

15

Pollution prevention in the U.S. Defense Department

Joseph Laznow, CCM, QEP, REA and Matthew P. Hanke, CQE***

* Director, Environmental Programs, ADI Technology Corporation

** Environmental and Engineering Services Manager, ADI Technology Corporation

15.1

Introduction

The Department of Defense (DoD) has long relied on “end-of -pipe” solutions to control and mitigate the effects of using environmentally harmful materials and processes. Pollution prevention, which addresses the reduction of pollution at the source, provides a more efficient and effective means for DoD to protect the environment. Pollution prevention options include conservation of energy, water and other natural resources; elimination or reduced use of hazardous materials; and pollutant reduction and recycling techniques. Implementation of pollution prevention programs has been effective in supporting a primary mainstay of DoD’s function, i.e., deterrence, by enhancing operational readiness, quality of life, and weapon system modernization goals.

Integrating pollution prevention at DoD military installations has resulted in reducing health and safety risks to personnel and surrounding environs while protecting facility natural and cultural resources. Pollution prevention activities have resulted in economic benefits by eliminating rather than controlling or cleaning up costly pollution problems and improving the effectiveness of other DoD operations, maintenance, and procurement budgets through more efficient use of materials and resources. Integrating pollution prevention into developing new or upgrading existing weapon systems has resulted in enhancing operational readiness. This has been accomplished by minimizing the environmental challenges associated with every stage of the life-cycle of a weapon system, in implementing process improvements to increase productivity and quality, in protection of human health, in improvement of operational performance, and in the significant reduction of the life-cycle costs.

In testimony before the Senate Armed Services Subcommittee on Readiness, Sherri W. Goodman, Deputy Under Secretary of Defense (Environmental Secu-

ity) indicated that pollution prevention is the core of DoD's environmental protection efforts. "Only by reducing or eliminating hazardous materials and those processes that generate hazardous byproducts can DoD begin to lower overall compliance and cleanup costs."

15.2

DoD pollution prevention mission and implementation policies

The DoD's environmental strategic goal has been developed in accordance with the requirements of the Pollution Prevention Act of 1990 (PPA), the Federal Facilities Compliance Act (FFCA), the Emergency Planning and Community Right-to-Know Act (EPCRA), and Executive Orders (EO) 12088, 12856, 12873, and 13031. The DoD pollution prevention policy is published and implemented through DoD Instruction 4715.4 and DoD's pollution prevention goals.

In the past decade, DoD has established a new vision and program direction, making pollution prevention the preferred approach to environmental management across all DoD activities and in all phases of acquisition, design, operations, maintenance, support and the ultimate disposal of its weapon systems. This approach ensures that pollution prevention is implemented over the entire weapon system life-cycle. It is DoD's policy to reduce the use of hazardous materials, the generation and/or release of pollutants, and the adverse effects on human health and the environment caused by its operations and activities.

It is DoD's policy to prevent, mitigate, or remediate environmental damage caused by weapon system acquisition programs. DoD has concluded that prudent investments in pollution prevention can reduce life-cycle environmental costs and liability while improving environmental quality and program performance. Such pollution prevention activities include process efficiency improvements, material substitution, preventive maintenance, improved house-keeping and inventory control.

DoD program goal for pollution prevention

- Comply with all legal requirements by promoting pollution prevention as the preferred means of achieving environmental compliance.
- Protect human health and the environment by reducing the use of hazardous materials to as near zero as possible.
- Reduce costs by integrating cost-effective pollution prevention practices into all DoD operations and activities, while ensuring performance of DoD's mission.

DoD pollution prevention objectives

- Effectively promote and instill the pollution prevention ethic through comprehensive education, training and awareness in all mission areas.
- Incorporate pollution prevention into all phases of the acquisition/procurement process.

- Achieve and preserve environmental quality for all activities, operations, and installations through pollution prevention.
- Develop, demonstrate and implement innovative pollution prevention technologies.

Each branch of the Armed Forces has established specific pollution prevention goals and milestones. Pollution prevention applies to all phases of the life-cycle process, and is required to be fully integrated into an activity's or organization's thought processes and work habits. A carefully managed and effective pollution prevention program can produce tangible results including cost and labor-hour savings, and reduces the compliance challenges that activities and organizations face.

The DoD is required to comply with all the traditional end-of-pipe regulations required of the private sector. DoD is also guided by additional pollution prevention requirements in managing its environmental quality programs. The primary legal drivers for the DoD pollution prevention program are EPCRA, PPA, and FFCRA. Taken together with the following international treaties and EOs, federal agencies are now required to conduct pollution prevention planning, practice source reduction, increase recycling, implement cost effective waste reduction practices, and make sound life-cycle decisions.

