated in nearly all major manufacturing companies, yet few engineering graduates are familiar with these concepts and other methods of pollution prevention.

This paper outlines the approach taken at the Department of Chemical Engineering at Michigan Technological University (MTU) in educating undergraduate and graduate students on the principles of pollution prevention. Two courses on P2 methods and technologies are major components. One course, "Environmental Chemical Engineering," is offered to senior students as a technical elective and covers several fundamental concepts in pollution assessment and prevention in the chemical process industry. These concepts include an overview of corporate management strategies, such as responsible care and product stewardship, and methods for assessing environmental impacts of chemical processes. These assessment methods include estimating process emissions, performing screening-level calculations of environmental persistence, and evaluating environmental and human

health impacts. P2 concepts and methods are demonstrated by using a case study that involves solvent substitution in a major chemical process.

The second course, "Advanced Plant Design," is offered at the graduate level. The course incorporates nontraditional factors and other advanced design concepts into the decision process in plant design. These factors include such noneconomic parameters as energy use and efficiency, pollution generation and emission, life-cycle assessment on material streams, and social benefit/cost and shadow economy considerations. Within a team structure, students apply these design concepts to the optimum configuration of a power cogeneration plant. Various fuel and furnace types are evaluated from the standpoint of public acceptance, profitability, and environmental impacts.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY OFFICE OF POLLUTION PREVENTION GRADUATE INTERNSHIP PROGRAM

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The goals of the Illinois Environmental Protection Agency's (IEPA's) Office of Pollution Prevention (OPP) Graduate Internship Program are to provide fresh perspectives and new ideas in pollution prevention (P2) techniques to interested Illinois facilities and to give graduate students the opportunity to apply new knowledge and skills in the workplace. The program's benefits include (1) short-term expertise in P2 applications at little cost to Illinois companies (the intern's stipend is provided by IEPA); (2) long-term savings because of reduced disposal and the cost of raw materials; and (3) summary results to promote technology transfer and greater participation in voluntary P2 programs by Illinois industries. The IEPA's OPP assists Illinois industries that choose to protect the environment through pollution prevention. This assistance is provided through a variety of voluntary programs, such as the Graduate Internship Program.

The Graduate Internship Program places a graduate-level student with participating Illinois facilities to work on P2 projects. Graduate students have expertise in engineering, science, and occupational health and safety. The IEPA has placed interns during the summer since 1989 and recently began a fall intern program. IEPA pays the intern's stipend, and the host facility provides supervision and workers' compensation coverage for the length of the intern's stay.

Over the years, the program has helped numerous Illinois companies save millions of dollars. Savings have included reduced disposal costs, improved process efficiency, conservation of raw materials, reduced energy usage, and less pollution from power generation.

Each interested company fills out and submits an initial application. OPP then requests a brief summary of the company's proposed project objectives. Priority is given to true P2 projects rather than to off-site recycling and end-of-pipe controls. An example of a successful 1995 graduate intern project dealing with P2 in industry is McWhorter Technologies, Inc., in Carpentersville.

McWhorter Technologies, one of the leading manufacturers of resins in the United States, produces alkyd, polyester, acrylic, and vinyl resins, which are used in the paint and coating industry. The plant also manufactures resin for the reinforced fiberglass plastics industry. Scrap resin totaling 3.5 million lb is generated on an annual basis from the manufacturing process. The intern concentrated on two projects: minimizing the scrap resin and recovering process aid solvent.

Scrap resin generation was minimized because the company changed its drumming procedures. These changes incorporated the reuse of partially filled drums in the finished product and topping off the partially filled drums with the next batch's rinse. These changes reduced scrap by 755,000 lb and saved $253,000 annually.

Recovery of process aid solvents was investigated in two ways. A pilot study of column distillation was conducted to recover xylene and process water. Potential savings on the recovered xylene has a value of $88,000. The recovered process water can be used in filter and floor cleaning. Separating alcohol from water requires further investigation of the impact of cyclohexane on the production process. Azeotropic distillating using cyclohexane to break the azeotrope can realize potential savings of $300,000.

INTERNATIONAL POLLUTION PREVENTION PARTNERSHIP WITH USAID

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The U.S. Department of Energy (DOE) and its sites around the country have many technical personnel trained in pollution prevention (P2) principles. Although much P2 work needs to be done at these sites, this expertise can also be useful in the industrial sector, especially in developing countries with severe environmental problems. Lawrence Livermore National Laboratory (LLNL)

has recently embarked on an international P2 effort in partnership with the U.S. Agency for International Development (USAID) that involves P2 analysis of a variety of industrial sectors and trains engineers and factory workers in host countries. The aim of these projects is to foster "environmentally friendly" manufacturing approaches in rapidly industrializing areas, where the potential for environmental harm is great. During 1995, LLNL participated in projects in Indonesia, Ecuador, and Egypt.

In each of the host countries, an arm of USAID has set up project offices, hired in-country engineers and clerical staff, and identified the industrial sectors most useful to work with. LLNL has developed "templates" for guiding P2 analyses of these sectors. For instance, LLNL staff studied metal finishing industry production and waste handling procedures in several shops in each of the host countries and developed pollution prevention opportunity assessments as guides for further study of the industry. In addition, LLNL staff helped to train technical staff in both the industries and in the USAID project office in P2 methodologies. This training was critical because although in-country engineers generally have good backgrounds in their fields, P2 training in most developing countries is rare or nonexistent.

The P2 activities in these projects are in concurrence with DOE missions and objectives, which recognize the importance of DOE's leadership role in improving the quality of the environment and in developing the technologies and institutions required for solving both domestic *and* global environmental problems.

SESSION 6:

RETURN ON INVESTMENT
TUESDAY AFTERNOON

HOW TO PREPARE A WINNING RETURN-ON-INVESTMENT PROPOSAL

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This paper summarizes the U.S. Department of Energy's (DOE's) High Return-on-Investment (ROI) Pollution Prevention Program, including a brief history of the program and an in-depth discussion of the selection process used in Round 2 of the program. The purpose is to provide potential participants with details on selection criteria and required elements, as well as potential pitfalls that should be considered in formulating a high ROI project proposal. Lessons learned from the Round 2 ROI program and proposal review are also included. The authors served as team leaders for the Technical and Financial Task Forces, which completed the review of all Round 2 proposals. (This paper complements the planned workshop on high ROI pollution prevention projects.)

When DOE's high ROI program was initiated in fiscal year 1994 as Round 1, 33 proposals were submitted by the field, 20 were selected, and 17 were implemented. Several insights were obtained during Round 1. These were incorporated in the Round 2 program. As a result, a considerably more comprehensive proposal review and selection process was developed.

In Round 2, a "core team" coordinated the review and recommendation of the 119 ROI proposals submitted by the field. The team was composed of Headquarters representatives from the Offices of Environmental Management, Defense Programs, Energy Research, Environmental Safety and Health, and the Chief Financial Officer. The core team was supported by a Technical Task Force and a Financial Task Force. Each task force consisted of seven or more people, both DOE employees and DOE contractors from Headquarters and the field, with varying backgrounds and expertise. The task forces completed a detailed review of each proposal and provided recommendations to the core team, which in turn selected proposals for implementation.

The Technical Task Force reviewed each proposal for technical feasibility and reasonableness of design/operation parameters used as the basis for the project and considered whether the proposed

implementation schedule would allow for completion of the necessary engineering activities. The key elements in determining technical feasibility included (1) the likelihood of achieving the desired technical goals; (2) the ability to achieve the project schedule considering permitting and procurement requirements; (3) consideration of environment, safety, and health requirements; and (4) the commercial availability of the proposed technology/practice, etc.

The Financial Task Force assessed the reasonableness of cost and ROI calculations, including review of the capital cost of equipment and installation and unit costs used in the avoided cost calculations. Other considerations included the likelihood of realizing projected savings; ensuring funding transfers and realistic spending rate to meet the project schedule; and recognizing potential pitfalls, such as ROIs based on illusory estimates, rather than on true avoided cost.

The efforts of the Technical and Financial Task Forces were integrated on cross-cutting issues. Once each team separately certified the viability of a proposal, it was reevaluated by both teams for recommendation to the core team. The ultimate aim of review was to determine whether the proposal was technically feasible, could provide a real savings for DOE, and should be funded/implemented.

The key elements, the potential pitfalls, and some often overlooked administrative criteria are discussed in detail, along with some examples. On the basis of the results of the Round 2 proposal review, several specific "winning" ideas or types of projects and the lessons learned from the ROI program are also presented.

POLLUTION PREVENTION BENCHMARKING: A TOOL FOR IMPROVING ENVIRONMENTAL PERFORMANCE

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Benchmarking can be integrated into an overall strategy to implement successful pollution prevention (P2) programs that are technically and institutionally feasible, cost-effective, and achieve maximum cost savings. In an environment of increasing budget constraints, effective P2 programs offer the U.S. Department of Energy (DOE) the opportunity to realize significant cost savings that

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* American Productivity & Quality Center's International Benchmarking Clearinghouse.

can help to ensure that limited resources (1) focus as much as possible on mission-related activities (e.g., basic research, technology development) rather than on the ancillary costs of these activities (e.g., waste management); (2) accelerate the cleanup program by minimizing the amount of wastes generated by cleanup activities; and (3) increase overall productivity. Extensive information is available on P2 technologies and the potential cost savings from implementing such programs. The key challenges for DOE, however, in implementing effective P2 programs include developing appropriate metrics by which to measure the success of P2 activities; integrating pollution prevention into an organizational mission; linking pollution prevention to success indicators; effectively addressing DOE institutional factors that affect decision making (e.g., DOE budget cycle, organizational structure); and establishing incentives to ensure management commitment and resource allocation. Benchmarking is a key element of an overall process tool that can be used to overcome these challenges.

The following topics are addressed:

- *What is benchmarking?* Benchmarking is a structured set of processes and procedures for comparing an organization's performance to that of a range of competitors, identifying best-in-class organizations and best practices for a given set of objectives, comparing best-in-class practices to one's own practices, targeting areas for improvement, and obtaining information that can serve as the basis for implementing a change strategy for improving performance.

- *What is the role of benchmarking in P2 programs?* Benchmarking can be used to compare P2 activities across similar organizations, to validate current practices and document progress and successes, to provide documentation to support budget requests for P2 investments, to obtain proof not only of what innovative P2 practices work but why these practices and processes have worked, and to identify "how tos" for integrating pollution prevention into ongoing mission activities. Benchmarking alone cannot improve performance; rather, benchmarking must be part of an overall P2 implementation strategy that identifies those areas that would produce the greatest cost savings and establishes the institutional processes (e.g., organizational structure, accounting conventions, information systems, worker training) to achieve these savings.

- *What are the elements of a successful benchmarking study?* Different approaches are available for gathering benchmarking information. The chosen approach depends on the overall objectives of the organization and the specific activities to be benchmarked. The consortium benchmarking approach is a highly flexible and interactive approach that is particularly appropriate for improving P2 performance. Consortium benchmarking is performed by a group of organizations, including best-in-class organizations, that are interested in the same issues and face similar problems. For

example, integrating pollution prevention into basic business functions and providing proper incentives to link pollution prevention to success in overall business factors are challenges for most organizations. The consortium approach focuses on gathering a group of organizations that wish to learn from others and are willing to share information. The benefits of this approach for DOE include access to best-in-class companies and information on best practices and processes used by these organizations, thus allowing DOE the opportunity to look "inside and outside the box" in search of best practices. This approach also provides participants with a wide network of contacts with best-in-class organizations and others with similar objectives and concerns.

- *How can the results of benchmarking be used to improve performance?* Benchmarking can be an effective management tool if it is part of an overall strategy for organizational improvement. Many organizations have made significant progress in implementing the most obvious P2 activities; the challenge now is for many DOE organizations to go beyond obvious process changes (e.g., material substitutions, good housekeeping practices) and implement organizational changes. Thus, the action plan should be an overall strategy that incorporates not only P2 activities that improve performance but also puts procedures and systems in place to facilitate continuous improvement (e.g., establishment of criteria for conducting benchmarking; process for ensuring linkages between pollution prevention and lines of business/mission).

- *What are the key elements of an action plan?* An action plan likely includes organizational reengineering to identify the organizational and structural changes necessary to effectively implement P2 strategies (e.g., management information systems, accounting conventions, incentive systems); training programs; and information systems (e.g., Lotus Notes groupware system that allows rapid communication and access to information, and linked systems to monitor performance.

SESSION 7:

ENERGY MANAGEMENT — 1
TUESDAY AFTERNOON

COOPERATIVE FISH-REARING PROJECTS AT HANFORD

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In an effort to use surplus facilities and equipment cost-effectively at the U. S. Department of Energy (DOE) Hanford site in Washington state, large (6 million-gal) water purification pools (K Pool) are being used as an aquaculture facility for rearing various fish species. These pools, which are located in the 100-KE Area near the Columbia River, were built in 1955 and operated at full capacity from 1955 to 1971. They provided up to 300 million gal of treated cooling water per day to the K Area plutonium production reactors.

The Yakima Indian Nation, the Washington Department of Fish and Wildlife, the Washington state legislature, and Westinghouse Hanford Company proposed to use the Hanford site K Area water treatment pools for rearing and acclimating warm-water species, such as walleye and channel catfish, for Washington lakes. The Pollution Prevention and Resource and Energy Management Teams were challenged to investigate how to isolate a fixed quantity (3,200 ft^3) of rearing water, heating it to acceptable temperatures for optimally raising these species year-round, and recirculating the warmed water through rearing tanks.

ICF Kaiser Hanford Energy Management and Westinghouse Hanford Company Pollution Prevention conducted a feasibility study in fiscal year 1996 to determine the most energy efficient method for heating Columbia River water in an existing 250,000-gal-capacity sand filter structure. Warm water is circulated through eight 8-ft-diameter rearing tanks on the floor of an empty, adjacent K Pool. An assessment established a cost-effective treatment method to remove solid materials, ammonia, and algae and to disinfect and destroy potential pathogens and viruses in the water.

The study included a comprehensive evaluation of the current energy-consuming systems at the aging water purification pool complex and presented recommendations for improving energy

efficiency. This task showed clear, cost-effective alternatives to the incandescent outdoor lighting sources predominantly in use and identified water pumping strategies to reduce energy consumption.

A tool was developed that combined the DOE pollution prevention opportunity assessment with the existing life-cycle cost analysis used by the DOE Site Energy Program. The new tool evaluated the cost-effectiveness and waste minimization priorities for energy management and pollution prevention. The opportunities identified will promote the implementation of this prospect at Hanford.

THE ROLE OF UTILITY/INDUSTRY PARTNERSHIPS IN PREVENTING POLLUTION

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The industrial sector offers significant direct and indirect pollution prevention (P2) potential with well-designed, cost-effective, energy-efficiency programs. Recent estimates of the electricity conservation potential in the industrial sector range from 9 to 45% of total industrial electricity consumption. Utility energy-efficiency programs can play an important role in capturing some of the energy-savings potential in industries, while branching out to encompass other, direct P2 measures.

Utility energy-efficiency programs called "demand-side management" (DSM) are changing in reaction to the impending restructuring of the utility industry, which will allow retail competition. While retail competition is not yet here, many large customers are seeking service at a lower cost and are threatening to either relocate, self-generate, or turn to alternative electricity service providers. As a result, energy-efficiency programs are shifting their focus to customer service, looking at customers' overall needs rather than just their energy needs.

While energy-efficiency programs may change, they will continue to be important to both utilities and their industrial customers. Partnerships will play an increasingly important role in these programs, as utilities strive to provide a broader range of services than they did in the past. It will be important that these services go beyond just energy efficiency by providing additional value to the customer. One area important to many of these industrial customers is assistance in meeting current and future environmental goals. Utilities have internal expertise to fulfill their environmental compliance needs, which can now become a valuable asset to their customers. They can also

introduce customers to alternative technologies that can improve their energy efficiency while addressing pollution reduction and productivity goals.

It is likely that industry will face future limits on carbon dioxide and other greenhouse gas (GHG) emissions. Energy-efficiency improvements will be the first technology deployed to limit these emissions. The experience that utilities have developed in energy efficiency represents a valuable service to industrial customers faced with reducing their GHG emissions.

This paper reviews and analyzes current utility/industrial program designs and proposes models for future programs built on partnerships. In addition, possible paths for utility restructuring are discussed, with an emphasis on the role and impacts of industrial partnerships. Direct and indirect linkages between energy efficiency and pollution prevention are explored.

IMPLEMENTING INTEGRATED ENERGY RESOURCE MANAGEMENT AS A POLLUTION PREVENTION STRATEGY

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This paper presents a plan for implementing integrated energy resource management (IERM) as a pollution prevention (P2) strategy. Implementing IERM as a direct cost reduction strategy is an easy decision — it saves money! However, the direct and indirect P2 impacts are also significant, but seldom addressed.

The paper focuses on the benefits of the "integrated" approach, defined as combining energy efficiency and energy procurement/central utilities strategies. The synergies of this approach and how the approach maximizes P2 results are presented, along with specific case study examples from U.S. Department of Energy (DOE) sites, private industry, and public institutions.

Application of the approach to both end user energy-consuming equipment and central steam/electrical generation systems is discussed. These discussions tie energy efficiency/ procurement opportunities directly to SO_x and NO_x reductions.

The "how to" for developing a site-specific plan is outlined, including data collection, facilities assessment, energy use pattern analysis, contractual analysis, alternative development and

prioritization, and implementation. Finally, the adjunct benefits of the approach to the important DOE issues of privatization, reengineering, performance measurement, and benchmarking are outlined.

MANAGING THE NEW RESIDENTIAL APPLIANCE — THE ELECTRIC VEHICLE: A CASE STUDY ON VEHICLE USE PATTERNS, RECHARGING BEHAVIORS, AND THE IMPACT OF VEHICLE CHARGING AND LOAD CONTROL STRATEGIES ON RESIDENTIAL CONSUMPTION

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One of the technologies being considered by electric utilities and state and federal policy makers is the use of electric vehicles in the residential sector to reduce pollution and boost off-peak power sales. Of significant concern to both policy makers and load managers is the effect of large-scale adoption of electric vehicles on the utility's ability to meet this new residential appliance power requirement and the effect of electric vehicles on residential load shapes. This study provides new information on residential electric vehicles when used as the primary mode of transportation and examines their impact on the household appliance mix. Conducted during the summer of 1995, this study has not been presented elsewhere.

The study took place in a 2,500 home recreational community in Michigan where electric vehicles are the primary mode of transportation. On weekends and holidays, the incorporated community is the largest city in the county. On weekdays, the population decreases, as home owners return to their primary residence. The electric vehicles are owned by the home owners and are used for typical residential weekend trips (e.g., trips to the store, restaurant, church, ball games). Most homes have one electric vehicle; however, some have more than one.

The study examined the use of electric vehicles in 120 homes, half of which were placed in a load control program. The homes are located in two different areas of the community, and all homes were metered at 15-min intervals.

The paper presents results in three areas: (1) vehicle use characteristics and recharging behaviors; (2) results of a load control program; and (3) the impact of vehicle charging and load control measures on the household, neighborhood, and community load shapes.

STEAM CONDENSATE LEAKAGE

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Argonne National Laboratory (ANL) is a multiprogram research and development center owned by the U.S. Department of Energy and operated by the University of Chicago. ANL's 1,700-acre site is home to more than 70 buildings that use steam for heating and other purposes.

Steam is generated from liquid water at the site's central boiler house and distributed around the site by means of large pipes both above and below ground. The central boiler house contains five boilers manufactured by Wickes Boiler Company during 1950-1965. Boilers 1–4 have an operating capacity of 85,000 lb steam/h, and boiler 5 has a capacity of 170,000 lb steam/h. All of the boilers operate at a pressure of 200 psig with saturated steam conditions.

Steam generated at the boiler house is distributed to each building on site. The steam enters each building and goes through a heat exchanger, giving off heat used for various purposes as it condenses to liquid condensate. The condensate flows to a condensate receiver, where it is pumped out of the building and returned to the boiler house. It is then reconverted to steam and used again — a continual process.

This process is not entirely efficient, however, as a substantial amount of condensate is lost on site (instead of being returned to the boiler house). The lost condensate has both economic and environmental significance. To compensate for lost condensate, makeup water must be added to the returned condensate at the boiler house. The cost of water will become significant when ANL begins purchasing Lake Michigan water. In addition, the water must be chemically treated. Another cost is associated with energy required to heat the water, as it enters the boiler house 100°F colder than the condensate return.

Estimates show that only approximately 60% of ANL's steam is being returned as condensate; thus, 40% is wasted. This expense is significant to ANL, and a study was done to locate areas where steam or condensate loss occurs.

The study identified several opportunities to repair condensate losses. Shortly after the project was completed, the largest condensate loss was repaired. This paper discusses the basis for the project, the potential savings, and the environmental impacts of savings.

NOTES:

SESSION 8:

DECONTAMINATION AND DECOMMISSIONING
TUESDAY AFTERNOON

EQUIPMENT DECONTAMINATION: THE BENEFITS OF REUSE AND AVOIDED DISPOSAL USING THE TECHXTRACT™ PROCESS

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Tools and equipment frequently become contaminated during nuclear operations or restoration projects. Routine decontamination is often ineffective on certain items because of the nature or severity of the contamination. The costs associated with these items, including replacement and disposal as radioactive waste, can be significant.