- International treaties, such as the 1978 International Convention for the Prevention of Pollution from Ships or Maritime Pollution Protocol (MARPOL) restrict disposal of shipboard wastes into the sea, and the Montreal Protocol bans most production of ozone-depleting halons, solvents, and refrigerants.
- Executive Order 12088, Federal Compliance with Pollution Control Standards, requires federal agencies to cooperate with the U.S. Environmental Protection Agency (EPA), States, and local agencies in the prevention, control and abatement of environmental pollution.
- Executive Order 12856, Federal Compliance with Right-to-know Laws and Pollution Prevention Requirements, requires federal agencies to comply with the provisions of EPCRA and PPA. DoD facilities and acquisition activities must put policies and practices in place which emphasize pollution prevention as the alternative of first choice in how they achieve compliance with existing regulations and requirements.
- Executive Order 12873, Federal Acquisition, Recycling, and Waste Prevention established requirements for the procurement of products containing recovered materials and environmentally preferable and energy-efficient products and services.
- Executive Order 13031, Federal Alternative Fueled Vehicle Leadership, which along with the Energy Policy Act of 1992, requires the purchase and use of alternatively fueled vehicles (AFV) for federal motor fleets.

DoD is also guided by State, regional, and local requirements, such as local recycling mandates that require reductions in solid waste generation, and state re-

quirements to reduce or report on the use of toxic materials. Clean Air Act (CAA) mandated State Implementation Plans, which establish guidance for the reduction of air emissions in nonattainment areas, are also a consideration.

15.2.1

Pollution prevention objectives and metrics

In 1996 DoD issued a Pollution Prevention Instruction (4715.4) collating all existing DoD pollution prevention policies. This document provided the first comprehensive presentation of DoD's pollution prevention program's objectives, metrics, regulatory and legal requirements, roles and responsibilities.

Key objectives of the Instruction included a requirement for all DoD installations worldwide to have written, publicly available plans detailing how the installation would reduce pollution to air, land and water and requirements for all installations to operate recycling and composting programs. Most significantly, the document required pollution prevention to be incorporated into all phases of a weapon system's life-cycle.

The Instruction codified specific indicators to measure progress in meeting DoD's pollution prevention goals. When developing these metrics, DoD considered regulatory, legal and other requirements; significant environmental impacts; technological options; financial, operational and business requirements; and opinions and comments from stakeholders.

Pollution prevention metrics and objectives

- Toxic Release Inventory: Reduce toxic releases and off-site transfers 50% by Calendar Year 1999 (CY99), from a CY94 baseline.
- Hazardous Waste Disposal: Reduce the quantity of hazardous waste disposed of by 50% by CY99, from a CY92 baseline.
- Solid Waste Disposal: Reduce the quantity of nonhazardous solid waste disposed of by 50% by CY99, from a CY92 baseline.
- Solid Waste Recycling: Increase the recycling of nonhazardous solid waste by 50% by CY99, from a CY92 baseline.
- Alternatively Fueled Vehicles (AFV): Increase acquisition of nontactical (general purpose) AFVs to 75% by Fiscal Year 1999 (FY99).

15.3

DoD's unique pollution prevention attributes and considerations

DoD has developed a strategy to implement projects and actions to meet its pollution prevention goals and work toward its stated pollution prevention vision. In general, the DoD strategy is to thoroughly review available pollution prevention opportunities, identify alternatives, evaluate the life-cycle costs of all alternatives, focus on the opportunities that demonstrate the best short-term and

long-term return on investment (ROI), and select opportunities that best balance cost and environmental performance.

15.3.1

Installation/facility operations

Executive Order 12856 and DoD's Pollution Prevention Instruction require all DoD installations worldwide to develop and routinely update their pollution prevention management plans. These plans call for an opportunity assessment, whereby the installation identifies all of its pollutant sources and defines opportunities (including the introduction of new materials, technologies, or management techniques) to reduce or minimize hazardous and nonhazardous wastestreams. The installation is also responsible for developing a prioritization roadmap and implementing pollution prevention projects to reach its goals. This planning effort provides the basis for DoD's pollution prevention budget requests, and also guides its research and development programs.

To assist installations in developing their pollution prevention plans, the DoD components have employed a variety of tools. For example, the Air Force has developed "Model Shop Reports," or prototype opportunity assessments for specific operations, such as Flightline Maintenance or Transportation shops. Each operations-specific model shop report can assist the applicable shop personnel in identifying typical raw materials used, potential wastestreams, processes to be examined, potential alternatives to be evaluated, and cost data. The report also provides guidance on how to implement the pollution prevention options. The Navy has also developed model pollution prevention plans for its industrial facilities, providing criteria, guidance and examples for installations to use in developing their pollution prevention plans.

The Navy's "P2 Afloat Program" has established prototype ships on each U.S. coast to demonstrate model pollution prevention programs. Each prototype establishes a hazardous waste baseline and demonstrates pollution prevention technologies and best management practices to reduce shipboard waste. The aircraft carrier USS CARL VINSON is one ship prototype for the program. The ship's crew plays a major role in helping reduce hazardous and other wastes by implementing new pollution prevention initiatives. The ship now recycles over 75% of its hazardous materials and has the lowest waste disposal cost of any aircraft carrier in the Pacific Fleet.