Recent testing of a new decontamination technology, known as TECHXTRACT™, has produced superior results on previously "uncleanable" equipment. Projects have been performed at the Idaho National Engineering Laboratory and at a private-industry, U.S. Nuclear Regulatory Commission-licensed manufacturing facility. In both cases, equipment was cleaned to "free release" standards with substantial net savings. Further testing is also pending at a nuclear power plant.

The TECHXTRACT process is a chemical technology for extracting radionuclides and other contaminants from solid materials, such as metal and concrete. TECHXTRACT uses sophisticated chemical compounds to penetrate below the surface and remove contaminants that have leached into the substrate through microscopic pores and voids. The technology has very high decontamination rates (DFs greater than 100). TECHXTRACT is a full-scale commercialized technology that has been used in the U.S. Department of Energy complex and by private industry.

Compared with other decontamination options, TECHXTRACT demonstrates significant advances along five important dimensions:

- *Effectiveness.* It is highly successful in reducing radionuclides, polychlorinated biphenyls, heavy metals, and hazardous organics to below regulatory standards.

- *Safety.* Chemicals are nonflammable and are not hazardous under the Resource Conservation and Recovery Act, thereby minimizing application and disposal problems.

- *Waste minimization.* Total waste (liquid) is typically 0.05 to 0.10 gal/ft^2, a fraction of the amount generated in demolition or most other processes.

- *Structural integrity.* Surfaces and equipment are not damaged during decontamination, allowing reuse without repair or disposal.

- *Cost-effectiveness.* Because of the above factors, the total project cost often represents dramatic savings.

The cost-effectiveness of the TECHXTRACT process depends on a number of project-specific factors, particularly disposal costs. Analysis of typical projects indicates that nondestructive decontamination using the technology can be 25 to 75% less costly than other options. This advantage is driven by savings in disposal costs and the ability to reuse the decontaminated structure or equipment. Disposal volumes using traditional methods are anywhere from 15 to 100 times as high as the secondary waste generated by the TECHXTRACT process.

This paper briefly covers the scientific principles of the TECHXTRACT technology and representative economics. The performance and economics of the technology are demonstrated by discussing one of the projects referenced above.

PUREX DEACTIVATION PROJECT WASTE MINIMIZATION EFFORTS

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The goal of the Plutonium-Uranium Extraction (PUREX) Plant Deactivation Project is to perform the activities necessary to achieve a safe and environmentally secure configuration for facility turnover to the environmental restoration contractor. Waste minimization has been a high-priority consideration during all aspects of the project. Successes include (1) sale of 187,000 gal of slightly radioactive nitric acid to British Nuclear Fuels Limited for reuse as a product; (2) elimination of approximately 200,000 gal of radioactive rinsate through the reuse of tank flush waters; (3) redeployment of approximately 3,000 ft^3 of laboratory equipment and 2.5 million lb of chemicals

for reuse; (4) elimination of approximately 60,000 gal of radioactive wastewater through the use of the F11 concentrator; (5) strict inventory and project management controls to minimize wastes; (6) "defrocking" of 12 high-efficiency particulate air filters, thereby reducing the total amount of mixed waste generated by 169 ft^3; and (7) redeployment of batteries, oil, and office supplies to other Hanford facilities. Successful waste minimization efforts used during the PUREX project have saved more than $30 million.

WASTE MINIMIZATION AND POLLUTION PREVENTION IN DECONTAMINATION AND DECOMMISSIONING OPERATIONS AT ARGONNE NATIONAL LABORATORY-EAST

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Decontamination and decommissioning (D&D) operations have been periodically performed at Argonne National Laboratory-East (ANL-E) over the last 20 years. Waste minimization (WMin) and pollution prevention (P2) measures were routinely incorporated into the D&D operations, although neither forethought nor preplanning actually referred to it as "waste minimization or pollution prevention." In most cases, the operations were conducted in a manner that at the time made the best use of the valuable time allocated to perform the D&D operations.

Since the late 1980s, more emphasis and efforts have been placed on integrating WMin and P2 activities into the D&D operations. Efforts have focused on closely evaluating options for disposal of materials and optimizing other in-use techniques to further reduce waste volumes while performing D&D. Efforts focus on further optimizing the manner in which D&D operations can be performed and releasing more material as recyclables.

This paper highlights the activities undertaken by the ANL-E site D&D program to implement the ANL-E WMin and P2 programs. Included are recycling of metallic wastes from a research reactor decommissioning project and reuse of several out-building structures by support services groups on site. Simple and innovative approaches to some aspects show the ease of implementing waste minimization and pollution prevention on a day-to-day basis in the field on D&D projects. Also included are case studies in which materials removed during D&D have been reused beneficially and in which surveillance and maintenance costs were minimized through decommissioning activities that focused on waste minimization and pollution prevention.

EVALUATING AND PLANNING THE RADIOACTIVE WASTE OPTIONS FOR DISMANTLING THE TOKAMAK FUSION TEST REACTOR

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The Tokamak Fusion Test Reactor (TFTR) is a one-of-a-kind tritium fusion research reactor originally scheduled to begin decommissioning in September 1995. It is the largest fusion reactor in the world and is tritium contaminated and activated from 14-MeV neutrons. The TFTR's activation and contamination present many unusual challenges with regard to dismantling, packaging, and disposal of its components and ancillary systems. In addition, because the location and some of the supporting equipment of TFTR were to be reused by a second-generation fusion reactor, and on a tight schedule, the sequencing of tasks was critical. To meet these challenges successfully, a team of experienced professionals performed a detailed field study to evaluate the appropriate methods and requirements for packaging the radioactive materials. This team focused on many current and innovative methods for waste minimization that resulted in determining the most cost effective way to package and dispose of the waste. Many special containers were designed to accommodate the vacuum vessel, neutral beams, and tritium delivery and processing systems. This study also produced a functional time-phased schedule that conjoins the waste volume, weight, costs, and container requirements with the detailed project activity schedule for the entire project scope. This software schedule allowed for testing different scenarios and strategies for their effect on waste generation, schedule impact, and cost prior to implementation. This study and project will be the first demonstration of the decommissioning of a tritium fusion test reactor. The radioactive waste disposal aspects of this project are instrumental in demonstrating the viability of a fusion power reactor with regard to its environmental impact.

SESSION 9:

PLANNING AND REGULATIONS
TUESDAY AFTERNOON

PLANNING TOOLS SUPPORTING HIGH-LEVEL WASTE PROCESSING AT THE SAVANNAH RIVER SITE

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The Savannah River Site (SRS) is the repository of 40+ years' production of radioactive high-level wastes (HLWs) in support of the nation's nuclear weapons programs. The mission of the HLW program is to receive and store these wastes in a safe and environmentally sound manner and to convert the waste into forms suitable for final disposal. The final forms are borosilicate glass to be sent to a federal repository, saltstone grout to be disposed of on site, treated wastewater to be released to the environment, and benzene for destruction by incineration. Also, the tanks used to store the wastes must be left in a state so that they can be decommissioned and closed under the applicable Federal Facility Compliance Agreement.

The SRS HLW complex consists of several large facilities that produce each of the final waste forms, plus other front-end and interface processes linking the facilities. The entire complex will need to operate for several decades. Over this long time span, the intent is to operate the complex in a manner that minimizes and prevents pollution of the environment, while simultaneously incurring the lowest life cycle costs to the taxpayer. The complexity of such a planning task requires computational tools to guide the planner.

Two such tools have been developed at SRS by using the SPEEDUP™ package. The first tool is a novel and fast-running Production Planning Model (ProdMod) that will be the routine planning analysis tool. ProdMod is a pseudo-dynamic simulation model, which, for computational speed, is cast in the form of algebraic equations. The dynamic nature of the plant process is captured by using simple linear constructs in which the time dependence is implicit.

Sets of cost equations are explicitly coupled to some of the process equations. Additional cost drivers will continue to be incorporated into the model. The resulting algebraic form requires only one

inversion of a sparse matrix, which is performed very efficiently by using a block decomposition method: the set of 80,000 equations describing the entire SRS HLW complex over 35 years is solved in a few minutes on a high-end workstation. The initial version of ProdMod has supported the latest version of the HLW System Plan out to fiscal year 2029. Researchers are taking advantage of ProdMod's linear equation form to create automatic optimization algorithms that will greatly reduce the planner's need for trial-and-error solutions.

The second tool is a much more detailed, truly dynamic simulation model of the entire HLW complex. The Integrated Flowsheet Model (IFM) represents mass transfer, evaporation, precipitation, sludge washing, effluent treatment, and vitrification unit operation processes through the solution of 7,800 coupled differential and algebraic equations. Twenty-seven discrete chemical constituents are tracked through the unit operations. The simultaneous simulation of concurrent batch and continuous processes is achieved by several novel, customized algorithms. Unlike ProdMod, IFM's computational burden is high: simulation of a year's operation of the complex requires approximately three CPU hours on an IBM RS/6000 Model 590 workstation. IFM has been used as an engineering analysis tool to better understand the dynamic interrelationships between different HLW unit operations over a shorter time horizon of several years. Model validation runs with comparisons against actual plant operating data have demonstrated an excellent match. IFM will also validate the much simplified process models in ProdMod: it will confirm the short-term predictions of ProdMod.

The use of both ProdMod and IFM allows the planner to generate consistent short- and long-term predicted operating scenarios, which first quantify, and then help reduce, the environmental and budgetary impacts of operating the entire SRS HLW complex.

THREE-PHASE POLLUTION PREVENTION OPPORTUNITY ASSESSMENT PLAN AT THE OAK RIDGE K-25 SITE

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The Oak Ridge K-25 Site Pollution Prevention (P2) Program has established a plan to evaluate and conduct efficient sitewide P2 assessment in all media (air, water, and land) and to support recycling and affirmative procurement of recycled materials to protect the environment and human health. The

approach aims to identify and achieve maximum pollution prevention. The program needs a systematic approach for identifying and evaluating site activities and operations that generate wastes. The K-25 Site Program has established a three-phase plan to identify and implement P2 opportunities:

- *Phase I.* Prepare "worksheets" that establish the quantity of waste generation by site waste stream and waste type for each division and for the site as a baseline and identify processes/activities that contribute to each waste stream.

- *Phase IIa.* Rank Level II and III pollution prevention opportunity assessments (PPOAs) by site waste streams.

- *Phase IIb.* Prepare Level I PPOAs for major processes in the top-ranked waste streams.

- *Phase IIc.* Prepare additional Level I multimedia PPOAs for secondary processes and rank Level II and III PPOAs by process.

- *Phase III.* Plan and prepare Level II and III PPOAs for processes in the major waste streams and high-ranked Level I secondary processes for implementing options.

Phases I, II, and III provide the K-25 P2 Program with a direction and plan for achieving its mission. The site prepared a PPOA status plan for future PPOA actions based on the 278 worksheets compiled. This site has prepared 18 Level I and 10 Level II/III PPOAs to date and has participated in three Oak Ridge Reservationwide PPOAs. Projects identified from PPOAs are submitted for funding and are implemented as funding becomes available.

TRI Reporting Update — What Has Changed and What to Expect

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The U.S. Environmental Protection Agency (EPA) is proposing a number of changes to the toxic chemical release inventory (TRI) reporting requirements that will affect U.S. Department of Energy (DOE) site personnel. This paper summarizes the most important procedural and policy changes that EPA has completed and is contemplating for the future. First, the paper addresses changes to the TRI

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* Analytical Services, Inc.

list of chemicals and provides instructions for submitting revised Form R reports or withdrawal requests for sites that have reported on chemicals deleted from the TRI list. Second, the paper provides an update on EPA's planned TRI expansion efforts, including the Phase II Industry Expansion and Phase III Chemical Use Expansion. In March 1996, EPA plans to publish a proposed rulemaking to expand TRI reporting to additional SIC codes outside of manufacturing. The industries EPA is currently targeting include oil and gas extraction and production, coal mining, electric utilities, and waste treatment. Under the Phase III expansion, EPA plans to expand TRI reporting to include additional chemical use information, such as quantity of chemicals brought on site, consumed in a process, and as product. As part of this effort, EPA is also considering adding occupational demographics data, including the number of workers potentially exposed to a chemical and whether occupational exposure monitoring has been performed for a chemical. This paper further summarizes how these expansion efforts could affect TRI reporting by DOE sites. In addition, this paper discusses two related efforts planned by EPA — the Key Identifiers Rule and revision of Form R. Finally, EPA's estimated date for releasing the *1994 Toxics Release Inventory Public Data Release* is given, along with suggestions to help sites prepare for its release.

INCENTIVES FOR RECYCLING IN THE U.S. DEPARTMENT OF ENERGY

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A 1994 change in public law (P.L. 103-329, Section 608) enables federal agencies to receive and use funds from the sale of materials recovered through recycling or waste prevention programs. The law states that these funds must be used for specified environmental programs or other authorized employee programs. Numerous recycling programs exist across the complex; however, revenues generated from these programs are either not captured or managed, are being used to fund unrelated programs (e.g., employee incentive programs), or are being donated to charities. This change in public law provides a valuable incentive for agencies to maximize the recycling of wastes otherwise bound for disposal, especially in light of recent and projected federal budget cuts. This paper discusses the provisions of the public law, the development of U.S. Department of Energy (DOE) recycling revenue policy, and incentives for recycling within DOE.

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* BDM Federal, Inc.

1994 DOE COMPLEXWIDE TRI DATA AND LABORATORY ACTIVITY ANALYSES

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Executive Order (EO) 12856 directs all federal facilities to comply with reporting requirements under the Emergency Planning and Community Right-to-Know Act of 1986 and the Pollution Prevention Act of 1990. Specifically, Section 3-302 of EO 12856 directs all federal agencies to reduce the total releases and transfers of toxic chemicals 50% by December 31, 1999. In accordance with EO 12856, the U.S. Department of Energy (DOE) established 1993 as its baseline for measuring progress toward achieving the 50% reduction goal. For 1993, DOE sites reported a total of 4.68 million lb of listed toxic chemicals released and transferred for treatment and disposal. To achieve the 50% reduction, DOE must reduce the complexwide total releases and transfers to at least 2.34 million lb. This paper presents the toxic chemical release inventory (TRI) data reported by DOE sites for 1994, compares the data to the 1993 baseline, highlights site-specific source reduction activities and accomplishments, and summarizes DOE's progress toward achieving the reduction goal.

In addition, this paper discusses a recent DOE study to determine whether DOE is exempting significant quantities of listed toxic chemicals from TRI reporting through the use of the laboratory activity exemption. Under this exemption, listed toxic chemicals manufactured, processed, or otherwise used in laboratory activities under the direct supervision of a technically qualified individual do not have to be considered for threshold and release calculations. This exemption is limited to certain laboratory activities, including research and development, sampling and analysis, quality assurance, and quality control. This paper identifies how many DOE sites are using the exemption and how many DOE sites are being exempted from TRI reporting by using the exemption.

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* Analytical Services, Inc.

GENERATOR SET-ASIDE FEE PILOT DEMONSTRATION — A STATUS REPORT

Jan Watson

On February 13, 1995, the Pollution Prevention Executive Board approved a limited-scope pilot demonstration of the generator set-aside fee program. Sites participating in the pilot study include Los Alamos National Laboratory, Sandia National Laboratories/New Mexico, the Savannah River Site, and sites managed by the OR Operation Office. The AL Operations Office was tasked with coordinating this pilot demonstration among the sites, participating operations office, and Headquarters program offices.

This program is intended to encourage accountability for waste generation by assessing a small fee on all wastes generated by operations managed by Defense Programs, Environmental Management, Energy Research, and/or Nuclear Energy. In addition to providing detailed information to each line/process manager on the amount of waste generated by their operations and the actual costs associated with managing that waste, limited funding is provided for waste minimization and pollution prevention implementation projects.

Implementation of the pilot demonstration began in fiscal year 1996, and joint Headquarters and field team meetings have been held quarterly to review progress. The formal "Implementation Plan" was delivered to Richard Guimond in February 1996, and all participating sites have begun to assess fees on waste generation.

A status report is given on the pilot demonstration, including background information, fees collected, projects implemented, and waste reduced as a result of the set-aside program. Last-minute information gathered from each participating site in June 1996 will ensure that information is up to date.

A Pollution Prevention Case Study in the Electroplating Industry (in Progress)

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Wastewater discharged from companies in the electroplating industry continues to be a source of environmental concern and financial liability for the managers of those companies. The Hazardous Waste Research and Information Center (HWRIC) was asked to assist one such company in decreasing its wastewater discharged to the sewer and simultaneously reducing the amount of dissolved metals in the remaining wastewater.

HWRIC staff members examined the company's process and made the following specific recommendations to enhance pollution prevention: increase the drainage time to reduce drag-out, reuse the dead rinse tank contents as make-up water, repair all leaky valves, limit rinse water flow rates, and recycle rinse water. Water usage of 20,000 gal/day was reduced to 8,500 gal/day — a 57% reduction. Total metals discharged to the environment were reduced from 176 to 38 lb — a 78% reduction. The total metal concentrations were reduced from an average of more than 4 parts per million (ppm) to an average of slightly more than 2 ppm.

NOTES:

SESSION 10:

MODEL FACILITIES — 2
TUESDAY AFTERNOON

LAYING THE FOUNDATION: THE SAVANNAH RIVER SITE POLLUTION PREVENTION PROGRAM

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In 1995, the Savannah River Site (SRS) aggressively began to pursue the implementation of a comprehensive model pollution prevention program (one did not previously exist). The SRS is a 300-mi^2 complex constructed in the 1950s for producing nuclear materials for the nation's defense. Currently, the primary focus of the site's activities is managing its nuclear waste legacy and remediating waste units. Haphazard, but well-intended, efforts to minimize waste were occurring, but not routinely. With decreasing resources, SRS found it essential to take an aggressive approach to source reduction and waste minimization.

The U.S. Department of Energy (DOE) established a five-person team to quickly implement a program. The team identified numerous areas to tackle and, working with Westinghouse Savannah River Company, the SRS management, and its *operating* contractor, quickly implemented several high-profile activities to "jump-start" the program.

An intensive marketing campaign was initiated to inform site employees of planned activities, increase awareness, and garner vital management support. A DOE Pollution Prevention Council and a sitewide Users Advisory Board, a forum for representatives of all site generating organizations to be actively involved in implementation, were created. Challenging site goals with performance-based incentives were established.

To assist in reaching the low-level waste (LLW) source reduction goal of 200,000 ft^3, a benchmarking with industry effort was initiated, and outside experts were brought in to evaluate facilities that generated the largest amounts of waste and to suggest corrective actions. As a result, three major initiatives (Green Is Clean, Contamination Area rollback, and the use of launderables)

with the largest source reduction potential have been or are currently being implemented. The second sort program, which has the potential for 20% LLW reduction, is currently being piloted before full implementation. An aggressive pollution prevention opportunity assessment (PPOA) program was implemented early.

More than 100 options with a potential for more than 330,000 ft^3 waste avoidance and more than $9.6 million cost savings were identified in 1995. Seventeen options have been implemented as of January 1996, resulting in a potential 36,238 ft^3 of waste avoidance and $1.86 million in savings. The Set-Aside Fee program has been implemented and serves as an additional funding source for high-priority PPOA options. By establishing a DOE team dedicated to these efforts, SRS initiated activities in a much shorter time (less than one year) than would have been otherwise possible.

HPLC Mobile Phase Solvent Recycling

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To reduce cost and disposal of solvent wastes in the analytical laboratory, a simple method was developed to recycle solvent used in the HPLC. The method used in-house equipment to install an activated carbon bed column. With the modified method, precision and accuracy of the analysis remained the same as obtained by using fresh solvent during each new analysis. The solvent use was reduced by at least 88%. Total savings was approximately $4,000 because of reduced disposal costs and avoidance of the purchase of new solvent. This method can be used by any U.S. Department of Energy laboratory (with minor modifications) at a cost of about $100.

Expanded Recycling at Los Alamos National Laboratory

Jim Betschart

The Pollution Prevention Program Office at Los Alamos National Laboratory (LANL) has optimized its operations by forming three distinct focus teams: nonradioactive, radioactive, and environmental restoration and decommissioning. Each team has objectives, actions, and activities specific to their respective customers.

For example, the nonradioactive team has persevered in its effort to increase recycling activities, reuse, and options to reduce sanitary waste streams. The application of best practices to leverage laboratory knowledge and experience to improve environmental performance in sanitary/industrial solid waste use, reuse, and recycling is beginning to show success. Capitalizing on closed-loop material flow for recycling processes, reducing the volume of waste products that require disposal, and increasing the diversion process for materials that have market value have greatly reduced the volume of LANL waste needing disposal.

The Pollution Prevention Program established and chairs a Solid Waste Management Solutions Group to address and solve specific problems in nonradioactive waste streams. By identifying materials with recycle potential and the best practices and paths to return materials for reuse, the group can divert much of the current waste stream from disposal. The group is developing procedures, agreements, and contracts to stage, collect, sort, segregate, and process materials and is also garnering support for the program by involving upper management, facility managers, and generators.