Toxic Release Inventory (TRI) data have become valuable in pollution prevention planning efforts. At Tinker Air Force Base (AFB), Oklahoma, for example, the installation's top TRI chemicals and the processes responsible for use of these chemicals were identified, pollution prevention opportunity assessments were conducted, and a roadmap to implement the findings of that assessment was created. This resulted in the most effective use of available funds, a positive impact on the mission, and increased worker health and safety.

The overall Tinker AFB TRI reduction roadmap projected an 88% reduction in TRI releases by CY99. Tinker's top TRI chemical, methylene chloride, is ex-

pected to be reduced by over 96% with the implementation of 6 new pollution prevention projects between 1994 and 1999. The first project, installation of high-pressure water blast robotic technology for aircraft component stripping (ACS), has eliminated about 15% of the use of the toxic solvent. Quantifiable benefits to the ACS operation thus far include: a financial savings of about \$1.3 million per year, a 30% reduction in worker turnover rate, reduced turnaround time per aircraft component, reduced occupational illnesses, reduced personal protective equipment requirements, and reduced safety hazards.

The Navy has established the Fleet Assistance Support and Technology Transfer (FASTT) mission to assist in finding opportunities to reduce the cost associated with environmental compliance and improve maintenance work processes using the best technology and management practices available. The FASTT Team uses on-site surveys to bring together engineers, scientists, maintenance personnel, and process improvement specialists from a wide variety of commands to focus on unique problems at individual installations. This approach involves an assessment of maintenance processes, hazardous materials usage, hazardous waste generation and local environmental requirements. Based on on-site observations and interviews with process operators, pollution prevention opportunities are developed which can protect the environment and reduce workload and operational costs. The collective experience gained during site surveys, combined with continuous recruitment of new members, has led to an ever-broadening pool of the Team's technical knowledge.

The FASTT Team has performed surveys at numerous naval activities and has expanded its role to include Air Force and Army installations. These visits have resulted in the formal preparation, documentation, and presentation of over 450 recommendations intended to increase the efficiency of a wide variety of maintenance processes that can assist the Navy and DoD in attaining its pollution prevention goals. FASTT efforts have resulted in a cumulative potential ten-year cost avoidance in excess of \$90 million since the Team's inception in 1993. The overall ROI is in excess of 50 to 1. The net savings identified by FASTT and used to calculate the ROI includes the cost to procure, install, and provide training for any equipment required and also accounts for labor, maintenance, and other operational costs associated with implementing the recommended initiatives.

15.3.2

Weapon systems acquisition (life-cycle costing)

The DoD's ability to maintain readiness is linked to modernization and minimization of infrastructure costs. The strategic focus of the defense acquisition and technology program is on force modernization, fielding superior operational capability and reducing weapon system life-cycle costs. An important element of DoD's strategy to reach these goals is ensuring that consideration of environmental, health, and safety (EH&S) issues is fully integrated into a weapon system's entire life-cycle. DoD implements this strategy by ensuring that each program's EH&S life-cycle effects and costs are understood and considered throughout the process.

DoD has been successful in reducing costs of environmental compliance and cleanup through sound pollution prevention initiatives. By conducting systematic assessments and cost data analyses early in the planning stages and the engineering and manufacturing phases of the weapon system life-cycle, DoD has been able to decrease the life-cycle costs and develop a more effective environmental management program. DoD studies indicate that the Operation and Support (O&S) phase of the life-cycle process accounts for at least 80% of the hazardous materials generated by weapon systems. The opportunities for applying pollution prevention efforts at this phase are significant. Additional studies indicate that environmental costs can encompass up to 15–30% of a weapon system's life-cycle costs.

The DoD has made significant progress in implementing acquisition reform initiatives that enhance pollution prevention in the weapon system acquisition process. Actions that reduce hazardous materials or that eliminate the need to follow command and control rules and regulations will produce savings in acquisition and O&S costs. These initiatives include the following:

1. Streamline acquisition management. DoD has issued new, streamlined acquisition policies. In addition, DoD has developed the Defense Acquisition Deskbook. The Deskbook is an automated reference tool that provides acquisition information for all DoD components across all functional disciplines. It contains standard practices and practical advice for environmental professionals. The Deskbook provides access to current mandatory directives, guidance, advice, and software tools. For example, one section describes the purpose and typical content of the “programmatically EH&S evaluation” that each weapon system's program must develop. Another section offers recommendations on how to include a hazardous materials management program in a weapon system's contract. A third provides advice on how environmental studies conducted to meet the requirements of the National Environmental Policy Act (NEPA) can enhance pollution prevention efforts.
2. Integrated Product Teams. DoD environmental staff actively participates on Integrated Product Teams (IPT) for many of the major acquisition programs. An IPT is a multidisciplinary team of experts from all DoD communities and includes customers and suppliers. This participation ensures that weapon system program managers provide early and continuous consideration of environmental issues, rather than after-the-fact oversight that had been common in the past.
3. Use cost as an independent variable. The Army has developed an “activity-based costing” methodology as a tool for identifying a weapon system's life-cycle environmental costs. The methodology helps program managers better predict what environmental issues drive significant O&S costs and make better decisions in designing and developing weapon systems.