Short-term initiatives implemented include developing solutions and options papers for existing items being recycled and reused. Existing pilots collect cardboard and mixed-paper products for sale to open markets. Procedures are being developed to assist in implementing practices that would reduce sanitary waste streams to an even greater extent. The outlook for some specific long-term recycling options includes developing a Materials Recovery Facility in conjunction with local governments; tailoring recycling activities to facility needs; providing a wider spectrum for collecting other sanitary waste streams; and continuing to assist, create, and implement programs to reduce waste streams destined for disposal.

NOTES:

SESSION 11:

ENVIRONMENTAL RESTORATION — 1
WEDNESDAY MORNING

AN OUNCE OF POLLUTION PREVENTION IS WORTH A POUND OF REMEDIATION CURE

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Since the end of the Cold War, the U.S. Department of Energy (DOE) has adjusted and refocused its mission from weapons production to environmental restoration (ER) activities. As this reprioritization unfolds in the wake of tight budget constraints, limited to nonexistent treatment/storage/disposal capacity and changes in public policy, it is prudent to implement measures that allow these resources to be maximized. Waste minimization and pollution prevention (Wmin/P2) activities, which include source reduction, recycling, treatment, and disposal, allow DOE to capitalize on the environmental and financial benefits of these actions.

Although Wmin/P2 activities began with the Hazardous and Solid Waste Amendments of 1984 and are primarily directed toward routine operations wastes, the concept is applicable to and can also be incorporated into activities conducted under CERCLA. The National Contingency Plan, codified as 40 CFR 300, embodies the CERCLA requirements for Wmin/P2 during scoping, performance of a feasibility study, and treatment. Section 300.430(a)2(b) promotes the compilation and evaluation of existing data, thus limiting data collection. Section 300.430(e)2 advocates recycling, and Section 300.430(e)9(d) includes reduction of toxicity, mobility, or volume through treatment as one criterion for evaluating alternatives.

Decommissioning and ER activities conducted under CERCLA generate primary and secondary wastes. Primary wastes are the result of past production activities; secondary wastes are generated while performing restoration activities. The *Pollution Prevention and Waste Minimization Guidance for Environmental Restoration Activities* suggests that recycling and reuse are the most significant Wmin/P2 opportunities for primary wastes and that source reduction is the most significant Wmin/P2 opportunity for secondary wastes.

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* U.S. Department of Energy.

It is necessary to distinguish between Wmin and P2 activities for routine process operations. Waste minimization is reactive — it typifies recycling, waste treatment, volume reduction, and transfer of waste. Waste minimization activities for process operations are P2 for some activities conducted under CERCLA. Examples of this idea include promoting solvent substitutions during decontamination, making recycling efforts after decommissioning activities, using noninvasive surveys during investigations where appropriate, and considering and evaluating various conventional and innovative treatment technologies that reduce toxicity, mobility, or volume of waste during feasibility studies. Pollution prevention, however, is proactive. It typically includes input-material changes that result in less waste from a manufacturing process, improved operating practices or technology changes that result in less waste from product assembly, and other practices or processes that reduce or prevent creation of waste (EPA 1992).

Although Wmin/P2 practices have been implemented during past ER and decommissioning activities conducted at DOE-ORO, these actions have received little or no documentation. However, DOE-ORO is implementing various documentable Wmin/P2 activities, one of which is a database for five sites in Tennessee, Ohio, and Kentucky. The database will track waste generated for ER projects, identify program resource requirements, and report cost benefits from implementing Wmin/P2 activities. It will also be used for internal and external reporting.

In conclusion, Wmin/P2 activities, if properly incorporated into activities conducted under CERCLA, will provide significant environmental and financial benefits. However, for the ER programs to capitalize on these benefits, Wmin/P2 needs to be incorporated into every element of program planning.

BASELINING POLLUTION PREVENTION/WASTE MINIMIZATION INTEGRATION INTO ENVIRONMENTAL RESTORATION ACTIVITIES AT EM-40 SITES

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The U.S. Department of Energy (DOE) Environmental Restoration Program (EM-40) has generally produced an increase in waste generation rates at sites across the complex. The contaminated media volume projections, as stated in the 1995 *Baseline Environmental Management Report*, illustrate that

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* U.S. Department of Energy, EM-431.

the waste from EM-40 activities will dwarf the current DOE operational volumes, if generated at the projected rate.

In keeping with DOE's mission to protect the environment, EM-40 has recognized the need to integrate waste minimization/pollution prevention (WMin/P2) into the remediation process to reduce the risks associated with WMin and to reduce waste volumes and WMin costs. It will be a significant challenge to minimize wastes during environmental restoration (ER) activities, but by understanding that primary wastes can be efficiently recycled or reused and that secondary wastes can be reduced or eliminated, the challenge can be met.

This paper discusses an EM-40 initiative to "baseline" WMin/P2 integration successes at approximately 20 restoration sites across the complex. The baseline task consisted of collecting project-specific data on integrating WMin/P2 during ER projects. WMin/P2 has been integrated during all phases of restoration projects, from planning through implementation. The integration efforts range from using effective project management techniques to implementing innovative technology. Several projects are discussed in detail.

The project data collected included discussions of the WMin/P2 technique, when WMin/P2 was used during the project; P2 impacts and effectiveness; and the resultant cost savings. Project managers and engineers at the ER sites provided detailed information and acted as the key link between waste generators and waste managers.

Information gathered during this effort will be shared with the DOE field offices and site contractor offices to encourage information exchange and share successful methods for integrating WMin/P2 into all projects. This initial baseline effort will provide EM-40 a means for measuring future waste reductions that can be attributed to implementing WMin/P2 actions.

INCORPORATING POLLUTION PREVENTION AND WASTE MINIMIZATION INITIATIVES INTO A SHORT-TERM, COMPLEX DOE REMEDIATION SITE

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This paper describes the approach used to incorporate pollution prevention (P2) and waste minimization (WMin) technologies and practices into the design, construction, and operating phases

of development at the Pit 9 Facility of the Idaho National Engineering Laboratory (INEL). The Pit 9 project is scheduled to be completed during a one-year period, which creates a number of challenges for developing an effective WMin/P2 program. Pit 9 operations will include retrieval and assay of buried radioactive waste and soil, soil cleaning and return of adequately cleaned soils to the pit, melting and solidification of waste materials in an arc melter, removal of actinides from process solutions, and recovery and reuse of chemicals and water in various Pit 9 processes.

Pollution prevention at most industrial facilities follows a well-established flow path that includes performing annual assessments, selecting and pursuing specific WMin/P2 projects to be accomplished during the year, setting annual goals, measuring WMin/P2 progress against those goals, and ensuring that employees are informed about and actively participating in good operating practices that promote WMin/P2. Pollution prevention at a short-term, complex U.S. Department of Energy remediation and treatment site like Pit 9 requires a different approach.

This paper describes the lessons learned at various stages of WMin/P2 development for the Pit 9 site, including considerations during the following:

- The initial planning phases, which involved identifying commodities that could potentially be recovered and reused in the process;
- The design phase, which involved incorporating equipment and processes into the design that would allow recovery and recirculation of various commodities in the process;
- The construction phase, which involved developing a recycling program for standard construction materials, such as oil, wood from pallets, and metal; and
- The WMin/P2 program development phase, which involved expanding the existing INEL procurement program to purchase additional green products, expanding the chemical control system, developing short-term recycling and reuse programs, identifying good operating practices (that will be specified in operating procedures) that promote WMin/P2, and identifying necessary training requirements.

The difficulties encountered during development of the program in the midst of a fast-paced evolving design environment and the challenges associated with identifying and implementing cost-effective WMin/P2 initiatives with short (less than one year) payback periods are also discussed.

MINIMIZING WASTE IN ENVIRONMENTAL RESTORATION

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Environmental restoration, decontamination and decommissioning, and facility dismantlement projects are not typically known for their waste minimization and pollution prevention efforts. Projects are usually driven by schedules and milestones; little attention is given to cost or waste minimization. Conventional wisdom in these projects is that the waste exists and cannot be reduced or minimized. In fact, waste and cost can be reduced in two significant areas: careful planning and execution. Waste reduction can occur in three ways: beneficial reuse or recycling, segregation of waste types, and reduction of the generation of secondary waste.

Historically, environmental restoration projects dismissed reuse or recycling as "not viable" options. However, these restoration projects generated large quantities of contaminated dirt that appeared to have no reuse potential. The Environmental Management Program then found an innovative way to use the dirt from restoration projects. Argonne National Laboratory's (ANL's) Waste Management Department packages all kinds of low-level waste (LLW), including rubble, metal, pipes, and other equipment. Inefficiencies in the packaging process, however, leave spaces that must be filled prior to shipment. These voids are usually filled with volcanic rock or other clean material. By working the 317 Area Remediation Project, Waste Management identified sources of contaminated dirt that could replace the rock as space filler. Although the dirt was slightly contaminated and required disposal, the isotopic composition was comparable with the LLW. The substitution process was successful, saving approximately $100,000.

The 317 Area Remediation Project also worked with Waste Management in remediating an area known as the "map tubes." The tubes were pipes 6.6 m long and ranged in diameter from 5 to 20 cm. When the facility was built, the tubes were fabricated using lead to waterproof the pipe centers and end seals. The pipes were then embedded in a concrete monolith. The project decontaminated the pipe sections and removed those that could not be decontaminated. Project managers recognized that the end caps and center union section were mixed waste because of the contaminated lead. The remaining portions of pipe were LLW. The pipe sections were cut to segregate mixed waste from LLW, resulting in a minimum generation of mixed waste. This approach saved approximately $300,000.

Several demolition projects at ANL have used sampling and segregation to maximize their recycling potential. The H-Wing Demolition Project took a foundry area that fabricated uranium fuel pellets and removed the major machinery. Careful sampling and surveys by Health Physics found that most of the material was recyclable. In addition, because contamination was very low and isolated to only a few areas, minimal protective clothing was required. The sampling increased worker productivity and maximized recycling of the metal. This same philosophy is being used in other projects with similar results.

Secondary waste, generated in the characterization step of a restoration project, can be very significant. Every borehole is expensive to dig and generates waste in the drilling process. The sampling and analysis steps for multiple boreholes also generate waste. Argonne used the PLUME™ code to identify high-priority sample locations at the 317 Area Project. This method resulted in fewer boreholes and reduced sampling. The reduced sampling program saved approximately $50,000 in analytical cost alone. The savings from reduced waste generation and digging of boreholes has not yet been calculated.

Waste minimization and pollution prevention play an important role in environmental restoration projects. These techniques can provide significant savings in cost and waste by using some very simple techniques. Project personnel must look for opportunities to save costs and aggressively pursue them. When each of these environmental restoration projects discussed here was being developed, waste minimization and pollution prevention were not planned. The opportunities were identified and implemented during project execution, as is frequently the case. As a result, it is essential to be alert to unexpected waste minimization and pollution prevention opportunities that may occur in projects.

SESSION 12:

SOLID WASTE
WEDNESDAY MORNING

DEVELOPING POLLUTION PREVENTION STRATEGIES THAT WORK: RECENT SOLID WASTE STREAM ASSESSMENT, CURRENT AND PLANNED RECYCLING ACTIVITIES AT LAWRENCE LIVERMORE NATIONAL LABORATORY

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Lawrence Livermore National Laboratory (LLNL), which is operated by the University of California for the U.S. Department of Energy, assessed a solid waste stream to determine the components of given waste streams. By evaluating the findings, components are targeted for effective source reduction, reuse, or recycling. The Livermore site is approximately 1 mi^2 and has several hundred facilities and approximately 10,000 employees (full time and contract). LLNL assessed 10% of its on-site dumpster locations (25 of 250). Dumpsters were selected on the basis of location and surrounding facility use. The following equipment was used for the assessment: tarps for sorting; 30-gal galvanized waste cans; gloves (leather and surgical); safety shoes; a portable eyewash; a portable "transportainer" to store equipment; shovels; rakes; forked weeding implements to open custodial bags; bathroom scales (a kitchen scale for light items is helpful); a front-loader waste hauling truck (or a fork lift); field tabulation sheets (with sort categories and space to note cubic yardage and weight of sort categories, date, and location); and a water jug and liquid soap for washing.

Dumpster contents were sorted according to type. They were weighed and photographed, and information was noted on field tabulation sheets. Dumpster locations, date of sort, sort categories, weight, and cubic yardage were then entered into a database for review and tabulation. Example sort categories included paper (by type), cardboard, glass, wood, plastic, polystyrene, aluminum, bimetal cans, food, cloth, and rubber. The solid waste stream assessments were conducted in the fall of 1992 and spring/summer of 1993 to track seasonal changes.

Approximately 7,000 lb of waste was sorted in each of the two assessments. A high incidence of cardboard (uncompacted) was present in most dumpsters. This finding validated the need to expand

the cardboard recycling program from the current drop-off system. Also found was a high incidence of polystyrene at LLNL cafeterias. This finding would not have surfaced without the assessment. Very little glass or aluminum was found. Enough waste paper was present to indicate that LLNL needs to increase employee awareness and possibly expand its paper recycling program.

As a result of the solid waste stream assessment, LLNL has expanded the cardboard and paper recycling programs. In addition, moving box and pallet reuse programs have been implemented. LLNL is also studying a possible recycling program for cafeteria polystyrene. Other possible program expansions include magazine, newsprint, and glass recycling.

Currently, LLNL operates many source reduction/reuse/recycling programs to create an environmentally responsible organization and meet federal, state, and local waste diversion mandates. Many of these programs were developed as a result of the solid waste stream assessments conducted at LLNL, and these are discussed during the presentation.

PACIFIC NORTHWEST NATIONAL LABORATORY SANITARY WASTE RECYCLING PROJECT

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The purpose of this project was to reduce costs of sanitary waste disposal by collecting and recycling sanitary recyclable commodities, thereby reducing the negative environmental impact associated with landfilling. Another purpose was to enhance the public perception of the U.S. Department of Energy (DOE) and the Pacific Northwest National Laboratory (PNNL) as environmentally responsible entities.

Paper and cardboard commodities have long been a part of the recycling program at PNNL. The Laboratory originally recycled paper and cardboard through a combination of two programs managed by either Westinghouse Hanford Company or the Laboratory. However, a number of recyclable commodities were being discarded instead of being recycled. This practice was due to the absence of a comprehensive recycling program to cover all sanitary recyclable waste streams. Existing programs were cumbersome and often expensive and difficult for generators to implement.

A pollution prevention opportunity assessment (PPOA) was completed for this waste generating activity on April 1, 1995, and submitted to DOE. As part of the PPOA, a pilot-scale recycling project

was initiated at one of PNNL's facilities, the Environmental Technology Building. The purpose of the pilot project was to test the physical and economic feasibility of expanding the project to all Laboratory facilities. The pilot project was very successful in meeting its original objectives. The PPOA documented the conclusions and made final recommendations that resulted in this project. The pilot project was valuable in providing data for the preparation of the PPOA and in subsequent funding requests for this project. Under this project, the Laboratory successfully secured a single recycling contract to cover the recycling of office paper, corrugated cardboard, mixed paper, newsprint, magazines, glass, plastic, tin, and aluminum.

Materials are collected by staff and placed in appropriate collection containers in various locations across the Laboratory. The vendor picks up all recyclable commodities in exchange for a percentage of the current market value of office paper and corrugated cardboard. Revenues generated by the project are used to maintain the program. The vendor provides monthly totals that are tracked and graphically displayed at various locations across the Laboratory. Annual cost savings resulting from the project are estimated at $30,000, with a project return-on-investment of 83%. An estimated 1,400 m^3 of sanitary waste will be recycled annually.

SOLID WASTE BASELINE

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The Princeton Plasma Physics Laboratory (PPPL) is a small, single-purpose research facility that conducts fusion research in support of domestic and international efforts for a safe, alternative energy source. On 72 acres in suburban central New Jersey, the laboratory staff of approximately 700 generates its share of solid waste or trash in the course of doing business.

PPPL had very little data regarding this solid waste stream, which, by law, must be reduced by 50% by 1999. Therefore, an evaluation was performed to provide a baseline for PPPL's solid waste. The evaluation was also designed to determine (1) the degree of source segregation by PPPL employees for recycling, (2) the cost benefit of direct sale of recyclable solid waste, and (3) changes to operations or the solid waste disposal contract to reduce cost and improve performance. A team with representatives from the maintenance and waste management organizations was assembled to

monitor and sample PPPL's solid waste. All site dumpsters were monitored for volume, and selected dumpsters were sampled for composition.

Volume data allowed the number of contracted trash dumpsters to be reduced by approximately 15% (with a commensurate reduction in cost) and the number of recycling containers to be increased by 5%. These data also allowed PPPL to report 86% less sanitary waste generated in 1994 compared to 1993, where, without data, only crude estimates were used. The team found that 75% of recyclable paper is recycled, and 94% of cans/bottles and cardboard. In spite of the high value of some recyclables, the team determined that the existing recycling contract (as opposed to direct sale of recyclables) was the best value for this small, single-purpose facility.

The data generated by this project will also be used by the team to design incentives and approaches for achieving further efficiencies in solid waste management and to provide the foundation for an employee pollution prevention incentive/awareness program.

ARGONNE NATIONAL LABORATORY: A DECADE OF WASTE AND POLLUTION MANAGEMENT

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Argonne National Laboratory-East (ANL-E), a U.S. Department of Energy multiprogram laboratory, operated and managed a sanitary landfill from 1966 to 1992 for disposal of general refuse generated at the Laboratory. The landfill received a permit through the Illinois Environmental Protection Agency in 1981 and closed in 1992. This paper focuses on the waste minimization and pollution prevention activities initiated in the years prior to and since the sanitary landfill has closed. The paper charts the interesting course of cultural and logistic changes that have evolved at the Laboratory within the past decade. ANL-E has evolved from a stand-alone, self-sufficient waste manager to a facility that looks beyond its boundaries for alternative solutions to waste and pollution management.

SESSION 13:

RECYCLING — 1
WEDNESDAY MORNING

THE HANFORD SITE CENTRALIZED CONSOLIDATION/RECYCLING CENTER

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On April 18, 1995, the U.S. Department of Energy, Richland Office (DOE-RL), received approval from the Washington State Department of Ecology to operate the Centralized Consolidation/ Recycling Center (CCRC) on the Hanford site. The CCRC was established to collect and consolidate selected waste streams for off-site recycling and on-site reuse. Collection points have been established at generating facilities across the site, and materials are shipped to the CCRC for processing. In effect, the CCRC becomes the point of generation for hazardous wastes, previously managed in satellite accumulation areas (SAAs) and shipped off site for disposal.

At this time, the CCRC accepts fluorescent lamps; lead acid batteries; full, partially full, or damaged aerosol containers; and Dioctyl Phthalate (DOP) ballasts. The damaged aerosol containers are repaired and redeployed to another on-site user. Aerosols with remaining usable product are also redeployed on site. The unusable aerosols are punctured: the contents are collected in SAAs, and the metal is recycled. DOP ballasts are dissembled. The metal components are recycled as scrap metal, while the DOP is consolidated and shipped off site as Washington-state-only hazardous waste. Intact and crushed fluorescent tubes, and lead acid batteries, are collected and shipped to off site recyclers.

As a result of this initiative, Hanford site contractors now manage these waste streams differently and more cost effectively. In the first six months of operation, the CCRC processed 2,141 aerosol cans, 930 linear meters of intact fluorescent tubes, 6,170 kg of crushed fluorescent tubes, and 42,270 kg of lead acid batteries. Overall, 90 SAAs have been eliminated at the Hanford site.

Other waste streams will soon be added to those currently processed at the CCRC. These include sodium vapor lamps, incandescent bulbs, mercury vapor bulbs, and small batteries. It is estimated

that these waste streams will result in an additional reduction of 18,000 kg, at an annual cost savings of about $100,000.

The ultimate vision of the CCRC is to develop a sitewide materials reuse and inventory management program. Unused chemicals and products would be sent to the CCRC for redeployment to on-site users, off-site recycling, or consolidation for disposal. This system would be linked with Procurement to ensure that the currently available stock is used prior to purchasing new materials. Plans are currently under way to obtain the initial funding necessary to implement this initiative.

DOWNPOSTING OF VAULTS AT THE OAK RIDGE K-25 SITE

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The Lockheed Martin Energy Systems K-25 Waste Management Division (WMD) has downposted in excess of 100,000 ft^2 of radiological area since 1991. The goal of this decontaminating and/or downposting is to reduce and/or eliminate the generation of low-level radioactive waste produced by using personal protective equipment and anticontamination clothing, and the waste generated by laundering the contaminated clothing. Downposting a contaminated storage vault entails sealing off ventilation from radioactive areas, decontaminating the vault by means of health physics support, and sealing the fixed contamination within the existing area. As low as reasonably achievable (ALARA) concerns are also addressed in the effort; downposting and/or decontaminating radiological areas effectively reduces the risk of employee exposure. Not only does it signify an area free of radiological contaminants, it also eliminates a waste stream that would fill a landfill quickly. This process involves two methods of source reduction: (1) product or process change and (2) good operating practices. In combination with waste minimization, mission success, and ALARA, the WMD has effectively reduced a substantial amount of waste throughout this project, while continuing to provide a safe working environment. Furthermore, not only does downposting make the area safer, it is cost-effective as well. Downposting one area alone saved the company $43,500 annually.

THE NATIONAL CONVERSION PILOT PROJECT: A *WORKING* RECYCLING PROJECT

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The National Conversion Pilot Project (NCPP) is an economic conversion project being conducted at the Rocky Flats Environmental Technology Site (RFETS). Facilities formerly used for nuclear weapons component manufacturing are being prepared for lease to private business interests for commercial manufacturing uses. This preparation includes decontamination and renovation of specialized industrial equipment, while other excess equipment is dismantled. The metal recovered from the dismantled equipment is then segregated and remelted into ingot form, with subsequent processing into usable products, such as special containers to be used for plutonium storage. Through an innovative work package approach involving the project team workers, nearly 1,000 ft^3 (about 35,000 lb) of metal has been removed from the low-level waste stream as candidate recyclable scrap.

Several facilities at RFETS are associated with the NCPP: a foundry, a metal fabrication building, and a research and development facility. Depleted uranium and beryllium are the principal contaminants of concern, along with limited enriched uranium, solvent, and polychlorinated biphenyls. In all, the replacement value for the equipment alone in these facilities is estimated at $92 million. This amount represents a significant investment by the public for now-idle facilities.

Rather than conventional decontamination and decommissioning, the NCPP is systematically decontaminating and *refurbishing* specialized equipment and facilities. Lease agreements will result in a positive cash flow to the U.S. Department of Energy, while providing a return to the public for the investment previously made in these facilities.

While an attempt is made to renovate the bulk of the equipment in these facilities, some equipment is unsuitable for further use. Examples include a cleaning tank system, ovens, and tooling. Traditionally, this equipment would be disposed of as low-level waste. Conversely, it is a goal of the NCPP Waste Management Program to aggressively save as much of this material as possible and divert it into the recyclable scrap metal stream.

Manufacturing Sciences Corporation has recently completed construction of an advanced metal recycling facility in Oak Ridge, Tennessee. Although the primary mission of the facility is

decontamination and free release of materials, metal sent from RFETS that cannot be decontaminated is remelted into ingots. By monitoring chemistry and other parameters, high-quality castings are made. These ingots can then be returned to RFETS for processing in the NCPP facilities. As a result, metal historically disposed of as low-level waste is now recycled into ingot form and processed into usable products in the very facilities from which it was generated.

PROGRESS IN RECYCLING OF AUTOMOBILE SHREDDER RESIDUE

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Argonne National Laboratory has been developing a process to recycle automobile shredder residue (ASR). Several potentially marketable materials that can be recovered from ASR were identified, and technologies to recover and upgrade these materials were developed. Argonne staff built and tested a field demonstration plant for recycling polyurethane foam and produced 2 tons of recyclable foam. Several 300-pound samples were sent for evaluation for various applications and were found to be of marketable quality.

Argonne researchers are also preparing for a large-scale test in which about 200 tons of fines (<0.25 in.) derived from ASR will be used as raw material in cement making. Small samples of fines prepared in the laboratory were evaluated by a major cement company and were found to meet their requirements as a substitute for iron ore or mill scale. Sufficient recovered acrylonitrile butadiene styrene (ABS plastic) was produced from ASR by selective dissolution to evaluate its properties. Samples were sent for evaluation by University of Akron staff. The results so far indicate that ABS properties could be readily upgraded to meet the specifications of the automotive industry. Overall, the results indicate that the process is capable of producing quality materials. Economic assessment of the process also indicates that the process is potentially economical. This paper briefly discusses the process as a whole and summarizes the results obtained from the field work on foam and fines recycling.

ADVANCED ELECTROCHEMICAL PROCESSES FOR METALS RECOVERY

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Advanced process development work being conducted at Argonne National Laboratory involves selective removal of leaded solder from copper-base scrap, electrolytic cell design for recovering zinc from dezincing solutions, and removal of copper from ferrous shredded auto scrap. This work is being done by using an electrochemical process evaluation facility that has the capability of anodic leaching of 100 kg of metallics, in solution volumes of 400 L, and of recovery of dissolved metals by electrolysis. Solutions can be heated to 90°C and electrolysis conducted up to 2,500 A.

Recycling of 100,000 net tons of soldered copper and brass automotive radiators is threatened because of anticipated regulations that would decrease or eliminate lead in plumbing fixtures. A cost-effective process for selective removal of lead from soldered radiators would allow their continued recycling without complete refining. A process based on anodic oxidation of the solder in hot alkaline solution is being evaluated. Preliminary experiments are promising with 10-kg batches, anodic dissolution efficiencies of 20-30%, and weight losses (solder removal) of about 12%.

Zinc electrowinning cell design studies are being conducted by using alkaline dezincing solutions from a dezincing pilot plant in East Chicago. A bipolar cell concept is being evaluated, which, if successful in replacing the monopolar cell design, will save one-third the capital cost of the electrochemical recovery system. This concept would save about $35 million in the cost of construction of dezincing plants in the next 10 years. The system would have the potential for being used in the recovery of 100,000 net tons of zinc, which is approximately 10% of U.S. domestic consumption or 30% of U.S. production. The results of the current effort indicate the preliminary feasibility of (1) a novel magnesium/nickel composite electrode and (2) the effectiveness of high-electrolyte-solution cross-flow in continuous stripping the cathode deposit.

Removal of tramp residual metallics in ferrous scrap is one of steelmaking's most intractable problems. This problem is particularly acute for the 0.2-0.5% copper found in the 10 million net tons of shredded automobile scrap consumed each year in the United States. Obsolete auto scrap cannot be used in high-quality sheet steels because of, in part, high levels of residual copper. Because of a worldwide shortage of high-quality scrap, imports to the United States of scrap substitutes in the form of various types of pig iron are increasing. A process for removing tramp metallic copper in

obsolete auto scrap is being evaluated. First experiments in scaling up the process using commercial scrap are reported.

This paper reviews an effort to identify and assess the technical and economic feasibility of three important recycling processes by using a flexible electrochemical process evaluation facility. Success in commercial adoption of these processes would decrease environmental insult, increase economic incentive for recycling, and improve the U.S. balance of payments because of decreased imports.

SESSION 14:

AFFIRMATIVE PROCUREMENT IN THE EXECUTIVE BRANCH
WEDNESDAY MORNING

POLLUTION PREVENTION POLICY IN THE U.S. DEPARTMENT OF ENERGY

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In an effort to encourage pollution prevention efforts within the U.S. Department of Energy (DOE), Secretary Hazel R. O'Leary issued a policy memorandum to the heads of DOE offices in March 1996. In the memorandum, the Secretary reiterated DOE's commitment to pollution prevention and established departmentwide source reduction, affirmative procurement, and recycling goals to be achieved by the end of the decade. Shortly following issuance this memorandum, the Secretary issued the 1996 Pollution Prevention Program Plan, which is guidance for operations offices, Headquarters offices, sites, and facilities on how to achieve the goals.

This paper discusses the goals in detail, including differentiating between goals for routine operations only and those for all operations (routine and cleanup/stabilization). The current waste generation amounts at DOE facilities are given, and performance measures are discussed that will be used by Headquarters decision makers to monitor field waste reduction, affirmative procurement, and recycling progress.

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THE ROLE OF ENVIRONMENTAL COSTING AND RISK ASSESSMENT IN WEAPON SYSTEM POLLUTION PREVENTION

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In 1994, in *The Lemon Juice Solution: Pollution Prevention and Acquisition Reform*, Sherri Goodman wrote:

> Since 80 percent of the hazardous materials we generate can be tied to weapons systems, the best place to start protecting the environment is in our acquisition process.... Actively moving to limit the potential environmental impact of a weapon system over its life-cycle — from design to production, operation, maintenance, and disposal — is the essence of pollution prevention.

The U.S. Air Force Human Systems Center, Acquisition Pollution Prevention Division (HSC/EMP) has developed a group of environmental cost elements that capture the expenses incurred from using hazardous materials in manufacturing and maintenance processes. The cost elements were developed for use in a computer model that estimates the costs of using hazardous materials over the life cycle of Air Force systems. Development of the 12 cost elements, which began in 1990, uses Air Force and industry costs associated with the manufacturing and maintaining Air Force aircraft.

In 1993, the cost elements were proved on Army and Navy weapon systems at manufacturing and maintenance sites. The HSC/EMP-developed environmental cost elements are procurement, transportation, management, handling, training, personal protection equipment, medical, facilities, support equipment, emergency response, disposal, and potential legal/environmental liability. These elements consist of many costs associated with the use of hazardous materials that typically are included in overhead costs of manufacturing and maintenance. Movement by industry to an activity-based costing system allows these expenses to be identified and collected with a process and/or specific products.

HSC/EMP is developing a Hazardous Materials Model designed to integrate the Hazardous Materials Cost Trade-off Analysis Tool. It will use the above environmental cost elements to perform environmental cost estimates for trade-offs of hazardous materials. As part of this model, the HSC/EMP is developing a Manufacturing and Maintenance Process Cost Analysis Tool to

provide cost estimates on a process level and a risk assessment tool. This integrated tool will provide for informed pollution prevention decision making.

AFFIRMATIVE PROCUREMENT IN THE U. S. DEPARTMENT OF ENERGY

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Executive Order 12873 requires that 100% of an agency's item purchases designated by the U.S. Environmental Protection Agency (EPA) contain recovered materials unless performance, availability, price, and competition criteria cannot be met. In fiscal year (FY) 1995, only 46% of the U.S. Department of Energy's (DOE's) EPA-designated item purchases contained recovered materials. To improve DOE's performance, Secretary O'Leary included an interim 50% affirmative procurement goal in her FY 1996 performance agreement with the president.

The Department's affirmative procurement track record and its plans for improving performance are discussed. Nineteen newly designated items, supply sources for all EPA-designated items, and EPA's process for designating additional items are reviewed.

BUYING RECYCLED: PUTTING THE HORSE BEFORE THE CART

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Here is an up-to-the-minute report on a campaign everyone can support: the National Recycling Coalition's Buy Recycled Business Alliance presents the how, where, and why of buying recycled and the important role played by the purchasing community. Elements of a buy-recycled program, consumer trends, product availability, and barriers are discussed. A hands-on demonstration keys an interactive presentation designed to assist participants in bringing the buy-recycled effort to their organization. The Alliance has presented more than 100 workshops that have received widespread

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* BDM Federal, Inc.

attention and support. More than 1,500 purchasing organizations have joined the Alliance in three years. Find out why! Specific areas covered include (1) why buy recycled, (2) consumer reaction, (3) purchasing's role, (4) supplier/vendor relationships, (5) Alliance formation/history, (6) myths and barriers, and (7) what participants can do.

SESSION 15:

SOURCE 4 SOLVENTS AND REDUCTIONS — 2
WEDNESDAY AFTERNOON

BUILDING A VENTILATION SYSTEM AS THE GOVERNING PARAMETER OF SANITARY EFFLUENT TRITIUM CONCENTRATIONS

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The High Flux Beam Reactor (HFBR) is moderated and cooled by heavy water. Because of the high neutron fluxes, large amounts of tritium are produced during operation. The tritium is in the form of tritiated water. This tritium in the vessel is not necessarily a problem. Because the primary system and all its auxiliary systems are not gas-tight, tritium water vapor is found throughout the HFBR complex.

The ventilation system has always been used to move tritium away from personnel. Recent concern about tritium in the environment has prompted a reexamination of the tritium pathways. It has been discovered that atmospheric humidity and the HFBR's ventilation systems response are the governing parameters that determine sanitary effluent tritium concentration. The largest source of the tritiated water in the sanitary effluent stream is from air handler condensate. This condensate water discharges directly into the sanitary system.

By manipulating the points of condensation (the building humidity) and modifying the discharge, not only has tritium concentration in the sanitary effluent been reduced by a factor of about 10, but the tritiated water can be recycled for other plant processes.

WASTE REDUCTION THROUGH ON-LINE OPTIMIZATION OF CHEMICAL PLANTS

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An effective approach to source reduction using on-line optimization of chemical plants has been demonstrated in two areas. Flowsheeting (ASPEN PLUS) is used for process optimization and parameter estimation, and the Tjao-Beigler algorithm is implemented in a mathematical programming language (GAMS/MINOS) for data reconciliation and gross error detection. Results for a Monsanto sulfuric acid plant with a Bailey distributed control system showed a 15% improvement in the profit and a 25% reduction in the stack gas sulfur dioxide emissions with respect to the current operating conditions. Results are applicable to any of the 7,000 plants nationwide that have distributed control systems. Details of the methods used are described.

DEDICATED GROUNDWATER SAMPLING PUMPS: REDUCED MONITORING COSTS AND INCREASED EFFECTIVENESS

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With the increasing complexity of environmental restoration activities and the current and anticipated budgetary constraints for the Environmental Restoration (EM-40) program, it is critically important that site characterization, remediation, and monitoring programs incorporate waste minimization measures to control costs while increasing effectiveness. This paper discusses a project at the Princeton Plasma Physics Laboratory (PPPL), funded through the Waste Minimization Program, to install dedicated groundwater sampling pumps in monitoring wells at the site.

Traditional groundwater sampling practices involve the pumping or "purging" of between three and five well volumes prior to sample collection. Where groundwater is contaminated, this water must be collected, stored, transported, and treated at considerable cost. Significant recent research, including U.S. Department of Energy (DOE)-funded research, indicates that more representative groundwater samples can be obtained by using dedicated low-flow sampling pumps and the "micropurge" or "millipurge" sampling technique. This technique generates significantly less purge water than traditional methods.

Adoption of this sampling method not only reduces the volume of wastewater that must be collected and treated, but also improves the quality of groundwater samples collected, reduces the associated analytical costs, and increases the efficiency and safety of sampling and monitoring activities. Benefits from this project cross-cut program boundaries and are shared by EM-30, EM-40, and Energy Research. Other DOE facilities where long-term groundwater monitoring is anticipated are strongly encouraged to adopt this strategy to reduce overall characterization and monitoring costs while improving data quality and program effectiveness.

PILOT STUDIES TO MINIMIZE WASTE AND ENHANCE RADIOACTIVE LIQUID WASTE TREATMENT AT THE LOS ALAMOS NATIONAL LABORATORY RADIOACTIVE LIQUID WASTE TREATMENT FACILITY

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The Radioactive and Industrial Wastewater Science Group manages and operates the Radioactive Liquid Waste Treatment Facility at Los Alamos National Laboratory (LANL). In 1995, the facility treated low-level radioactive liquid waste generated by research and analytical facilities at approximately 35 technical areas throughout the 43-mi^2 site. The facility treats between 5 million and 8 million gal (19 million and 30 million L) of liquid waste annually.

The primary treatment technology used by the facility is clarification and filtration. This technology has been used since the facility became operable in 1960, and it removes greater than 99.9% of the radioactive components in the waste stream. The treatment process requires the addition of

chemicals to enhance the flocculation and subsequent precipitation of radionuclides. The resultant sludge generated during this process is solidified in drums and stored on site at LANL.

To minimize waste generation and enhance waste treatment, the group tested membrane filtration technologies for treatment of the facility's influent. Technologies evaluated were centrifugal, hollow fiber, and tubular ultrafiltration for pretreatment of influent and reverse osmosis as a final polishing step for the effluent. The study indicated these technologies achieved higher concentration factors and improved removal of radionuclide contaminants in comparison with the technology currently used. Results have demonstrated the operability and feasibility for the eventual scale-up of membrane filtration systems to enhance and/or replace the current technology. The new treatment scheme would reduce chemical usage and the number of drums destined for disposal while improving the quality of the facility's effluent.

SESSION 16:

CONSTRUCTION AND DEMOLITION — 1
WEDNESDAY AFTERNOON

POLLUTION PREVENTION FOR CONSTRUCTION/DEMOLITION ACTIVITIES

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Nonroutine activities, such as construction/demolition activities, present unique challenges to traditional pollution prevention opportunity assessment (PPOA) approaches. Construction/demolition activities are diverse, waste streams and amounts vary, and personnel and locations change from job to job. ICF Kaiser Hanford Company (ICF-KH), a contractor to the U.S. Department of Energy at the Hanford site in southeast Washington state, faced this challenge head-on in 1995 with a dedicated effort that completed 25 construction/demolition PPOAs. This effort identified potential savings of $1.5 million, with projected waste reductions of 55,000 kg of hazardous waste, 41,000 kg of radioactive waste, and 23,000 metric tons of sanitary waste. Four PPOAs were implemented in full, resulting in actual savings of $200,000.

However, this effort further underscored the need to approach construction/demolition activities from a completely different perspective than fixed facilities when performing PPOAs. Pollution prevention (P2) opportunities need to be identified and planned prior to the start of construction/demolition work. Construction/demolition activities are driven by cost and schedule; therefore, it is very difficult to implement P2 opportunities once a job is under way. The difficulty arises because the mechanisms and processes that generate waste are already in place (e.g., materials have been specified and procured, design is complete, and a contract has been awarded based on a prescribed scope of work). As a result, P2 in construction/demolition is often relegated to the lower end of the waste minimization hierarchy, i.e., "end-of-the-pipe" activities, such as reuse, recycling, and compliant disposal. This practice can disqualify source reduction ideas with the greatest potential to prevent pollution and cut costs, because these ideas cannot be implemented midstream in a construction/demolition project without adversely affecting overall project cost and schedule.

This paper summarizes the results of the dedicated ICF-KH construction/demolition PPOA effort. The major emphasis is placed on initiatives that incorporate P2 into the construction/demolition process in the early stages of ICF KH projects. Examples of initiatives undertaken by ICF-KH include the following:

- Revising design specifications to call for environmentally friendly products,
- Changing contract language to make subcontractors more accountable for their waste,
- Generating a product substitution database,
- Using environmental life-cycle cost analysis to more accurately reflect the true cost of waste generation, and
- Increasing P2 reviews during all stages of design.

USE OF CONCRETE AND CEMENT CONTAINING FLY ASH FOR CONSTRUCTION ACTIVITIES AT THE HANFORD SITE

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Cement and concrete that contain fly ash are one of five identified products with recovered product content that must be included in federal agencies affirmative procurement programs (APP), as required by Section 6002 (i) of the Resource Conservation and Recovery Act and Executive Order 12873. In addition, the U.S. Environmental Protection Agency has established preference standards for cement and concrete and fly-ash-containing concrete in Title 40, *Code of Federal Regulations*, Part 252.

ICF Kaiser Hanford Company has actively specified concrete and cement that contain fly ash for various uses at the Hanford site. The most successful application has been its use in controlled density fill (CDF). This flowable fill is often used in place of native backfill. It is a mixture of fly ash, cement, sand, and water. The material has several properties that make it an ideal backfill material: it is pumpable; it requires no compaction and can be used in adverse weather conditions;

it can be specified in different strengths and can be excavated; and it is self-leveling and flows around obstacles and under structures.

Because of these qualities, CDF is the preferred fill material for use in radiation zones. It can be pumped from outside a contamination area, thereby reducing personnel exposure, labor time, and the generation of low-level or mixed waste from personnel protective equipment. In a recently completed ventilation upgrade in the Hanford Tank Farms, more than 100,000 kg of fly ash was used in the CDF mix, resulting in a reduction of $7,700 in project costs.

In addition to using fly ash in CDF, the product has also been specified in mixes for structural concrete. Efforts are under way to modify the procurement specification for the use of preapproved concrete mix. New specifications would require the inclusion of 10-20% pozzolon fly ash.

This paper discusses the past and planned uses of fly ash in cement and concrete in construction activities at the Hanford site. Inclusion of fly ash in mix designs not only satisfies APP requirements, but has also proved to yield a superior product.

THE LOS ALAMOS NATIONAL LABORATORY CHEMISTRY AND METALLURGY RESEARCH FACILITY UPGRADES PROJECT: A MODEL FOR WASTE MINIMIZATION

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The Los Alamos National Laboratory (LANL) Chemistry and Metallurgy Research (CMR) Facility, constructed in 1952, is undergoing a major, multiyear construction project. The project involves making significant changes in building infrastructure, environmental control, and worker and public safety to meet changing mission requirements and to extend the useful life of the facility by 20 years.

Phase I addresses urgent capital equipment replacements and upgrades identified as the minimum essential effort required to maintain short-term operations. This phase contains eight construction subproject modifications in various stages of completion. Phase II addresses building modifications required for extending the buildings' life, with several subprojects currently under conceptual design. Many of the operations required under both phases of the project (i.e., design, demolition, decontamination, construction, and waste management) mimic the processes required of a large-scale decontamination and decommissioning job and are identical to the requirements of several upgrades

projected for LANL and other U.S. Department of Energy sites. For these reasons, the CMR Upgrades Project is seen as an ideal model facility — to test the application and measure the success of — waste minimization (WMin) techniques that could be used in similar projects.

The CMR Upgrades Team has launched an aggressive WMin effort intended to avoid waste destined for disposal. The application of WMin activities in preliminary design has avoided the generation of 16,200 yd^3 of radioactive wastes. Work on the goal to reduce waste by an additional 40% is under way, with the recovery of more than 3,000 lb of wire and conduit, recycling more than 150,000 lb of copper and 3,000 lb of lead. The purpose of this paper is to discuss the past, present, and anticipated WMin applications at the facility and focus on the development and execution of the project's "Waste Minimization/Pollution Prevention Strategic Plan."