4. Reform military specifications. DoD initiated the Toxic Reduction Investment and Management (TRIM) pilot program to identify and revise the military specifications that require the greatest use and ultimate release of toxic chemicals. DoD plans to expand the TRIM program to include all DoD installations that submit TRI reports.
5. Single Process Initiative (SPI). SPI is an important tool that will afford the opportunity for contractors to eliminate separate production lines for their military and commercial products. Separate production lines have increased DoD's costs to produce weapon systems and often require the use of greater quantities of hazardous materials per military specifications and standards. The SPI is an expedited process for testing and validating new alternative processes so that they can become acceptable to multiple program managers. The DoD Joint Group on Acquisition Pollution Prevention (JG-APP) is partnering with major defense contractors to reduce the use of toxic chemicals used in weapon system manufacturing processes through the SPI program.

The Environmental Technology Team at the U.S. Army Missile Command Research, Development and Engineering Center, for example, has incorporated pollution prevention into the systems engineering process. This was accomplished by developing new source selection evaluation criteria, participating on Integrated Product Teams, reviewing trade-off studies and recommending alternative materials and processes that will result in reduced pollution. A similar environmental team from the Air Force's Kelly AFB, Texas won the 1996 Secretary of Defense Weapon System Pollution Prevention Team Award for revising aircraft maintenance technical orders which had required the extensive use of hazardous materials and for incorporating pollution prevention into its program management business practices.

15.4

Installation/facility pollution prevention accomplishments

In FY97, DoD invested about \$244 million in pollution prevention. About \$64 million or 26% of the pollution prevention investment was spent on recurring costs, or those routine activities required to support the mission and maintain compliance at an installation, such as running a recycling program or TRI reporting. The remaining \$180 million or 74% was spent on one-time, nonrecurring projects such as the purchase of new pollution prevention technologies.

Hazardous material, hazardous waste, solid waste, clean air and clean water requirements are DoD's biggest cost drivers. These are also the areas of greatest emphasis in the pollution prevention program. FY97 pollution prevention expenditures by media (see Fig. 15-1) indicate that about 40% of the nonrecurring funds were used to reduce the generation of hazardous material, including releases reported under the TRI program. About 13% of the funds went to reduce

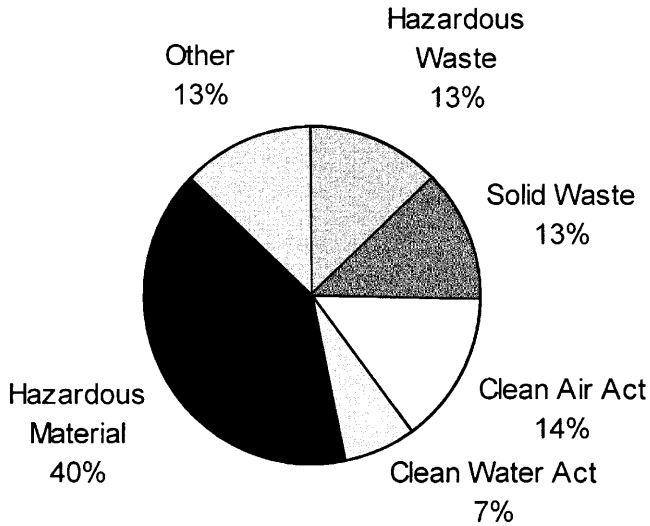


Fig. 15-1 FY 97 nonrecurring pollution prevention investment by media

hazardous waste and about 14% were used to reduce CAA pollutants, including the use of ozone-depleting substances (ODS). Additionally, about 12% of the funding were used to reduce generation of solid waste and establish recycling programs and about 7% went to reduce Clean Water Act pollutants. The remaining 13% went for other miscellaneous efforts.

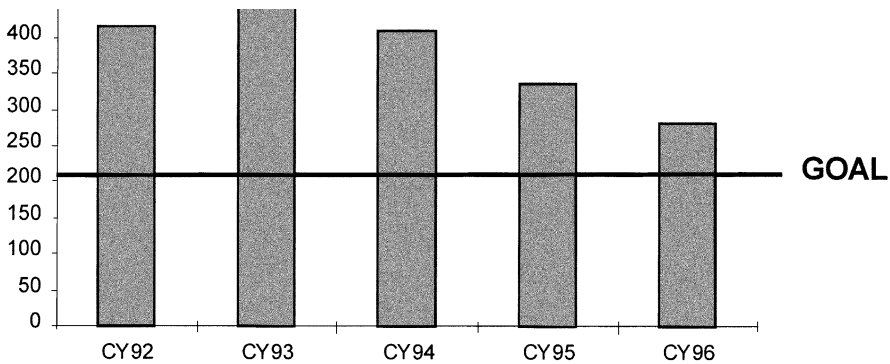
15.4.1 Hazardous materials and toxic chemicals

The DoD has made significant progress in reducing the use and release of toxic chemicals and hazardous materials to all media. One of DoD's key pollution prevention metric is the reduction of hazardous waste because of the high costs and potential liability associated with its handling and disposal. DoD has made significant progress toward its goal to reduce the amount of hazardous waste it disposes. From CY87 through CY92, DoD met its first goal to reduce hazardous waste disposal by 50%. After CY92, DoD expanded its definition of hazardous waste counted in the metric and established a new 50% reduction goal, using CY92 data as the baseline. Since 1992, hazardous waste disposal within DoD declined from approximately 415 million lbs. to about 283 million lbs., or some 32% (see Fig. 15-2). Information on the annual hazardous waste disposal by individual DoD component is provided in Table 15-1.

Table 15-1 DoD components: hazardous waste disposal

(Millions of lbs.)

	CY 92	CY 93	CY 94	CY 95	CY 96
Air Force	49	38	33	31	25
Army	60	83	67	41	44
Navy	207	223	220	181	136
Marine Corps	79	114	76	79	75
Defense Logistics Agency	20	12	15	4	3
Total	415	470	411	336	283

**Fig. 15-2** Hazardous waste disposal

The DoD components have developed numerous cost-effective tools and techniques to reduce the use and release of toxic chemicals. They generally fall into two categories: improved business practices and innovative technologies.

15.4.1.1

Improved business practices

One of DoD's most successful pollution prevention tools has been the use of improved management techniques based on centralized control and cradle-to-grave management of hazardous materials. In short, these common-sense practices of managing hazardous materials can be summed up by the phrase, "Buy what you need, use what you buy, and manage what you use."

Each of the DoD components has established significant hazardous material "pharmacy" programs at most of their major installations. The pharmacy concept is a program that establishes a single point of control and accountability for the requisition, receipt, and distribution of hazardous materials. Additional management practices include "just-in-time" delivery, exact quantity product distribution, and distribution to authorized users only. These practices have

greatly reduced purchase and handling costs of hazardous materials, reduced the amount of expired shelf materials that require disposal, reduced worker exposure to hazardous materials and potential liability from improper handling, and improved supply support to customers.

For example, under the Navy's Consolidated Hazardous Material Reutilization and Inventory Management Program (CHRIMP), every shore facility and ship inventories the locations, kinds, and amounts of its hazardous materials and establishes a central point for procuring, storing, issuing, reissuing, and eventually disposing of hazardous materials as waste. Cost avoidance throughout the Navy from the reduction of hazardous waste disposal and hazardous material procurement has been as high as \$18 million in a single year.

The most significant reductions and savings are found at the large depots, such as the Tobyhanna Army Depot, Pennsylvania. As the largest communications-electronics facility in DoD, Tobyhanna produces large quantities of hazardous waste. A new hazardous materials management program established at Tobyhanna is projected to save the depot over \$1.6 million from FY96 to FY02 as a result of a 30% reduction in hazardous material purchases alone. This is in addition to previous accomplishments in which the depot had reduced hazardous waste generation 82% and solid waste generation 74% from FY95 to FY96.

The pharmacy concept has even realized positive results from smaller activities. Four aviation maintenance battalions located at Fort Campbell, Kentucky, saved over \$100,000 in the first six months of operating a new hazardous materials control center (HMCC). The initial focus of the HMCC was to reduce inventories that contained dozens of unique and hazardous chemicals, thereby reducing the amount of hazardous materials that need to be managed and disposed of.

The benefits of establishing a hazardous materials "pharmacy" at Hill AFB, Utah, included the following:

- Elimination of 1000 tons of hazardous waste and 170 tons of air emissions
- Reduction of annual hazardous materials acquisition from \$14 million to \$4 million
- Reduction of on-hand inventory from \$2.3 million to \$0.2 million
- Reduction of supply processing time from 1 day to 15 min
- Reduction of delivery time from 25 days to 10 days
- Reduced potential for spills and worker exposure to hazardous materials

The Defense Reutilization Marketing Service (DRMS), operated by the Defense Logistic Agency (DLA) provides a major contribution to DoD's pollution prevention program. DRMS recovered and recycled over 16% of all hazardous material dispositions in FY96. The acquisition value of this property was about \$48 million and resulted in disposal cost avoidance for DoD of about \$3.6 million. A new DRMS initiative, the "return to manufacture" program, which offers surplus hazardous property to the original manufacturer or other manufacturers in lieu of waste disposal, will further reduce the disposal of solid and hazardous wastes.

The DoD is also deploying a standard software system for installations to track hazardous materials from procurement to disposal. The Hazardous Substance Management System (HSMS) tracking system provides environmental managers with a detailed picture of how and where installation personnel use hazardous materials. It supports the rapid identification of processes and materials that are potential candidates for alternative pollution prevention opportunities. It also enhances DoD's ability to comply with regulatory and legal requirements and communicate important health and safety information to its personnel and the local community.

15.4.1.2

Innovative technologies

Another keystone of DoD's pollution prevention program is the utilization of innovative technologies. DoD has recognized significant savings from both the use of relatively simple and low-cost technologies as well as the application of state-of-the-art technologies.