WASTE MINIMIZATION PLANNING FOR CONSTRUCTION AND OPERATION OF A NEW FACILITY AT THE HANFORD SITE

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Pollution prevention/waste minimization (P2/WMin) concepts are increasingly being included in facility designs, but seldom is there a follow-up plan to ensure that P2/WMin is incorporated into the construction and design of a facility. ICF Kaiser Hanford Company (ICF-KH) is completing a plan for constructing and operating a replacement cross-site transfer line. The new transfer line will consist of two side-by-side seven-mile lines for transferring radioactive wastes from the 200 West Area to the 200 East Area on the Hanford site. Older transfer lines do not meet newer environmental regulations and have become inoperable. The project will include a double-contained slurry and liquid transfer line, a ventilation station, and a diversion box. ICF-KH will manage the construction of the cross-site transfer line; Westinghouse Hanford Company will operate and maintain the completed facility. The plan will identify and evaluate alternatives to minimize waste during the construction and subsequent operation of the cross-site transfer line.

The guidance document used to develop the WMin plan is contained in Title 173 of the Washington Administrative Code, governed by the state of Washington, Department of Ecology. The section that specifically applies to WMin plans is 173-307 Plans, Appendix H. This section is the first WMin guidance on site written for the construction of a new facility.

ICF-KH plans to complete a pollution prevention opportunity assessment (PPOA) for each idea developed by construction and operations personnel. These PPOAs identify areas where WMin principles can be incorporated into the construction and operation of the facility. Completed PPOAs will be the basis for recommendations in the final WMin plan. The plan has proved to be a good tool for combining ideas from construction, operations, and engineering into focused resolutions. The projected cost savings through P2/WMin activities ultimately will pay for the cost of preparing the plan.

This paper discusses the completed WMin plan and selected opportunities and provides a status report on the incorporation of P2/WMin opportunities in the construction of the cross-site transfer line.

NOTES:

SESSION 17:

ENERGY MANAGEMENT — 2
WEDNESDAY AFTERNOON

PREVENTING POLLUTION THROUGH ENERGY EFFICIENCY: A STRATEGY FOR PROFITABLY MAXIMIZING ENERGY SAVINGS IN BUILDINGS

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Approximately 68 billion ft^2 of commercial space is available in the United States. This space annually consumes 5.8 quadrillion Btus of energy at a cost of $70 billion and accounts for 15% of U.S. greenhouse gas emissions, including 785 million tons of carbon dioxide, 6.4 million tons of sulfur dioxide, and 4.5 million tons of nitrogen oxide. On average, by using proven off-the-shelf technologies, commercial building owners can reduce their energy consumption, and the associated emissions, by 43%, while earning a 58% return on investment.

The U.S. Environmental Protection Agency's (EPA's) Energy Star Buildings Program asks building owners to partner with EPA to make cost-effective, energy-efficiency investments. A key element of the program is its five-stage upgrade strategy, which takes advantage of system interactions to maximize energy savings and minimize equipment costs. Upgrades are sequenced so that heating and cooling loads are reduced before major heating, ventilation, and air conditioning (HVAC) equipment upgrades are initiated. This approach provides immediate energy cost savings and ensures proper load matching when upgrading major HVAC equipment in the latter stages. Obviously, this approach is especially critical in 1996 when many building managers are seeking to retrofit or replace chillers that use coolants containing chlorofluorocarbons.

Many technologies are available to building owners interested in profitably achieving energy efficiencies. However, maximizing savings requires both skilled selection of technologies appropriate to each building and staging implementation in the proper order to integrate systems and avoid wasted expense on equipment. The EPA offers Energy Star Buildings Program partners access to technical workshops, documents, and, more important, an assigned account manager with

extensive experience and proficiency in energy services. The EPA also provides partners with a wide range of public recognition support, including advertising, direct mail, and public relations services to communicate messages important to stakeholders, such as employees, shareholders, tenants, customers, and the larger community. In the past, messages have ranged from fiscal responsibility and environmental stewardship to national economic competitiveness and avoiding the need for downsizing. In addition, a labeling program, allowing buildings to be identified as EPA Energy Star Buildings, was launched in January 1996.

IMPROVING BOILER HOUSE OPERATIONS THROUGH WASTE MINIMIZATION AND POLLUTION PREVENTION TECHNIQUES

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Argonne National Laboratory's boiler plant generates steam for use throughout the Laboratory for heating buildings and for use in research experiments. Recently, Plant Facility and Services-Utilities and Systems (PFS-US), the organization responsible for the operations and management of the Boiler House, initiated several waste minimization and pollution prevention techniques at the Boiler House, while increasing the energy and cost-efficiency of the plant. The following paragraphs briefly describe these techniques and how they have improved Boiler House operations.

Screening and separating coal fines from the larger mass of coal resulted in a more efficient coal-burning process and a reduction in the emissions of nitrogen oxides. The coal fines, prior to separation, were unrecoverable waste and a source of operating problems. The separated fines are now sold to cement kilns as a resource. The coal fines screening procedure reduced waste and pollution and avoided costs for the Laboratory. In addition, coal fines accumulated over 30 years were salvaged from the surface and subsurface of the coal storage area and sold to a cement kiln.

PFS-US depleted the existing inventory of high-sulfur-content coal and is burning only low-sulfur-content coal. Burning only low-sulfur-content coal enables the Boiler Plant's scrubber to be shut down and exhaust waste gas through the baghouse. This practice is acceptable because emissions from low-sulfur-content coal meet U.S. Environmental Protection Agency standards. The idling of the scrubber eliminates lime spraying (yielding an average cost avoidance of $150,000 per year) and a reduction in the use of electricity.

PFS-US enacted a policy to minimize the amount of coal stored or inventoried at the Boiler Plant. This policy minimized the amount of run-off from the coal piles. Run-off ditches were also constructed to prevent future run-off from coal stockpiles, thus eliminating NPDES violations.

An upgraded dealkalizer was installed for Boiler House make-up water. The dealkalizer reduces the bicarbonate alkalinity in the make-up water. The end results are decreased boiler blowdown to the waste stream, which reduces chemical costs and ultimately fuel inputs. Chemical costs for the first quarter of FY 1996 were reduced by $55 per million lb of steam. Because of this upgrade, an estimated cost avoidance of $25,000 was incurred during this time.

NOTES:

SESSION 18:

ENVIRONMENTAL RESTORATION — 2
WEDNESDAY AFTERNOON

REDUCING WASTE VOLUMES AND COSTS DURING ENVIRONMENTAL REMEDIATION: THE FUSRAP EXPERIENCE

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Using new pollution prevention (P2) methods and applying well-known techniques in innovative ways have significantly reduced waste volume and saved substantial expense for the U.S. Department of Energy's Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP has used these methods in remediating 20 sites containing more than 1.1 million ft^3 of radioactive low-level waste materials.

Recycling and reuse efforts have paid big dividends for FUSRAP. At the Colonie, New York, site, several recycling conservation efforts have been initiated. Approximately 1.9 million lb of radioactive scrap metal has been recycled into shield blocks by a commercial metal melter. This beneficial reuse method avoided land disposal of 40,000 ft^3 of metal. Also, at Colonie, an innovative respirator cartridge recycling program significantly reduced the number of cartridges used and lowered annual costs by $103,000. A rock crusher used at several FUSRAP sites reduced rubble and building debris into soil-like material that can be beneficially reused on site as backfill, eliminating the need for off-site disposal and the cost of buying and transporting clean fill to the site. To date, use of the crusher has saved more than $800,000, and the projected total program savings is more than $6 million.

An example of applying a variety of P2 techniques to remediation work is the FUSRAP Chapman valve program. By combining proven volume reduction techniques with an innovative hazard assessment approach, the final project cost was reduced to $2 million from the original $4.3 million estimate. Waste volumes were reduced from the original estimate of 9,000 to 460 ft^3 by selectively surveying concrete and debris for release, treating contaminated lead paint on site, and using launderable protective clothing.

A new technology was applied at the FUSRAP GM site. Inspecting and cleaning radioactive underground piping were a major portion of the remediation activity. Lengthy runs (greater than 100-ft sections) of subsurface drain pipe, ranging in depth from 5 to 12 ft, were contaminated with uranium. High-pressure water flushing combined with an innovative in situ inspection instrument were used to clean the underground piping and verify that it met the specified cleanup criteria. This approach precluded the need to excavate and remove concrete, overburden, and the piping as waste material. This approach reduced the waste volume by 2,000 ft^3 and saved $750,000.

DUAL-PHASE LIQUID AND VAPOR TREATMENT SYSTEM

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More than 50 years of operations at Pantex Plant have resulted in an accumulation of high explosives (TNT, RDX, and HMX) and contaminants (TCE, DCE, and hexavalent chromium) in a perched aquifer under the plant. A fine-grained aquitard separates the perched aquifer from the Ogallala Aquifer, a primary source of drinking water. An accelerated program initiated to delineate the extent of contamination found that, while no contamination existed in either the Ogallala or the perched aquifers, it had reached the southeastern plant boundary. The U.S. Department of Energy, Mason & Hanger, and Battelle Memorial Institute (subcontractor) developed one of the most flexible and sophisticated multimedia treatability demonstrations in Texas.

THE CITY OF CHICAGO BROWNFIELDS INITIATIVE

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This paper discusses the progress made to date by the City of Chicago Brownfields Initiative. Brownfields are abandoned or idle properties because of the presence or suspected presence of environmental contamination.

In October 1993, the City of Chicago assembled an interdepartmental team to address the complexities of the Brownfields problem. The team included representatives of the Departments of Environment, Planning and Development; Buildings; Law; and the Mayor's Office and has developed a three-tiered approach to the Brownfields problem:

- Cleanup and redevelopment of pilot sites. The team initially identified five pilot sites and has worked together to close the loop among environmental cleanup, building demolition (where necessary), and economic redevelopment. The purpose of this effort is to gain first-hand experience in the cleanup and redevelopment of the Brownfields sites, so that changes can be made to regulations and processes that will help motivate businesses to reuse similar properties. Significant progress has been made on these pilot sites by using $2 million in General Obligation Bond funding (details follow). The focus is now on additional sites.

- Policy Development Forum. Since December 1994, the City of Chicago has been conducting a large-scale effort to identify and remove barriers to the cleanup and redevelopment of the Brownfields sites. This effort, the Brownfields Forum, has drawn on the wide range of expertise from the public, private, and not-for-profit sectors in the Chicago area. A final report, including recommendations, was released in October 1995. The City of Chicago and a range of private and not-for-profit entities have taken responsibility for implementing the recommendations and have started to produce results. The forum was supported by a grant from the John D. and Catherine T. MacArthur Foundation. Clean Sites, a not-for-profit organization, has served as the facilitator of this process.

- Economic Analysis of Brownfields vs. Greenfield Development. An economic evaluation of the Brownfields problem is being performed by a team of economists at the University of Illinois at Chicago. This project is also being supported by the MacArthur Foundation.

The U.S. Environmental Protection Agency is directly supporting the city's Brownfields efforts by providing a full-time employee to manage the environmental efforts and has provided a second employee for a period of four months. Support from the MacArthur Foundation for the forum and the economic analysis (as described above) has been significant. Additional funding is now being sought from other sources to implement the forum's recommendations.

The City of Chicago Mayor's Fellows Program accesses expertise from the private sector and links this talent to programs within the city government that address particularly complex issues. This program has arranged for two individuals to support the city's Brownfields efforts. The first is a real estate consultant, provided by the First National Bank of Chicago to the Department of Planning and Development. The real estate consultant will assist in evaluating complex real estate transactions.

The second is an environmental specialist provided by Amoco Corporation to the Department of Environment. The environmental specialist will help implement the broad-ranging policy recommendations of the Policy Development Forum.

By using $2 million in General Obligation Bond funds, the City of Chicago has made significant progress in evaluating, cleaning up, and remediating the Brownfields sites. Although the original intent was to test five sites and to clean up two sites, testing has begun on a number of others. The lessons learned from progress on these pilot sites are summarized in the following paragraphs.

At the beginning of the process, it became apparent that many individuals involved with the program assumed that "Brownfields" sites were roughly equivalent to "Superfund" sites. Superfund thinking has poisoned the Brownfields debate. In reality, the majority of Brownfields transactions is much smaller and more accurately environmentally cleanup situations.

Experience gained through the City of Chicago's Brownfields pilot projects indicates that the fear of environmental costs and liabilities in each case far exceeds what was actually found on the sites. It was assumed that $2 million would pay for the cleanup of two of the five sites. We now know that all five sites will be cleaned up with only $850,000 in environmental expense.

To fully benefit the community, multiple city resources need to work cooperatively to close the loop among environmental cleanup, building demolition (where necessary), and economic redevelopment. If this is not done, the result may be a clean empty lot that is a target for illegal dumpers, who will recontaminate the property.

USING A ZONED ANALYSIS TECHNIQUE TO IDENTIFY AND DISPLAY REGULATORY DRIVERS AND DELIVERABLES FOR THE INEL POLLUTION PREVENTION UNIT

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Zoned analysis (ZA) is actually a bird's-eye view of a work breakdown structure. The center zone, or circle, is Idaho National Engineering Laboratory's Pollution Prevention (P2) Unit. The next circle contains the various drivers or requirements. Pie sections are drawn from each driver with expanding zones. As the zones expand from the drivers or requirements, the subject is focused, and ultimately, the last zone, or outermost part of the pie section, contains a terminal task or deliverable required

for the P2 unit to perform. This graphic example could be expanded to include the time or hours required for each task or could be used to divide tasks among staff members.

The P2 ZA cannot show all of the interactions and duplications of the many regulatory drivers, but the intent is to recognize the ultimate deliverables from the drivers. The ZA tool is versatile and readily adaptable to most situations and is very useful in matching the ultimate tasks and deliverables to the regulatory drivers and other requirements. Generating a ZA can be divided into four parts: making the initial thrust, putting the data onto a computer graphics software program, revising the efforts, and accepting the final product.

The construction of this ZA, the iterations it went through, and how it was finalized are shown. A brief explanation is given on how this ZA has benefitted the P2 unit. As time permits, another ZA will be presented to illustrate how to work through the mechanisms and processes, so that attendees can produce a ZA that meets their specific esoteric requirements and tasks.

MATERIALS EXCHANGE PANEL
WEDNESDAY AFTERNOON

Moderator: Arnie Edelman, U.S. Department of Energy, Office of Energy Research
Panelists: Mark Davillas,* Kim Kerry,† Kevin Twitchell,‡ and Robert Wiebers**

Many federal agencies and private entities face shrinking budgets and increased difficulty in obtaining resources necessary to do business. Materials exchange is one method that can resolve this dilemma. A recent workshop sponsored by the U.S. Department of Energy (DOE), Office of Energy Research, explored opportunities, barriers, and deficiencies of current materials exchange programs. The panelists discuss recent successes in the areas of materials exchange, new concepts of materials issue, and implementation of exchange programs.

Some DOE sites have developed successful internal materials exchange programs (e.g., Lawrence Livermore National Laboratory and Oak Ridge National Laboratory). These programs save significant costs in avoided procurement, waste handling surveillance, and disposal charges.

Organizations are attempting to resolve barriers to inter-DOE exchange. One barrier is learning what is available at other sites. Another barrier to rapid exchange is the DOE property system, which adds steps to off-site transfer. These issues are discussed.

The Navy has developed programs to issue the correct amount of hazardous materials for a job. These programs are being implemented worldwide and will avoid small stockpiles of materials and ensure proper handling.

A specific example of a successful materials exchange program is the McLean County (Illinois) Integrated Solid Waste Management Program. The program implemented an information clearinghouse to facilitate the exchange of discarded, but usable, nonhazardous materials between McLean County businesses and local organizations. Priority is placed on waste reduction and recycling as a means to economic development and efficiency in the business community.

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† U.S. Navy.

‡ Idaho National Engineering Laboratory.

** Lawrence Livermore National Laboratory.

SESSION 19:

RECYCLING — 2
THURSDAY MORNING

CLOSED-LOOP PROCUREMENT CONTRACTS — CLOSING THE CIRCLE ON PRODUCT USE AND WASTE MANAGEMENT

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ICF Kaiser Hanford Company (ICF-KH) has taken a leadership role at the Hanford site and in the U.S. Department of Energy complex in establishing and managing closed-loop contracts. A closed-loop contract is one in which the supplying vendor accepts the used product or waste material generated from the product's use. The vendor then processes or recycles the wastes into a reusable product that is supplied to the customer. Closed-loop contracts reduce liability and the costs associated with waste management and satisfy the federal affirmative procurement requirements. Returning a potential waste to the manufacturing process avoids wastes and conserves raw materials necessary to produce the product.

Among the closed-loop contracts that ICF-KH has successfully implemented are the following.

- *Tires.* Used tires casings are recapped four times. All spent casings are returned to the vendors for recycling into products, such as hoses, belts, railroad crossings, and other rubber products, or for energy and metal recovery.

- *Automotive batteries.* For each battery purchased, a spent battery is returned for recycling.

- *Used oil.* Spent lubricating oils are reprocessed, and the re-refined product is supplied for use in Hanford site vehicles and equipment.

- *Contaminated rags.* Rags contaminated with oils, greases, and solvents are sent to an industrial laundry. The laundered rags are returned for use.

- *Plastics.* Vendors deliver products in plastic containers. Once emptied, the containers are returned to the vendor for recycling.

- *Cardboard.* ICF-KH requires the vendor to supply parts in returnable plastic containers. Using the plastic bins reduces the amount of cardboard, packaging, and waste paper produced by our operation.

- *Lead.* Wheel weights are made of lead. Once the wheel weights have been expended, they are returned to the vendor for recycling.

The key to establishing a successful closed-loop contract is to become involved at the beginning and continue to be involved throughout the procurement process. It is essential to work closely with procurement personnel and potential vendors to ensure that the product meets required specifications, that the returned waste material is properly managed and recycled, and that the negotiated contract is cost-competitive.

This paper describes the successful closed-loop contracts at the Hanford site and discusses the lessons learned by ICF-KH in securing these contracts. In addition, ongoing efforts to establish a closed-loop materials inventory system are discussed.

INTERACTIVE EFFECTS OF pH, SURFACE TENSION, AND SOLUTION DENSITY FOR FLOTATION SYSTEMS FOR SEPARATING EQUIVALENT DENSITY MATERIALS: SEPARATION OF ABS FROM HIPS

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This paper presents the results of research being conducted at Argonne National Laboratory to develop a cost-effective, environmentally acceptable process for separating high-value plastics from discarded household appliances. The process under development has separated individual high-purity (greater than 99.5%) acrylonitrile-butadiene-styrene (ABS) and high-impact polystyrene (HIPS) from commingled plastics generated by appliance-shredding and metal-recovery operations. The process consists of size-reduction steps for the commingled plastics, followed by a series of gravity-separation techniques to separate plastic materials of different densities. Individual plastics of similar densities, such as ABS and HIPS, are further separated by using a chemical solution. Controlling the

pH, the surface tension, the density, and the temperature of the chemical solution allows researchers to selectively float/separate plastics that have equivalent densities. This separation technique has proved, in laboratory-scale tests, to be highly effective in recovering high-purity plastic materials from discarded household appliances and other obsolete durable goods. A pilot plant is under construction to demonstrate and assess the technical and economic performance of this process. This paper examines the technical and economic issues that affect the recovery and separation of plastics and updates Argonne's plastics separation research and development activities.

CATALYTIC PYROLYSIS OF PLASTIC WASTES — TOWARD AN ECONOMICALLY VIABLE PROCESS

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The project's ultimate goal is an economically viable pyrolysis process to recover useful materials from mixed plastic waste. From automobiles to appliances, furniture, household goods, computers, and other items, the use of difficult-to-separate plastic components increases steadily. In Europe and Japan, pyrolysis processes are commercial realities.

The best yields measured so far in the laboratory from catalytically pyrolyzing a simulated auto shredder residue are 30 weight percent (wt%) liquids, 45 wt% gases, and 25 wt% char. At present, the study has only dealt with ZnO, Al_2O_3, Bi_2O_3, and a few other catalysts. Studies of other catalysts are planned. However, pyrolysis in the absence of these catalysts usually produces a char yield as high as 35 wt%, and the liquid hydrocarbon yield can be 30 wt% lower. A catalyst can also affect product distribution. For example, ZnO significantly improves the yields of two principal liquid products: methyl heptane-1 and styrene.

Gaseous olefins make up 25 wt% of all products, with a weight ratio of propene/ethene/butene of 3/1/1. Saturated hydrocarbons make up about 15 wt%, with a methane/ethane ratio of 2/1. The remaining gases are CO_2 and CH_3Cl. The latter, which can be removed at lower temperatures, carries almost all the chlorine from PVC. This has been a novel finding in these investigations and will be important in practical applications. The presence of such materials as wood, paper, and polyacrylates during pyrolysis of plastic wastes containing PVC apparently enhances the formation of CH_3Cl instead of the corrosive HCl.

Systematic determination of the solid, liquid, and gaseous compositions is done by using gas chromotography/mass spectrometry for analyzing liquids, gas chromotography for analyzing gas, and Fourier Transform Infrared (FTIR) spectrometry for determining and positively identifying gases such as CH_3Cl. These investigations will be expanded by FTIR determinations of new catalysts and liquid distillations for isolating individual products.