The DoD has widely implemented water jet technologies to reduce the quantity and toxicity of wastestreams from many cleaning and depainting operations, two of its major waste-generating activities. For example, a high-pressure water jet system is being used by the Navy to remove paint, corrosion and marine growth from underwater mines. The previous system used an abrasive media that created a hazardous wastestream and posed potential health and safety problems to workers. This off-the-shelf high-pressure water jet technology will improve the work place environment and reduce the quantity of hazardous waste generated by approximately 48,000 lbs. per year. It has resulting in a pay back of the initial investment in less than a year and a projected saving of over \$2.5 million during the 10-year lifetime of the equipment.

Tinker AFB also uses high-pressure water stripping in lieu of toxic solvents to repaint aircraft, eliminating more than 140,000 lbs. of methylene chloride, 100,000 lbs. of solid waste, and 8.3 million gallons of waste water each year. This application reduces potential worker health hazards, reduces processing time by about 21%, and has resulted in savings of over \$1 million a year when compared to the previous process.

The DoD has been, and continues to be, on the cutting edge of developing and transferring the use of new pollution prevention technologies. One of DoD's largest wastestreams is used lead acid batteries from both tactical and nontactical vehicles. Using a new technology called "sweeping pulse," DoD can extend the life of its batteries by nearly 80%. The technology is solar powered, and can be permanently mounted on vehicles, providing a safe, energy-efficient and environmentally sound alternative to the replacement and disposal of spent batteries. Army implementation of this technology at Fort Hood, Texas, and for its entire III Armored Corps is projected to reduce its battery procurement and disposal costs by more than \$2 million a year.

The DoD is also developing novel approaches to pest control and management without using toxic or ozone-depleting pesticides. An ancient Egyptian

tactic, heat, has been particularly successful. Because insects have no way of perspiring, heat quickly and effectively kills them. At Fort Knox, Kentucky, Fort Bragg, North Carolina and Fort Belvoir, Virginia, the Army heated 14 buildings to 120 degrees to kill roaches. The DLA has also successfully used heat to control termites in infested crates and boxes, in lieu of using fumigants containing ozone-depleting chemicals.

15.4.2

Nonhazardous waste reduction and recycling

Solid waste reduction and recycling programs have helped DoD cut waste, reduce costs and generate income from the sale of recyclables. Recycling programs operate at every DoD installation. Many also have composting programs in place. The DoD set goals to reduce solid waste disposal 50% and increase recycling 50% by CY99. Since 1992, solid waste disposal at DoD declined from about 10.3 billion lbs. to 6.1 billion lbs., or about 41%. Recycling increased to nearly 50%, from about 868 million lbs. to about 1.3 billion lbs. (see Figs. 15-3 and 15-4). Information on annual nonhazardous solid waste disposal and nonhazardous solid waste recycling by individual DoD component is provided in Tables 15-2 and 15-3 respectively.

The Marine Corps Recruit Depot Parris Island, South Carolina, is an example of a comprehensive recycling program at a DoD installation. The installation's recycling center recovers grease from the mess halls, used tires, used oil, paint,

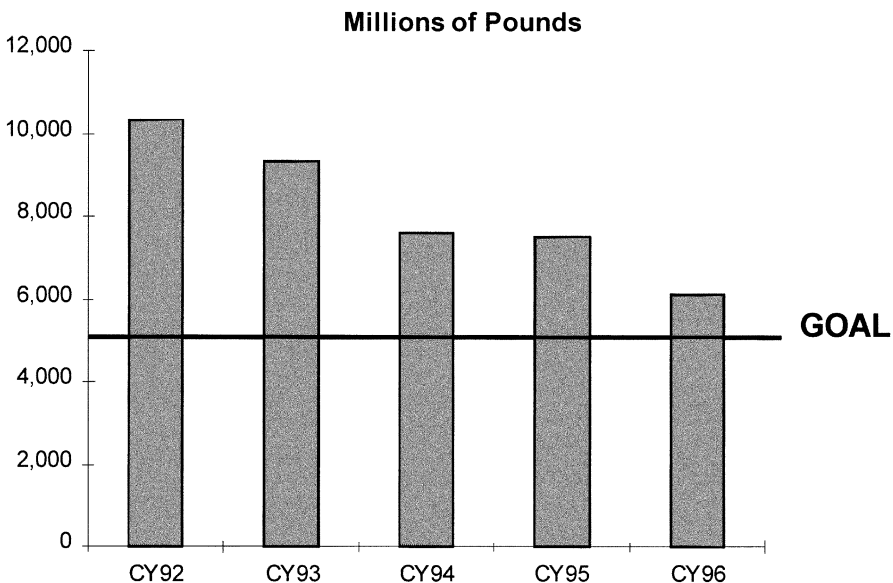


Fig. 15-3 Nonhazardous solid waste disposal

steel cans, aluminum cans, ethylene glycol, scrap metal, brass shell casings, expended grenade fuses, plastics, glass, office paper, newspaper, cardboard and pallets. The program has reduced the Depot's wastestream by about 52% in less than 2 years and reduced the demand on the installation's operating budget by about \$435,000 through reduced disposal and maintenance costs and the generation of revenue from the sale of recyclables.