TOWARD A 100% RECYCLING FACILITY

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Since fiscal year (FY) 1995, the Savannah River Site (SRS) pollution prevention and waste minimization program has been looking for initiatives to drastically reduce radioactive and hazardous waste generation. Low-level waste (LLW) became a FY 1996 priority because of the large quantities being generated, that is, more than 500,000 ft^3/yr by 55 generators. Because zero waste generation in operating facilities is impossible, the second best option is to substitute potential waste into items that can be reused or recycled, hence reducing generation by reducing its rate. During FY 1995, LLW characterization studies were conducted at the largest generating facilities at SRS. These studies yielded an accurate composition of the waste generated at the step-out pads, and items were targeted for reduction or elimination. Plastics appeared to be the largest contributor to the LLW stream volumes (bags, sheeting and roll goods, and protective clothing), amounting up to 60% in some facilities. By reducing the number of nonreusable plastics at these facilities and addressing some of the administrative and/or facility practices, significant reductions can be achieved.

Although complete exemption of disposables may not be feasible for every facility, large reductions can be achieved in most facilities. For example, the Effluent Treatment Facility, the F-Area Tank Farm, and the new Defense Waste Processing Facility are excellent candidates for 100% recycle facilities because of their current reduced level of activity. As in most situations, pros and cons affect the decision to substitute some of the disposable items by recyclables. Cost is an important factor in waste reduction, and it plays a subtle role at SRS, given the low costs of waste disposal and treatment. This fact presents a challenge when comparing the life-cycle costs for disposal versus those of recycling.

The goal for one of the facilities, soon to be selected, is that all the materials used in conducting or supporting radiological work be reusable and recyclable as much as possible and be suitable

candidates for incineration afterward. When declaring a facility a 100% recycle zone, all plastics, sleeving, tape, paper, wood, and other disposable materials are substituted. Proper training and employee awareness are required to ensure that workers understand the objectives and do not compromise the conduct of operations. Establishing 100% recycle zones is an extremely powerful tool for controlling waste generation and well suited for implementation in new facilities or in facilities with little activity, because the low work activity allows workers to become familiar with the concept and the new materials.

APPLYING A LIFE-CYCLE DECISION METHODOLOGY TO FERNALD WASTE MANAGEMENT ALTERNATIVES

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The U.S. Department of Energy's (DOE's) Fernald site in Ohio is developing a "defensible" basis for determining the economic value of recycling metals. The integrated decision-making process will identify various disposition alternatives for radioactively contaminated metals in support of scheduled dismantlement of the site's plants and buildings during the next decade. This life-cycle-driven process will be used by DOE decision makers at Fernald to develop defensible values for a list of decision parameters and provide a structure for using these parameters when comparing and ranking various disposition options. Fernald disposition options include on-site disposal, off-site disposal, and recycle and reuse of the metals. The direct costs and benefits; market and socioeconomic considerations; and environmental, safety, and health impacts will be fully evaluated within this effort. The methodology is expected to be completed by March 1, 1996, and will be applied against a Fernald building during April 1996. The results of this first use are detailed in this pollution prevention briefing.

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* U.S. Department of Energy, Fernald site.

DEVELOPING PERFORMANCE-BASED STANDARDS FOR RECYCLED PLASTIC LUMBER AND ITS PRODUCTS

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Discarded plastic products and packaging have been a growing portion of the municipal solid waste stream. The U.S. Environmental Protection Agency estimates that by the year 2000 the amount of plastics thrown away will increase by almost 50%. Only 4% of this total is currently recovered. More important, because of its low density, the volume of plastics in landfills reached almost 24% of the total volume. The key to successful recycling of plastics is to convert them into products that are both technically feasible and economically viable.

One important product manufactured from waste plastics in the last decade is recycled plastic lumber (RPL). If successful, RPL will not only consume a significant percentage of waste plastics, but will also provide a superior alternative to wood in certain applications, given its corrosion and insect resistance and its nonpolluting nature. At the same time, it would also create a large industry in the manufacturing sector. For these reasons, RPL production has been growing at 40% per year, and there are now more than 25 manufacturers. Currently, most RPL is used in applications, such as trash containers, park benches, or picnic tables, and is sold for its aesthetic appeal. Future success of RPL depends on its use in structural, load-bearing applications.

The U.S. Department of Energy (DOE) and the state of Ohio, Department of Natural Resources, have been supporting a pilot program at Battelle to address this need for standards, specifications, and design protocols for RPL and its products in structural use. Establishing a procedure to develop such standards will help local and state agencies to write procurement guidelines for RPL products, thereby significantly expanding the market.

An RPL shipping pallet was selected for this pilot study, as it could provide DOE (and other agencies) with an alternative pallet material that is both recycled and recyclable. This paper reports progress on this on-going program and details: (1) types of RPL and the manufacturing processes; (2) standards test methods and specifications currently being developed for RPL; (3) design guidelines and optimization, using advanced numerical simulation; (4) full-scale laboratory and field performance evaluation of RPL and pallets; (5) proposed life-cycle cost analysis of the product; and (6) performance-based specifications for RPL pallets. Plans for future work and recommendations are also discussed.

RECYCLING OF TUNGSTEN ASH

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Ash from dismantlement activities was disposed of as radioactively contaminated low-level waste. The ash was tested and found to contain noncontaminated, reusable tungsten. The tungsten ash will be sent to Oak Ridge National Laboratory, Metals and Ceramics Laboratory, for U.S. Department of Energy (DOE) research. The ash will then be reduced to pure tungsten and used to manufacture environmentally safe projectiles, replacing lead used in the Safeguards and Security Program. This project is an example of identifying waste for use at another DOE site without reducing the value of the material. In this case, costs will also be minimized for another DOE environmental project.

NOTES:

SESSION 20:

INTERNATIONAL AND ISO 14000
THURSDAY MORNING

THE IMPACT OF ISO 14000 ON POLLUTION PREVENTION

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It is anticipated that the international standard for Environmental Management Systems, ISO 14001, will be issued this year. Many international companies and organizations are already starting to reevaluate their environmental management systems in light of this new standard. In addition, other international environmental guidance standards are being developed. At the same time, one of the environmental areas to which these groups are devoting substantial attention is pollution prevention (P2) because of its potential impact on financial results. The question to be answered is how these two activities are to be related.

The best approach would appear to be to use the new ISO 14001 standard as a tool to help management and organizations to focus on developing an overall P2 strategy, including setting goals and objectives. This effort would not only focus on end-of-pipe solutions, but it also would integrate the P2 philosophy throughout the organization. This goal can best be accomplished during a reevaluation/reengineering of the environmental management system, which is required for achieving conformance with ISO 14001.

Other international environmental guidance standards, especially the guidance standards for life-cycle assessment (ISO 14040 and 14041), will also affect P2 planning. While these guidance standards are currently in the development phase, the work in progress has already increased the focus on this area and caused more companies and organizations to start evaluating these tools in their planning.

CHANGING THE WAY WE DO BUSINESS: USING ENVIRONMENTAL MANAGEMENT SYSTEMS FOR FOLIATION PREVENTION

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After a decade of struggling to comply with single-purpose, end-of-pipe environmental legislation, the U.S. Department of Energy (DOE) has an opportunity to demonstrate leadership in environmental protection. This presentation focuses on three aspects of that opportunity. First, it outlines the role that environmental management systems (EMSs), such as the ISO 14001 Standard, can play in managing environmental protection at DOE sites. The focus is on using an EMS approach to integrate pollution prevention with the full range of site activities. Second, the broader aspects of a paradigm shift in environmental protection are discussed, focusing on its importance for waste minimization and energy and water management at DOE sites. Finally, the roles an EMS approach and pollution prevention can play in innovative regulatory programs being initiated by federal and state regulators are addressed.

INTERNATIONAL DIFFUSION OF POLLUTION PREVENTION TECHNOLOGIES

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The Illinois Environmental Protection Agency (IEPA) is the lead agency in a partnership with the U.S. Environmental Protection Agency, China's National Environmental Protection Agency, the World Bank, the U.N. Environmental Programme, and the Chemical Industry Council of Illinois in an Environmental Technology Initiative project funded through the U.S. Technology for International Environmental Solution program. The projects's objectives are to create market opportunities for U.S. technologies in China and to help selected industries in China address

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* Battelle Pacific Northwest Laboratories.

environmental problems by using pollution prevention (P2). The project is composed of the following tasks:

- *Host a delegation from China (early December 1995).* The delegation included government and local officials and industry representatives. Activities scheduled for the delegation included meetings with U.S. experts and visits to companies that have successfully implemented P2 projects.

- *Present a four-day workshop in China (mid-January 1996).* The workshop was taught by U.S. and Chinese experts, and topics covered general P2 issues and topics specific to the selected industries. During the trip, the experts also finalized preparations for audits to be performed at participating Chinese companies.

- *Evaluate and recommend implementation of options resulting from the audits (January – June 1996).* The U.S. experts and the IEPA will work jointly with their Chinese counterparts to oversee the audits performed at the participating companies. At the conclusion of the audits, one facility will be selected for a technology transfer demonstration project.

- *Demonstration and evaluation of technology transfer project (July – August 1996).* The final workshop will be held in China to disseminate the results of the demonstration and overall project (late September 1996).

NOTES:

SESSION 21:

SOURCE 4 SOLVENTS AND REDUCTION — 3
THURSDAY MORNING

DO YOU KNOW WHERE YOUR CHEMICALS ARE?

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This paper explains how tracking chemicals electronically increases the ability of companies to comply with applicable federal requirements. Federal law requires that companies know what chemicals are on site, where they are located, and how to communicate about these chemicals (40 CFR 370, 29 CFR 1910.1200, and 29 CFR 1900.1450).

An electronic system was developed to track the location, quantity, and ownership of hazardous chemicals (Figure 1). The system is based on requirements of the Emergency Planning Community Right-to-Know-Act, which is codified in the U.S. Environmental Protection Agency's Right to Know Requirements and the Occupational Safety and Health Administration's Hazard Communication and Laboratory Standards. Hazardous chemicals are tracked electronically, which allows companies to implement such programs as chemical and waste minimization more efficiently. In addition, Superfund Amendments and Reauthorization Act (SARA), Hazardous Waste Biennial, and other system reports can be generated.

The reduction of chemicals and hazardous waste was another reason for developing a chemical tracking system. Without knowing what chemicals were on site or where they were located, chemicals were overstocked and eventually disposed of as hazardous waste. Providing a system that searches for on-site chemicals reduced ordering excessive quantities, limited the amount of hazardous waste generated, and saved the company money.

A built-in summary function ensures tracking of all regulatory compliance requirements for SARA, Hazardous Waste Biennial, and other related reports. The reports are completed electronically by pulling data from the chemical tracking system into the appropriate form. Employees no longer spend hours filling out forms and waiting for approval to add, transfer, or delete chemicals in the system. They now have more time to perform research, while the company maintains compliance.

The program was developed in Visual FoxPro and uses a unique bar code number, a bar code scanner, and IBM-compatible computer to track chemicals. The chemical tracking system is a multiuser program; therefore, anyone on site can access the system to locate chemicals. Control and accuracy of the chemical inventory are maintained by restricting the ability to make changes in the chemical inventory. Each employee's password and identification number correspond to an access code. The access code determines what functions the employee can perform. Transfers, deletions, additions, and corrections are restricted to authorized personnel.

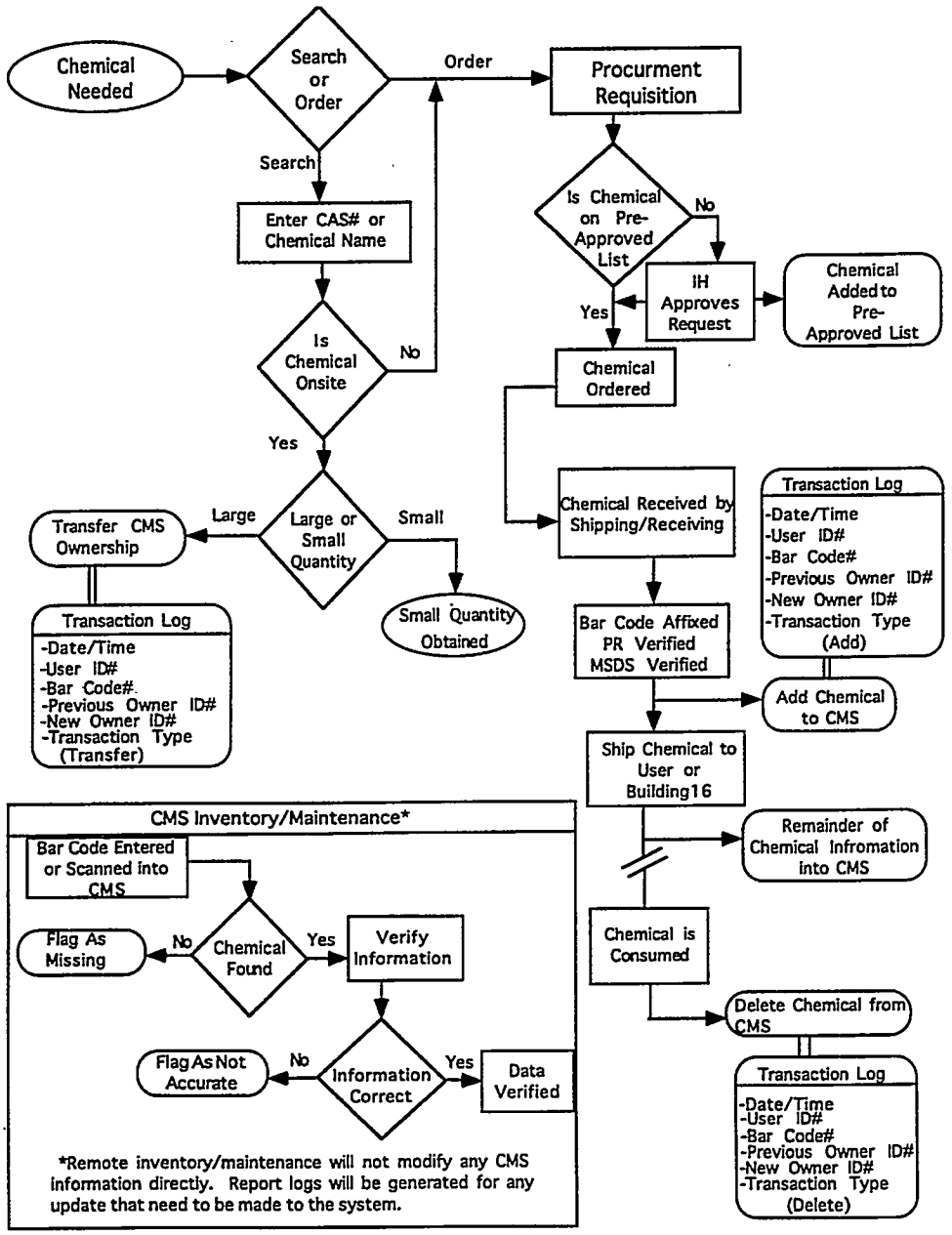

Figure 1 Electronic Tracking System for Hazardous Chemicals

U.S. Environmental Protection Agency Chemical Transfers

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As part of an overall effort to prevent pollution, the U.S. Environmental Protection Agency (EPA) focused on minimizing waste within the EPA Central Regional Laboratory in Chicago. The laboratory waste stream targeted for reduction was excess chemicals. Traditionally, individuals within the various laboratories ordered chemicals independently. As a result, excess chemicals were often ordered because individuals were not aware the chemical was available within the laboratory prior to ordering, and redundant orders were placed simultaneously. In addition, changes in laboratory analysis techniques resulted in chemicals that were no longer useful to EPA. Excess, unused chemicals eventually were disposed of as hazardous waste at a significant cost to EPA.

A method to reduce the amount of excess chemicals was established by designating a central contact for chemical procurement. The contact ensures that excess chemicals are stored in a central location within the laboratory. In addition, before an order is placed, the contact reviews all new chemical purchase requests to ensure that the chemical is not available within the laboratory and that no similar purchases are pending.

A procedure for dealing with excess chemicals was also established. The procedure follows the General Service Administration requirements for excessing surplus government materials. It was determined that excess chemicals could be made available to other federal agencies, states, and not-for-profit organizations (universities, etc.) within a relatively short time. To date, chemical transfers under this procedure have saved $5,177 for the facilities receiving the chemicals (U.S. Department of Energy [DOE]/Fermilab, DOE/Argonne, Drug Enforcement Agency, Public Health Service, and Northwestern University). Transfers have also saved the EPA approximately $9,300 in avoided disposal costs. The environmental benefits of these transfers include the savings of energy and natural resources that would have been consumed to produce equivalent chemicals and the potential hazards associated with the disposal of the excess chemicals.

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SESSION 22:

CONSTRUCTION AND DEMOLITION — 2
THURSDAY MORNING

IMPLEMENTATION OF POLLUTION PREVENTION DURING FACILITY DESIGN

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Pollution prevention opportunity assessments (PPOAs) can be used by design engineers and project managers to identify and evaluate pollution prevention (P2) measures during the design phase of a project, where 60 to 70% of the total cumulative costs for a product are fixed. Pollution prevention opportunity assessments conducted during a project's design phase have a much higher potential for identifying strategies to reduce costs than do assessments performed after design is completed. Because changing a drawing is much less expensive than retrofitting a facility, implementing P2 strategies in the design phase is significantly less costly than doing so later in a project.

The PPOA approach presented is called a pollution prevention design assessment (P2DA). The P2DA approach is based on the experience of Hanford contractors, funded by the U.S. Department of Energy (DOE), in developing three tools to support P2DAs and in working with engineers and project managers to implement pollution prevention in case studies of actual projects. These tools were developed as part of a total P2 concept in which the first tool, a 6-h training class, is both an orientation to pollution prevention and training for using the other two tools — a software program and the P2DA guidebook. The software program, Pollution Prevention Environmental Design Guide for Engineers (P2-EDGE), includes a database of opportunity examples for implementing pollution prevention during the design stage and hypertext support in the form of documented examples, pictures, and references. The P2DA guidebook, designed to be used with the software, standardizes the identification, evaluation, and implementation of pollution prevention during design. During fiscal year (FY) 1995, these tools were deployed throughout the DOE complex and applied on a case study basis in three actual facility design projects. Implementation on additional case study facility design projects continues in FY 1996.

The P2DA is based on experience gained in developing and implementing the three tools. The costs and benefits of implementing a PPOA during design are discussed. Results from FY 1995 case

studies show that benefits can be expected to exceed costs. The P2DA may be implemented as part of any facility design project (and many other types of design projects). Although not required, the three tools are helpful in successfully implementing a P2DA and may encourage engineers and managers to implement pollution prevention during the design phase of projects where it can provide the most benefit.

ECONOMIC ENVIRONMENTAL SUSTAINABILITY: ITS DEPENDENCE ON EASILY ACCESSIBLE TECHNOLOGY INFORMATION

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Creation of economically sustainable pollution prevention (P2) process improvements increasingly depends on the engineer's quick access to usable technology information. Merely increasing the designer's access to growing amounts of unsorted and poorly organized information often proves frustrating. Process and product designers frequently work under compressed design schedules. As a result, better design tools are needed that contain well-organized, "high-grade" technology information and clear, well-written examples of how others have improved environmentally driven processes.

Long-term technology innovation depends on well-informed design engineers. In large organizations, it may also depend on uniformly informed design engineers. Until now, quick access to usable technology information and P2 case studies from within the same industries and organizations was difficult or impossible. The Clean Process Advisory System™ (CPAS) is being developed under collaborative agreements by three major industrial consortia to make it easier to access examples of waste reduction improvements from all industries. The development status of the CPAS effort is presented, with demonstrations of a few CPAS design tool prototypes. The emphasis is on how they give the design engineer ease of access to many technology examples and waste reduction process improvements made to existing production technologies and operating facilities.

RECYCLING OF ASPHALT AND CONCRETE AT PANTEX PLANT

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A subcontractor has been recycling asphalt and concrete products from construction projects at the Pantex Plant. Asphalt and concrete generated during various demolition projects were crushed into an aggregate usable for parking lots or gravel and dirt roads on site. The project cost the plant approximately $41,000 and saved more than $2.3 million by avoiding costs associated with the disposal of waste materials and the purchase of an equivalent amount of virgin aggregate.

NOTES:

EXHIBITS
10:00 A.M. TUESDAY – 10:00 A.M. THURSDAY

POLLUTION PREVENTION BY DESIGN

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Three tools developed by Hanford contractors to assist engineers in implementing pollution prevention (P2) as part of facility design are displayed: the Pollution Prevention Environmental Design Guide for Engineers (P2-EDGE) software program, the Pollution Prevention Design Assessment (P2DA) guidebook, and a training course. The P2-EDGE software program includes a database of opportunity examples for pollution prevention during design and hypertext support in the form of documented examples, pictures, and references. The P2DA guidebook standardizes the identification, evaluation, and implementation of pollution prevention during design and is used with the software. The training course is an orientation to pollution prevention and instruction in the use of the P2DA process and the P2-EDGE software. The P2-EDGE software is available for hands-on demonstration, and a five-minute video that describes the P2DA process and the P2-EDGE software is available for viewing.

WASTE REDUCTION HOW AND WHY?