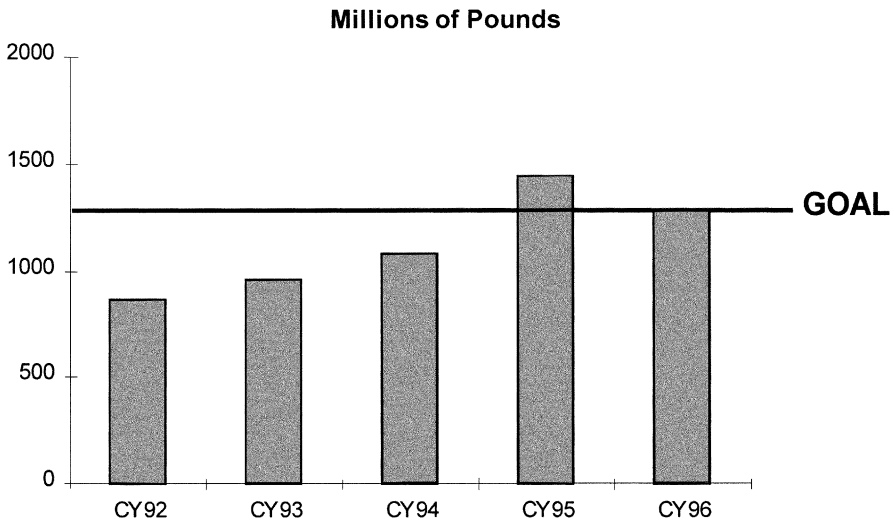


Fig. 15-4 Non-hazardous solid waste recycling

Table 15-2 DoD components: non-hazardous solid waste disposal

(Millions of lbs.)

	CY 92	CY 93	CY 94	CY 95	CY 96
Air Force	1,943	1,376	1,295	1,159	1,016
Army	6,415	6,079	4,415	4,453	3,478
Navy	1,531	1,459	1,522	1,532	1,224
Marine Corps	409	399	367	322	326
Defense Logistics Agency	1	1	29	26	76
Total	10,299	9,314	7,628	7,492	6,120

Table 15-3 DoD components: non-hazardous solid waste recycling

(Millions of lbs.)

	CY 92	CY 93	CY 94	CY 95	CY 96
Air Force	213	186	272	345	370
Army	97	65	134	215	172
Navy	509	637	556	745	573
Marine Corps	477	55	97	121	114
Defense Logistics Agency	2	15	20	20	54
Total	868	958	1,079	1,446	1,283

The Navy is also focusing on finding ways to reduce its use of plastics in order to reduce solid waste from ships. Faced with a significant threat to the readiness of its fleets, the Navy implemented an aggressive affirmative procurement program, Plastic Reduction In Marine Environments (PRIME), to find alternative plastics or plastic-free packaging in order to comply with the MARPOL international protocol. The protocol prohibits disposal of plastics into the sea. The PRIME program has reviewed over 670,000 shipboard consumables and identified nearly 375,000 for alternative products and processes for use in the Fleet.

For example, paper substitutes are being used instead of polystyrene peanuts or bubble wrap; 100% biodegradable rayon scrimms are replacing nylon scrimms used in cleaning machinery; new biodegradable paper cups are replacing polystyrene; water-soluble packaging are replacing plastic bottles; and wet-strength paper trash bags are replacing plastic bags. Since the PRIME program was initiated, the Navy has reduced shipboard generation of plastic waste by about 70%. Any remaining plastic waste generated on Navy ships is returned to shore for disposal.

The reuse and/or recycling of construction and demolition wastes has also been a growing concern for DoD. At McClellan AFB, California, new rock and rubble crusher equipment was installed to crush demolition rubble and recover the material as useful construction aggregate. About half of the demolition material has been used for on-base construction projects. It took approximately four months to recover the initial \$554,000 investment for the crusher through reduced landfill disposal costs. Additional benefits included the elimination of approximately 56 tons of air emissions that would have resulted from hauling the wastes to a distant landfill.

15.4.3

Environmentally preferable products

The DoD has also made significant progress in purchasing recycled goods and other environmentally preferable products. The purchase of these products has assisted DoD in reducing its life-cycle environmental impacts. DoD policy requires that all contract documents eliminate preferences for use of virgin materials and encourage the use of recovered, recycled, reused and other environ-

mentally preferable products. It also requires the procurement of “EPA guideline products,” products EPA has designated as having recycled content, such as paper products, re-refined lubricating oil, retread tires, certain building insulation, and concrete and cement that contain fly ash. In addition to changing its policy, DoD has successfully encouraged procurement of environmentally preferable products and services through better awareness, marketing and the use of innovative contracting arrangements.

The DLA’s Defense Supply Center in Richmond, Virginia, publishes an Environmental Products Catalog marketing over 800 environmentally friendly products stocked by DLA and purchased across the federal government. This simple tool has resulted in almost doubling the sales of these products in just the past few years.