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This exhibit expands on the initiatives and work in progress presented in the U.S. Department of Energy 1995 Waste Minimization and Pollution Prevention Progress Report for the California sites completed in December 1995. The sites include the Energy Technology Engineering Center (ETEC), Lawrence Livermore National Laboratory (LLNL), Lawrence Berkeley Laboratory (LBL), the Laboratory for Energy-Related Health Research (LEHR), and the Stanford Linear Accelerator Center

(SLAC). Updated waste generation tables for calendar year (CY) 1991-1995 highlight specific waste stream reductions that occurred during CY 1994 and 1995 in the hazardous, mixed, radioactive, and nonhazardous categories. The waste minimization (WMin) and pollution prevention (P2) opportunities implemented are detailed in a poster session and cover characterization and assessment tools, chemical substitution, green product testing and sustainable building design, recycling and reuse of materials, and projects that reduced emissions and waste. In addition, information on P2 partnerships developed with the U.S. Environmental Protection Agency (EPA), local businesses, and regulatory agencies is included. A listing of the pollution prevention opportunity assessments completed by the California sites is available, along with plans for the immediate future.

Specific projects for each site are described by giving details of the process that reduced the waste (with photographs) and saved costs. Potential projects include (1) the LBL Digital Photographic Shop and Photofabrication Shop acid waste reduction; (2) ETEC characterization and assessment tools for decontamination and decommissioning (results from an engineering evaluation of five different tools) and the Torit self-cleaning filter; (3) LLNL approaching zero discharge with metal plating and finishing operations (EPA's Environmental Technology Initiative); (4) LEHR's reuse of radioactive sources and volume reduction techniques; (5) SLAC's radioactive waste minimization program and petition to recycle activated metals; and (6) an example of the poster session WMin/P2 opportunity.

In four years, LBL converted a conventional wet chemical photo processing laboratory into a completely digital photo laboratory. The conversion of the photo processing facility to a digital system is worthwhile based on operational factors alone. In the age of the information superhighway, digital images can be enhanced and transmitted across great distances by using the phone line. The capital investment over four years was $300,000-$350,000. As of 1995, the LBL Photographic and Digital Imaging Shop is a zero waste generation operation. Since the conversion, other federal agencies, research institutions, and local private industry have made numerous inquiries and site visits.

The annual waste generation for the conventional photo processing facility at LBL averaged approximately 500 gal of developers, 1,000 gal of fixers, and 90 gal of system cleaners. Based on research from the total cost assessment work at LBL, it costs approximately $21.23 to manage 1 kg of hazardous waste. The annual waste reduction at LBL is now 6,000 kg, and the cost of purchasing photochemicals is $2,500 per year. Additional savings of $127,000 per year come from waste management. The payback period for this investment is less than three years.

U.S. DEPARTMENT OF ENERGY Y-12 PLANT
RETURN ON INVESTMENT

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The Oak Ridge U.S. Department of Energy (DOE) Y-12 Plant (managed by Lockheed Martin Energy Systems, Inc.) is primarily a Defense Program-funded site. At the site, many pollution prevention (P2) projects that require capital expenditures and some expensive projects have not received funding because of the decreasing budget within Defense Programs. Thus, many P2 projects have been on hold due to funding constraints. The Y-12 Pollution Prevention Program Office has tried several means to secure funding and has been successful in securing funds from the DOE Headquarters' Return on Investment (ROI) Program.

Of the $2.2 million Round 1 funds committed to this effort, the Y-12 Plant received $1.7 million. These funds were allocated for the following Y-12 Plant projects: (l) elimination of radwaste in Building 9995, (2) condensate recycle, (3) gas chromatography/mass spectrometry/solid-phase microextraction, (4) rad wood reduction prospects, (5) packaging segregation, and (6) cyanide by MIDI distillation. The projects are estimated to reduce 694,412 lb of low-level waste (LLW) per year; 4,750 lb of Resource Conservation and Recovery Act (RCRA) hazardous waste per year; and 84,000 gal of mixed LLW per year. The projects are expected to save a total of approximately $3.3 million per year.

The Y-12 Plant has been notified that three additional projects will be funded: (1) photographic chemistry waste through digital imaging, (2) radioactive/RCRA wastewater elimination, and (3) upgrade of thermal ionization mass spectrometer to reduce acid waste and decrease analysis time. These Round 2 projects represent an additional cost savings of $2 million per year.

The projects submitted for funding were P2 projects that would reduce pollution through source reduction or recycling activities. The exhibit contains graphic representations and pictures of various projects being implemented at the Y-12 Plant. As part of the exhibit, handouts of the actual proposals are available. These were submitted for funding and demonstrate how the cost savings and ROI were determined. This exhibit provides an information exchange on the types of P2 projects being implemented and valuable examples of how to document and market projects to secure funds needed for implementation.

K-25 Site Pollution Prevention Program Highlights

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The winner of the 1994 National DOE Pollution Prevention "Bang for the Buck Award," the Oak Ridge K-25 Site Pollution Prevention Program, has a well-developed, effective pollution prevention (P2) awareness program and a well-tracked, well-recorded waste reduction and recycling program. The K-25 Site P2 Program is centrally developed and managed by the K-25 Site P2 program manager, a staff member of the K-25 Site Waste Management Division. The program coordinates all site P2 activities and supports technology development and transfer of P2 information. The organizational structure for the program maximizes dissemination and collection of P2 regulatory and programmatic information and delegates managerial responsibility to waste-generating organizations. Several matrix relationships and organizations also exist within the site: Lockheed Martin Energy Systems, Inc., which manages the site; the U.S. Department of Energy (DOE) Oak Ridge Operations; and DOE Headquarters, which supports the program's infrastructure. The following program elements identified by DOE Headquarters are integrated into the K-25 Site Pollution Prevention Program work structure: program organization and infrastructure, program development and evaluation, reporting and tracking, source reduction and recycling implementation, and technical assistance and information technology exchange. The photographic exhibit shows program highlights from the annual P2 Awareness Month activities and other P2 projects undertaken during the year.

U.S. DEPARTMENT OF ENERGY Y-12 PLANT RECYCLING PROGRAM

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Executive Order 12783 mandates that federal agencies initiate a program to promote cost-effective waste reduction and recycling of reusable materials from wastes generated by government activities. At the U.S. Department of Energy (DOE) Y-12 Plant in Oak Ridge, the site assessment manager developed an exhibit to enhance the awareness of recycling and waste reduction. To promote awareness at the Y-12 Plant, the exhibit is displayed on a periodic basis. The exhibit is also used to share the success of the Y-12 recycling program at various conferences. The Knoxville Advertising Federation chose this exhibit as the winner in trade show competition.

The exhibit displays four sections made from full electrostatic images. Recycling and waste reduction promote recyclables available at the Y-12 Plant. The items on display are an aluminum beverage container, wood, paper, toner cartridge, tire, and battery products. Photographs depict each of these items, along with some of the daily activities involved in transforming these products. In some of the photographs, Y-12 Plant employees demonstrate the recycling process used for these products. Unique to Y-12 is the Olathe tub grinder used to recycle wood pallets into mulch to reduce waste and promote recycling. Velcro signs update the numerical data.

PREVENTING POLLUTION THROUGH ENERGY EFFICIENCY: A STRATEGY FOR PROFITABLY MAXIMIZING ENERGY SAVINGS IN BUILDINGS

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The United States has approximately 68 billion ft^2 of commercial space, which annually consumes 5.8 quadrillion Btus of energy at a cost of $70 billion and accounts for 15% of U.S. greenhouse gas emissions. These emissions include 785 million tons of carbon dioxide, 6.4 million tons of sulfur dioxide, and 4.5 million tons of nitrogen oxide. On average, using proven off-the-shelf technologies, commercial building owners can reduce their energy consumption, and the associated emissions, by 43%, while earning a 58% return on investment.

The U.S. Environmental Protection Agency's (EPA's) Energy Star Buildings Program asks building owners to partner with them to make cost-effective, energy-efficient investments. A key element of the program is its five-stage upgrade strategy, which takes advantage of system interactions to maximize energy savings and minimize equipment costs. Upgrades are sequenced so that heating and cooling loads are reduced before major heating, ventilation, and air conditioning (HVAC) equipment upgrades are initiated. This approach provides immediate energy cost savings and ensures proper load matching when upgrading major HVAC equipment in the latter stages. Obviously, this approach is especially critical in 1996 when many building managers seek to retrofit or replace chillers by using coolants that contain chlorofluorcarbons.

Many technologies are available to building owners interested in profitably achieving energy efficiencies in their buildings. However, maximizing savings requires both skilled selection of technologies appropriate for each building and staging implementation in the proper order to integrate systems and avoid wasted expense on equipment. The EPA offers Energy Star Buildings Program partners access to technical workshops, documents, and, more important, an assigned account manager with extensive experience and proficiency in energy services.

The EPA also provides partners with a wide range of public recognition support, including advertising, direct mail, and public relations services, to communicate messages important to stakeholder groups, such as employees, shareholders, tenants, customers, and the larger community. In the past, messages have ranged from fiscal responsibility and environmental stewardship to

national economic competitiveness and avoiding the need for downsizing. In addition, a labeling program that allows buildings to be identified as EPA Energy Star Buildings was launched in January 1996.

U.S. Department of Energy's Pollution Prevention Information Exchange Clearinghouse

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The U.S. Department of Energy's (DOE's) Pollution Prevention Information Clearinghouse (EPIC) is a Worldwide Web-based (WWW) system that facilitates the exchange of pollution prevention (P2) information throughout federal, state, and local government agencies, as well as industries, academic institutions, and the general public. The types of information on EPIC include DOE facility pollution prevention opportunity assessments, DOE guidance and policy, project summaries, newsletters, contacts, Internet resource listings, and other information relevant to DOE's internal P2 program.

EPIC is composed of a file that lists DOE-specific P2 information that is searchable and available to download to your computer; a DOE P2 Listserve that allows communication among DOE users; and a calendar of upcoming DOE-sponsored conferences, meetings, and training events related to pollution prevention.

The EPIC WWW system connects with various Internet resources, such as the U.S. Environmental Protection Agency's (EPA's) Enviroene and Solvent Substitution Data systems, the U.S. Army's Environmental Technology Office Home Page, Envirotext, Energy Efficiency and Renewable Energy Network, and General Services Administration's Environmental Products Guide. EPIC also provides software tools, such as Pacific Northwest National Laboratory's P2Edge, which is part of the P2Design Package, also available on the system. The EPIC exhibit provides information on connectivity to the system, brochures, and demonstrations of the WWW system.

WASTE MINIMIZATION AND POLLUTION PREVENTION THROUGH THE WORLD WIDE WEB AND DATABASE MANAGEMENT AT ARGONNE NATIONAL LABORATORY

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Argonne National Laboratory has served as a leader in science and technology and would like to extend this expertise to waste minimization (WMin), pollution prevention (P2), environmental protection, and environmental restoration in an effort to contribute to the U.S. Department of Energy's mission of excellence and leadership in environmental quality. Argonne's goal is to expand upon existing WMin and P2 practices and develop new initiatives that will improve the Laboratory's ability to operate in a cost-effective manner.

One strategy incorporates custom software applications designed to effectively manage inquiries and transactions of available and desired recycled items through the World Wide Web (WWW). Using Netscape, HTML, and a custom database, Argonne tracks employee concerns, needs, and questions regarding waste minimization and pollution prevention (WM&PP). The home page offers a "WM&PP swap mart," topics of the month, on-line newsletters, employee contacts, suggestion boxes, and formal Argonne policy statements regarding waste minimization and pollution prevention. The program is an extension of a WWW safety system developed by the Accelerator Systems Division of Argonne's Advanced Photon Source.

POLLUTION PREVENTION AT ALLIED SIGNAL FEDERAL MANUFACTURING AND TECHNOLOGIES

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The Pollution Prevention Program at the Kansas City Plant (KCP) is committed to reducing material releases to the environment, both internally and through industry involvement. The KCP's exhibit shows ways in which the plant has practiced the four "R's" — reduce, reuse, recycle, and rebuy — of pollution prevention within the past year. The KCP has made great progress and continues toward the goal of zero emissions of hazardous waste. The display shows how KCP continues to reduce these wastes. Many new recycling programs have recently been implemented in the plant. These programs include fuel blending, coolant recycling, asphalt and concrete recycling, waste-treated sludge recycling, and glass recycling. The exhibit features some of these programs. The recycling loop is completed at the KCP with the Affirmative Procurement Program. The display shows examples of some of the recycled products that the associates in the plant use. The KCP not only looks internally, but also partners with industry to convert wastes to commodities and products. The exhibit also features some of the latest products made from wood flour, crumb rubber, fly ash, and printed circuit boards.

DEMONSTRATION OF CONFERENCE PROCEEDINGS ON CD-ROM

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This year's conference offers participants a unique opportunity — an environmentally friendly alternative to hard-copy proceedings. CD-ROMs are taking the place of bulky paper volumes.

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* Federal Manufacturing and Technologies, Kansas City.

Argonne National Laboratory's Information and Publishing Division (IPD) demonstrates how to use a CD-ROM and gives you the opportunity to become comfortable with using it. IPD provides tips on the use of the extensive toolbar, which has many options for quickly locating information — more than any hard-copy binder.

The advantages of CD-ROMs are numerous. They are compact, easy to carry, and require minimal storage space. Most important, they offer unsurpassed speed in accessing information. With the CD-ROM, you can find words or word patterns anywhere in a document. The table of contents makes it possible to locate your particular area of interest immediately. The size of the display can be adjusted to correspond to a specific magnification. Like any tool, the CD-ROM requires practice before you can master all its intricacies. IPD's experts give you the opportunity to work with the functions of the CD-ROM, including the toolbar.

No computer is better than its software program. The Adobe Acrobat, which is installed on the CD-ROM, has capabilities to make your work easier. Its functions are particularly valuable for persons who need information quickly. Anyone can feel confident about experimenting with any function of the Adobe Acrobat, because all information is stored permanently and cannot be changed or erased. Unlike the contents of bulky binders, information will not be smudged, torn, or mislaid.

POSTER SESSION — 1
8:30 – 11:30 A.M. WEDNESDAY

RECYCLING AND REUSE OF MACHINE COOLANT IN A METALS FABRICATION PROCESS

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Machining processes at the 272 West Site Fabrication Services produce a waste stream of dirty machine coolant. The coolant is contaminated with metal chips from milling and from oil, dirt, and solvents used in the machining process. The mixture is designated as a Washington state dangerous waste with WP02 (persistence), D007 (chromium), and D008 (lead) waste codes. Machining processes generated 13.5 m^3 of hazardous waste per year, with an annual cost for coolant replacement, waste management, and waste disposal of approximately $138,000.

To identify alternatives to this situation, ICF Kaiser Hanford Company (ICF-KH), North Environmental Services, conducted a pollution prevention opportunity assessment on the machining processes. A coolant recycler and Sump Sucker unit were selected as the most cost effective waste reduction options. In December 1994, ICF-KH received return-on-investment (ROI) funding from the U.S. Department of Energy, Richland Office, to implement the selected options. The coolant recycler and Sump Sucker units were purchased and installed in July 1995 for a total cost of $61,000.

The coolant recycling system reconditions the filtered coolant for use in the machining equipment and mixes the concentrated coolant to the correct concentration. The system has two holding tanks, one for dirty coolant and one for clean coolant. An oil skimmer removes floating oil in the dirty tank. The coolant then flows through a centrifuge that removes emulsified oil. The reconditioned coolant is transferred to the clean tank, and the separated oils are collected in a waste drum. A water-driven, positive-displacement metering pump blends the reconditioned coolant with deionized water or concentrated coolant to achieve the necessary concentration and then dispenses it to machining units.

The Sump Sucker removes the dirty coolant from the fabrication machinery and filters it to eliminate shavings and sludge. The filtered coolant is then transferred to the coolant recycling system for further processing.

Implementing these options reduced the annual generation of waste coolant by 12 m^3. The annual cost savings exceed $121,000, with an ROI of 188%. Additional benefits include reduced coolant usage; improved tool life, wheel life, finish, size control, corrosion protection, and operator working conditions; increased machine "up-time"; and reduced machine tool maintenance.

RECYCLING OF HYDROCARBON RESIDUALS FROM UNDERGROUND STORAGE TANK REMOVAL

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The scope of the Hanford Site Infrastructure Underground Fuel Storage Tank Program is to upgrade all old and noncompliant underground storage tanks (USTs). ICF Kaiser Hanford Company (ICF-KH) supported this effort by performing the definitive design, project management, and waste management functions for project L-044. Project L-044 consisted of removing 25 single-walled, steel USTs and installing 13 double-walled fiberglass tanks throughout the Hanford site. The steel tanks were primarily aging fuel (diesel and gasoline) tanks that were replaced with state-of-the-art underground tanks, in accordance with state of Washington requirements (Washington Administrative Code, 173-630). During excavation and removal of these tanks, residual quantities of hydrocarbon fuel remained in the bottom of the tanks.

In an effort to minimize wastes and reduce project costs, a pollution prevention opportunity assessment (PPOA) was performed. Historically, the residual material in USTs was cleaned with a caustic degreaser, causing the mixture to be designated as a hazardous waste. The PPOA recommended using high-pressure water to remove the residual material. As a result of this change, all residual material was sent off site for recycling, taking advantage of an existing ICF-KH contract with Connel Oil to re-refine used motor oil. This conservation effort resulted in the recycling of 3,952 L of residual fuel material and avoided approximately $31,000 in hazardous waste costs. In addition, the cleaned steel tanks were recycled as scrap metal.

RADIOACTIVE WOOD REDUCTION PROJECT

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The Oak Ridge Y-12 Site was built in 1943 by the U.S. Army Corps of Engineers as part of the Manhattan Project of World War II. The Y-12 Site is one of the two installations managed by Lockheed Martin Energy Systems, Inc., for the U.S. Department of Energy (DOE).

The Y-12 Site occupies more than 800 acres adjacent to the city of Oak Ridge in East Tennessee. The work force at the Y-12 Site is more than 6,800 people. In addition to the approximately 5,700 employees of Lockheed Martin Energy Systems, the facility also houses more than 1,100 employees from Oak Ridge National Laboratory, DOE, MK Ferguson Construction Company, and various subcontractors.

In 1992, a total of $300,000 was spent to send pallets contaminated with radioactive material from the Y-12 Site to a commercial vendor to be treated and disposed of at a cost of $1.70/lb. In 1993, pallets were held at the Y-12 Site, and this money was used to remove contaminated metals. Since 1992, the contaminated pallets have been held at Y-12, causing housekeeping concerns and using valuable outdoor storage space.

During their work activities, the Y-12 Enriched Uranium Operations Decontamination and Plant Support Department (DPSD) discovered that the total amount of contamination present on each pallet averages only 25% of the wood contained in the pallet. The DPSD, in association with Site Shift Operations personnel, sought an alternative to the current disposal methods. A pallet disassembly unit was purchased and paid for as part of the tub grinder used to convert excess uncontaminated and nonpressure-treated wood scraps into mulch for landscaping and erosion control at the Y-12 Site.

The pallet disassembly unit was designed and developed by the Machine Kinetics Corporation of Knoxville, Tennessee. The mobile unit is skid-mounted. Individual pallets are placed on the unit's loading deck. The unit is then activated to shear apart the pallet boards. The boards are taken by conveyor to a monitoring area. Once monitored, the boards are segregated, packaged, and weighed. Only contaminated boards need to be disposed of by the aforementioned methods. Uncontaminated boards are taken to the tub grinder.

In 1994, the DOE Pollution Prevention Executive Board, chaired by the Deputy Secretary of Energy, began a process to identify and implement pollution prevention projects that provide a high return on investment (ROI) by reducing waste and associated waste management costs. The Radioactive Wood Reduction Project reduces the number of radioactive-contaminated wood pallets that must be sent to a commercial vendor for treatment and disposal; the result is a reduction in treatment and disposal costs. The project ended as an ROI project.

The current cost for treating and disposing of contaminated pallets is $2.50/lb. By disassembling the Y-12 Site backlog of pallets and segregating the contaminated and uncontaminated boards, approximately $500,000 will be saved from the estimated 200,000 pounds of uncontaminated boards, which will be shredded into mulch rather than being treated and disposed of as contaminated wood. The project will also save costs from the production of mulch that would otherwise be purchased and from saving landfill space by shredding the uncontaminated wood instead of sending it to the Y-l2 Landfill. Approximately 800 yd^3 of landfill space will be saved through the mulching process, resulting in a cost avoidance of more than $44,000.

THERMAL DECONTAMINATION OF TRITIUM-CONTAMINATED MATERIALS AT THE PANTEX PLANT

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This project reduces the low-level radioactive waste generated from nuclear weapons dismantlement by utilizing a thermal treatment method for decontaminating tritium-contaminated components, which allows them to be reused. Previously, nuclear weapon components contaminated with tritium were shipped to the Nevada Test Site (NTS) for disposition. The pilot project was performed in 1995 on beryllium parts. A contract was established with Idaho National Engineering Laboratory to have beryllium fabricated into reflector blocks to be reused in their Advanced Test Reactor (ATR). Approximately 35,000 lb of beryllium components from weapons dismantlement will be diverted from NTS to the ATR. Total savings is estimated at $1.1 million.

RECYCLING PROGRAMS AT THE PANTEX PLANT

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In November 1994, the Pantex Plant began a recycling program for collecting paper, plastic, tin cans, and cardboard to replace an outdated end-of-pipe segregation contract. Desktop accumulation containers were provided for employees. The custodial staff removed paper from central accumulation containers to the "recyclables only" dumpster. Through a unique "no cost/no charge" contract, a local paper recycler collects and transports the recyclables for bailing and sale. Since implementation of the program, employees have sent more than 360,000 lb of material to be recycled and diverted more than 550 yd^3 of waste from the landfill.

Concerns about the ability of second parties to recover information left on the drum of toner cartridges led to implementation of an on-site recharging program. Hewlett Packard LaserJet printers are supported by the program: Models II, III, IIISi, IV, IVSi, and IV+. These printers use one of three cartridges: 92291A, 92295A, or 92298A. The Administrative Services Division recharges about 250 toner cartridges annually. This program has saved the Pantex Plant about $40,000.

In other recycling efforts, rechargeable batteries are used in place of disposable alkaline batteries at the Pantex Plant. The Pollution Prevention Technical Team studied battery usage and proposed to use Rayovac Renewal rechargeable alkaline batteries. Documentation shows these batteries to be free of hazardous materials found in regular alkaline batteries. The batteries may be recharged up to 25 times. Additionally, the batteries do not exhibit the "memory effect" associated with recharging nickel cadmium batteries. This program was implemented in 1994 and is estimated to have saved the Pantex Plant more than $23,000.

WASTE MINIMIZATION AND POLLUTION PREVENTION INITIATIVES IN VEHICLE MAINTENANCE

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The Argonne National Laboratory-East Plant Facility Services-Vehicle Maintenance (PFS-VM) operates a 20,000-ft^2 vehicle maintenance facility. The facility maintains and services approximately 300 vehicles, ranging from cars to large construction equipment. Currently, PFS-VM is implementing a variety of waste minimization and pollution prevention initiatives. The following lists these initiatives:

- Fleet emission testing program
- Aerosol spray can removal program
- Air conditioning freon recovery and recycling
- Antifreeze recovery and recycling
- Retreading and recapping of tires
- Waste oil filter recycling
- Waste oil and fluids recycling
- Asbestos treatment program
- Cleaning solvents recycling
- Battery recycling
- Soiled shop towel/rag recycling
- Technician certification training
- Standardization of fluids and lubricants

These waste minimization and pollution prevention initiatives have decreased the amount of waste and pollution generated at the facility, while reducing costs and liability. Detailed descriptions of these programs and the benefits derived from each are presented.

BUILDING MAINTENANCE AND CRAFTS: IMPLEMENTING WASTE MINIMIZATION/POLLUTION PREVENTION PROCEDURES

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Argonne National Laboratory-East (ANL-E) contains 25 major buildings. Maintenance activities in these buildings are performed and managed by Plant Facilities and Services-Building Maintenance and Crafts (PFS-BM&C). PFS-BM&C has developed waste minimization/pollution prevention (WMin/P2) procedures that have substantially reduced the amount of waste, pollution, labor, and cost associated with specific PFS-BM&C activities. Two WMin/P2 initiatives are summarized below.

Buildings at ANL-E are equipped with units to chill water for use in laboratory research and/or for cooling. These units are used seasonally and in the past have required extensive winterization to prevent damage from cold temperatures. Specifically, PFS-BM&C staff had to drain water from all chilled-water coils and replace it with glycol. This procedure freeze-protected the coils throughout the winter. However, the glycol caused maintenance problems within the coils and generated large amounts of glycol wastes when the units were put back into service in the spring. Therefore, PFS-BM&C developed and implemented a procedure that eliminates the use of glycol. The procedure modifies the coils of each unit so that a minimum flow of chilled water can be maintained through the coils in the winter. The minimum water flow freeze-protects the coils without adding glycol or other chemicals and maintains the integrity of the closed-coil system. This procedure eliminates the purchase of hundreds of gallons of glycol each year and, as important, eliminates the generation of waste glycol by the same amount. This procedure decreased the Laboratory's costs for the purchase and disposal of glycol and dramatically reduced labor costs for this essential seasonal activity.

Buildings at the Laboratory contain mechanical equipment (such as compressors, chilled-water units, and motors) that requires routine maintenance. In the past, a maintenance schedule determined the frequency of mechanical equipment service. One aspect of routine maintenance is the removal and replacement of oil on a routine basis (i.e., quarterly). To reduce the amount of waste oil generated through routine maintenance, PFS-BM&C developed and implemented a procedure for regular sampling of mechanical equipment oil to determine whether oil removal and replacement are necessary. Oil is not removed or replaced until an analysis determines that the standard grade of oil has significantly diminished. The oil sampling procedure reduced the amount of oil purchased by

PFS-BM&C and the amount of waste oil generated from routine maintenance activities. In addition, the oil sampling procedure reduced the labor-hours required to perform these maintenance activities.

POSTER SESSION — 2
2:00 – 5:00 p.m. Wednesday

SOLVENT SUBSTITUTIONS

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Hazardous chemicals, such as toluene, acetone, Freon TF, and Hercules, used in cleaning operations in various crafts shops were replaced with nonhazardous solvents. Three new solvents were purchased from Safety Kleen, Inc.: Actrel PC 95 Cleaner, Premium 150, and Aqueous Cleaner. The cost of the new solvents was significantly lower than that of the hazardous solvents, and the price included the cost for recycling the spent solvent. In addition, the nonhazardous solvent exhibited a longer cleaning life than previously used solvents. This project is estimated to save the Pantex Plant more than $700,000 over the next two years.

DIGITAL PHOTOGRAPHIC EQUIPMENT

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Pantex Plant has eliminated wet photography processing by purchasing digital photographic equipment. A quality photographic print or transparency can be produced by adding digital (filmless) cameras and a high-quality computer scanner and then printing the images to a printer. The negative image is captured on a compact disk; therefore, the image could be stored many years without fading or changing. Other benefits include (1) elimination of Resource Conservation and Recovery Act hazardous waste and associated waste handling, (2) elimination of permitting and inspection requirements, (3) elimination of process/rinse water, (4) risk reduction to personnel (eliminating hazardous materials), and (5) reduction in cycle time for prints. This project is expected to save Pantex more than $711,000 over the next two years.

INDUSTRIAL X-RAY FILM PROCESSING

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The Quality Control Department has developed industrial X-ray film manually since the 1940s. The manual film processing station consisted of a large stainless-steel sink divided into two 40-gal sections. The first section held three smaller 10-gal tanks of working solutions consisting of developer, fixer, and stopbath. Once the three film processing tanks were filled and placed in the first 40-gal section, the section was filled with water. The water circulated around the small processing tanks, maintaining the chemicals at the proper processing temperature of 68°F, and also prerinsed the film between each processing tank. The second half of the workstation was a water bath for washing the processing chemicals off the film. Both sections were filled with water through a mixer valve that kept the water at 68°F and had a water flow exchange rate of eight times per hour.

The 10-gal solutions of developer, fixer, and stopbath were depleted through the film processing process, oxidation, and "carry-over" effects during film developing operations. When the solutions were depleted to a certain level, they were either replenished by adding solutions or disposed of, with new chemicals then being mixed. This 50-min processing cycle used 30 gal of chemicals (working solutions) and 400 gal of water.

An NDT M film processor was purchased for two reasons: reducing the amount of photographic waste generated and expediting film processing. The NDT M uses developer, fixer, and water for film processing, thus eliminating two chemicals — stopbath and replenisher. Only 5 gal of developer and fixer are mixed when charging the NDT M system. The working solution used for both the developer and fixer is 1.7 gal, and the remainder of the solution is stored in a holding tank and added automatically, as required. The film's surface is scanned when entering the film processor, and the proper amount of chemicals is added to the working solutions on the basis of the size of the film. The processor has two water tanks (0.3 and 1.7 gal) and uses 0.2 gal per minute during operation. The total operating or developing process for one piece of film is 8 min from start to finish, with a total water consumption of 1.6 gal.

By purchasing the NDT M, the Quality Control Department reduced the amount of photographic waste chemicals generated by approximately 80% and the amount of water used by approximately 99%. The drastic reduction in photographic waste generated made this a high-priority project and

one of great interest to the Lockheed Martin Energy Systems Pollution Prevention Project Management.

POLLUTION PREVENTION OPPORTUNITY ASSESSMENT PROGRAM AT THE SAVANNAH RIVER SITE

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The Savannah River Site (SRS) is a 300-mi^2 U.S. Department of Energy (DOE)-owned, contractor-operated site in southwestern South Carolina. The SRS was constructed in the early 1950s to produce defense-related nuclear material. Currently, the primary missions of the site are waste and nuclear materials management, environmental restoration, and technology transfer. In fiscal year (FY) 1995, an integrated effort to implement a comprehensive, aggressive sitewide pollution prevention/waste minimization (WMin) program was initiated. The site has 16,000 workers, primarily in the industrial core of the site, and is made up of 50 different waste generating organizations that contributed to the 650,000 ft^3 of radioactive waste generated in 1995. Forecasts for FY 1996 predict generation of more than 600,000 ft^3 of radioactive low-level waste (LLW), with packaging, transportation, and disposal costs exceeding $24 million.

One of the first efforts initiated as part of the SRS WMin effort was the pollution prevention opportunity assessment (PPOA) program. In FY 1995, the WMin team from Westinghouse Savannah River Company, SRS management, and its operating contractor kicked off the program by conducting 78 PPOAs that identified 105 different WMin options. Options were identified for LLW and transuranic, hazardous, and mixed waste. If all of these options were implemented, up to 335,974 ft^3 of waste avoidance and associated costs would yield savings in excess of $9 million.

The identified options were further analyzed and ranked for implementation on the basis of potential costs savings, waste avoidance, and implementation cost. As of January 1995, 17 options had been implemented in site facilities; estimates for waste and cost avoidance are 36,238 ft^3 and $1.86 million respectively. At this time, 20 more options are in various stages of implementation at the facilities, and 84 options are being analyzed. Options with a high potential for success and no funding source will be prioritized for funding from the Set Aside Fee program recently implemented

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* Westinghouse Savannah River Company.

at SRS. The success of the PPOA program at SRS to date can be attributed to increased generator awareness and ownership for not only implementing the options previously identified, but for incorporating PPOAs as a way of doing business and reducing waste generation in their facilities.

REPLACEMENT OF LEAD SEALS WITH PLASTIC SEALS ON PRESSURE RELIEF VALVES

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Pressure relief valves are required on water, steam, and air high-pressure systems throughout industry to prevent accidents due to the system(s) overpressurizing. Manufacturers of pressure relief valves have a variety of styles and sizes of adjustable pressure settings that can be made without disassembling the valve. Such valves are required by ASME code to be sealed after being adjusted, which prevents unauthorized pressure adjustments.

The body and adjustable part of the valve have a small hole drilled completely through them, which allows a thin wire to be drawn through. The wire is passed through each piece of the valve, and the ends of the wire are then inserted into and through a tamper-proof disk seal. These wires are twisted together and fed back through the top of the seal. Once the wire has been properly fed into the seal disk, the disk is "sealed," locking the wire in place. This sealing process produces a closed-loop seal that prevents the valve from being adjusted without breaking the wire or seal.

Traditionally, manufacturers and testing facilities use lead disk seals (7/16 in. diameter × 5/32 in. thick) and hand presses to accomplish this task. The 26 gauge wire is inserted into the two small holes in the lead disk and "sealed." The press embeds the wire in the soft lead disk, making it impossible to open and reseal. The problem with using lead seals is that they generate approximately 11 lb of Resource Conservation and Recovery Act (RCRA) waste per year.

A year ago, a search was initiated for a replacement seal disk that was not a RCRA waste but would still seal the wire, forming a closed tamper-proof sealing system. Several plastic and metal self-locking seals were available on the market; however, none had small enough straps to go through the small holes of the relief valves. Further investigation showed that the vendor of our lead seals handled the plastic seals but did not advertise them.

The vendor sent samples of the plastic seals, indicating that they were not recommended for use with petroleum chemicals or at temperatures above 250°F. The plastic seals were distributed to the three sites operated by Lockheed Martin Energy Systems in Oak Ridge, Tennessee, for evaluation in comparison to the lead seals in use. The response was unanimous. The plastic seals could be used in at least 95% of our applications.

The plastic (TPC COSOTHENE) seals are 3/8 in. diameter × 5/32 in. thick and pliable enough to mold around and secure the wire when sealed. An immediate cost savings of $6.87 per 1,000 seals makes these seals more cost-efficient. The plastic seals can also be sealed by using the same hand press as used with the lead seals, and best of all, they are not a RCRA waste.

OPTIMIZING THE DESIGN AND PACKAGING OF A TYPE A DISPOSAL CONTAINER FOR TRITIUM

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The Tokamak Fusion Test Reactor is a one-of-a-kind tritium fusion research facility that uses deuterium-tritium gas mixtures to develop high energy plasmas for energy production and physics analysis. The exhaust gas from the plasma research is processed by using vacuum pumping systems, holding tanks, catalysts, and molecular sieve beds. As a result, the tritium oxide is absorbed onto the molecular sieve beds within stainless steel containers. These containers are characterized for total tritium oxide (water form) content during processing and removed from the system for packaging as radioactive waste. Two container designs were developed and fabricated for U.S. Department of Transportation (DOT) Type A and B quantities of tritium.

The original Type A container design encompassed system parameters, transportation requirements, and disposal site requirements. The quantity of tritium within the Type A container exceeded the Westinghouse Hanford disposal site requirements that specified the use of a high-integrity container (HIC) overpack for these quantities. The Type A container was placed inside a Type A 55-gal drum to meet DOT requirements prior to being packaged in the HIC. This satisfied all but the system requirements, which were the least difficult of the total design.

The Waste Management Branch at Princeton Plasma Physics Laboratory determined that a more cost effective, improved design and packaging scheme was possible for the Type A quantity container. A small group, including representatives of several disciplines, evaluated and redesigned the container and its packaging requirements. The redesign resulted in significant cost savings through material changes, simplified fabrication, and fewer components. Increased water loading capacity was also a primary objective of the new design. This change provided an additional waste minimization benefit by reducing the total number of disposal containers required. The packaging configuration also reduces burial volumes and requires less material to fabricate.

This paper discusses the process used for redesigning these containers. This process includes the design change process, material selection, container fabrication, pressure testing, and overall shipping package testing to assure compliance with U.S. Department of Energy and burial site requirements and regulations. The paper also shows the derived cost benefits from this redesign.

PROCESSING LIQUID SCINTILLATION VIALS

Keith Rule and Robert Cislo
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The Princeton Plasma Physics Laboratory (PPPL) conducts fusion research in support of domestic and international research for a safe, alternative energy source. The Tokamak Fusion Test Reactor and associated facility uses deuterium-tritium gases to fuel fusion reactions for high energy plasma physics research. These fusion reactions produce radioactive contamination that requires both environmental and facility radiological monitoring for tritium. The predominant detection method for tritium is liquid scintillation counting, which requires the use of vials and scintillation fluid. PPPL uses glass vials and Optima Gold™ scintillation fluid to measure tritium contamination in surface smears and various liquid and air samples.

In the past, these vials were collected in 55-gal drums for final disposal at approved vendor facilities. This process was labor-intensive and had high packaging, transportation, and vendor costs.

The Waste Management Branch at PPPL reviewed options for reducing each of these costs. First, the volume of waste generated was reduced by using smaller vials. Second, labor was reduced by crushing these vials on-site. Third, vendor costs were eliminated by separating the fluid from the glass and releasing it to sanitary sewer under an existing permit. A commercial glass crusher was

modified by the vendor to accommodate the small containers in use, separate the liquid scintillation fluids, and mate with a drum collection device. This system provides a safe means to crush and collect the crushed glass vials and separate the liquids. The crushed glass designated for burial is used as a void space filler in other radioactive waste containers. This paper describes the equipment and procedures that accomplish this waste minimization success and identifies the associated cost savings.

CERTIFIED REFERENCE MATERIALS

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The New Brunswick Laboratory (NBL), as the U.S. government's nuclear reference materials laboratory, provides certified reference materials to meet the analytical needs of the nuclear safeguards community. NBL is replacing six uranium isotopic reference materials. The form of the reference materials is being changed from a solid oxide to an ampulated solution. The uranium concentration of the solution is suitable for immediate loading into a thermal ionization mass spectrometer. The form and reduced quantity of materials packaged in each unit allow customers to minimize waste generated from sample dissolution steps. NBL also has prepared a uranyl nitrate reference material, CRM 145. This material is useful for qualification and calibration of low-level uranium instrumentation. Again, smaller quantities of this material were packaged to minimize waste generation.

DEVELOPMENT OF PLUTONIUM ISOTOPE DILUTION MASS SPECTROMETRY FOR ROUTINE ANALYSIS

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The plutonium isotope dilution mass spectrometric method was successfully tested and developed for routine laboratory use. Proper choice of apparatus and experimental methodology led to considerable waste minimization. The small sample size required for this analysis also permits easier shipment of plutonium samples. This project involved developing standardized analytical procedures and quality control samples. Two different methods of isotopic equilibration, hydrogen peroxide and ferrous ion, were tested and qualified. No statistically significant difference surfaced between the two methods. The hydrogen peroxide method will be used for relatively pure samples, and the ferrous ion method will be used for less pure samples. The mean percent relative difference of less than 0.25% is of suitable quality for most nuclear safeguards measurements.

A COMPUTER-BASED SYSTEM FOR PRIORITIZING POLLUTION PREVENTION OPPORTUNITY ASSESSMENT AT SANDIA NATIONAL LABORATORIES

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Sandia National Laboratories/New Mexico (SNL/NM) is a multiprogram science and engineering organization with several hundred independent processes that produce thousands of waste streams. Prioritizing waste generators is necessary to determine an efficient, logical order in which to conduct pollution prevention opportunity assessments (PPOAs). The PPOA ranking system discussed here runs on a personal computer in Microsoft Access™. The system uses a multimedia approach by

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* Ogden Environmental and Energy Services Company, Inc.

considering hazardous and radioactive waste disposal, hazardous chemical usage (from which air emissions are extrapolated), and water discharges. Pollution prevention (P2) information is included from the SNL Pollution Prevention Opportunities database, which identifies waste streams that have readily apparent P2 opportunities. The system also considers the relative costs of waste management and the chargeback fees paid for waste generation. From this information, organizations are ranked. Although this system is designed primarily for use by the Pollution Prevention Program, it can be used by other departments at SNL/NM that need to rank waste generators sitewide. The concept is simple, effective, and easily transferable to other U.S. Department of Energy sites that need to decide where to perform PPOAs.

SUBSTITUTION AND RECYCLING OF AQUEOUS CLEANERS TO REPLACE SOLVENTS IN A FABRICATED METALS PROCESS — A CASE STUDY

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Harris Corporation operates a plant that manufactures radios and television transmitters in Quincy, Illinois. The process used to manufacture the cabinets that housed these products incorporated vapor degreasing with methyl chloroform to clean the cabinets before painting. In a short-term effort to comply with the Clean Air Act, Harris began to use methyl ethyl ketone for degreasing parts. The corporation recognized the need to change to aqueous cleaning and worked with the Hazardous Waste Research and Information Center to develop an appropriate substitution process for the existing vapor degreasing method.

Bench- and pilot-scale testing was determined the appropriate process steps required to convert this facility from vapor degreasing to aqueous cleaning. This evaluation included determining such critical parameters as agitation and drying methods. Additionally, an evaluation of a suitable ultrafiltration system for recycling the aqueous cleaning solution was made.

On the basis of this testing, Harris implemented an aqueous degreasing process and an ultrafiltration recycling system in the facility. The reduction in hazardous waste generation and the resulting cost savings realized by Harris corporation are summarized.

USE OF THE U.S. DEPARTMENT OF ENERGY'S REPORTABLE EXCESS AUTOMATED PROPERTY SYSTEM TO OBTAIN AND REUSE EXCESS PROPERTY

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The Reportable Excess Automated Property System (REAPS) database offers a centralized information point for U.S. Department of Energy (DOE) excess property. Individual users can access and search the database through the Internet. Once equipment is identified, final transfer of the property is coordinated through the site property office where the equipment is located. The list is updated by all DOE offices as soon as any equipment or property is identified as excess.

Reuse of property from other DOE sites reduces idle inventories and maximizes its "useful life." Using the database not only eliminates the time and cost of procuring new or additional assets, but also eliminates disposal costs associated with property in a usable condition. This method is the most efficient way of recycling and reusing property and equipment owned by the government.

According to DOE Regulations 109–43, all efforts should be made to see if new requirements can be met by using DOE-owned property, if such items are available. Furthermore, these regulations state that efforts to locate such property should also include direct inquiries. The regulations make clear that it is DOE policy "to consider excess property as the first source of supply," and the starting point is a review of the REAPS database.

On the basis of the number of sites with similar missions and projects within DOE, many opportunities exist for reusing major equipment. For example, many sites require major excavation equipment during remediation. However, the durations of individual projects are not typically long enough to utilize the entire "useful life" of the equipment. Therefore, at the end of the project, the equipment is either indefinitely stored or excessed through the REAPS database.

This presentation provides information about REAPS, which, at this time, is an underutilized resource within DOE. The presentation should heighten individual awareness that sites should not only search the database for useful equipment, but also continuously survey sites to promptly identify and report excess property available for use elsewhere. Also noted is the use of GSA's FED/SCREEN system, which may eventually become a standard for all government departments.

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