15.4.4

Alternatively fueled vehicles

The DoD has been instrumental in increasing federal purchasing of AFVs as required by the Energy Policy Act and in ensuring that these clean vehicles support other important objectives such as reducing dependence on foreign oil and complying with the CAA’s air pollution emission reduction requirements. The vehicles are generally assigned to installations located in air quality nonattainment areas because they can assist installations in achieving their emission reduction goals. For example, McClellan AFB received emission reduction credits for its fleet of AFVs.

The DoD operates nearly 8,000 AFVs nationwide. DoD is also purchasing 150 hybrid electric vehicles to replace gasoline-fueled vehicles at Navy and Air Force installations in CAA nonattainment areas, including Sacramento, California; Atlanta, Georgia; and Washington, DC. The Navy is managing data collection for performance and life-cycle costs at the demonstration sites and will operate about one-half of the hybrid AFVs. The Navy also operates over 2,700 AFVs and has installed 21 compressed natural gas stations to support its vehicles.

15.5

Weapon system programs pollution prevention accomplishments

The DoD acquisition pollution prevention program has made substantial progress in reducing pollution associated with developing, testing, operating, and disposing of its weapon systems. This effort includes new, developing and mature systems. The LDP 17 (amphibious-transport docking ship) program is a good example of what DoD is accomplishing in the acquisition of new systems. The Navy plans to replace 4 entire amphibious ship classes with 12 new ships. The new ships are designed to minimize many of the environmental problems associated with older ships. For example, the LDP 17 will have a dry bilge (i.e., no deck or other drains leading to the bilge that can cause water contamination).

“Blackwater,” or sewage, will be handled by the latest vacuum transfer systems. The refrigeration and fire suppression systems will be ODS free. Plastics will be recycled and the most advanced solid waste processing equipment will be installed.

Further along in the development cycle, the Air Force’s F-22 program successfully eliminated a requirement for cadmium plating, a highly toxic and strictly regulated heavy metal, on the aircraft’s nose and main landing shock strut assemblies and replaced it with nonhazardous plating materials. This change will greatly reduce the Air Force’s use of cadmium plating in the future.

The Navy’s F/A-18 E/F and V-22 aircraft programs had each won EPA Stratospheric Ozone Protection Awards for their pioneering work in developing and using non-ODSs for fire suppression. The fire suppression alternatives developed will not compromise aircrew safety or the defense mission and are environmentally acceptable. The F/A-18 E/F will employ a revolutionary inert gas generation system and the V-22 will use a combination of inert gas generation and hydrofluorocarbon-125 (HFC-125). These systems will be the first new aircraft to enter DoD service that do not use halon-1301 for fire suppression in engine nacelles and dry bays.

During production of the B-2 Bombers ODSs were reduced from 180,000 lbs. of emissions to less than 50 lbs. and the cost of the hazardous waste management system was reduced from \$3.7 million to less than \$1000.

The DoD has also succeeded in preventing pollution from systems that have been in production for many years. The Army’s Bradley Fighting Vehicle System continues to be improved both operationally and environmentally. In FY96, a Bradley Pollution Prevention Program was established, requiring every prime and major subsystem contractor to establish pollution prevention programs based on National Aerospace Standard (NAS) 411, Hazardous Materials Management. The program has already achieved significant reductions in the use of zinc chromate, methylene chloride, methyl ethyl ketone, acetone, ethylene glycol, and many other volatile organic compounds (VOC). The Air Force, working with its contractor, reduced the number of Class I ODSs used on the F-15 aircraft from five to one.

The Navy’s New Attack Submarine is being designed and constructed so that its operation, deployment, maintenance, overhaul, and ultimate disposal meet or exceed all current environmental requirements. To accomplish that goal, teams representing all aspects of a submarine’s life-cycle were formed to make environmentally conscious decisions. Key elements in the approach of the program included identifying applicable compliance requirements and performing environmental analysis on systems, components, materials, and wastestreams. It also included investigating alternatives if items currently used do not meet environmental requirements; assessing alternative materials and processes; and planning to control and manage those hazardous materials that must be used. The New Attack Submarine won the 1997 Secretary of Defense Weapon System Acquisition Team – Pollution Prevention Award. The benefits of the New Attack Submarine’s life-cycle EH&S program thus far include the following:

- Reduction of hazardous waste by 90%
- Reduction of high level radioactive waste by 50%
- Utilization of low VOC paints
- Recycling of lead ballast and chromated water
- Elimination of ODSs in air conditioning and refrigeration
- Deployment of fewer oil systems
- Elimination of dredging requirements at operating bases due to the boat's smaller size

The DoD has made substantial progress in improving its ability to share information about innovative pollution prevention technologies and processes. For example, the Air Force and Army Joint Surveillance and Target Attack Radar System (STARS) program has taken advantage of the Navy's efforts to eliminate the use of chlorofluorocarbon 114 (CFC-114). By applying the results of the Navy's work, the program will be able to reduce the costs of eliminating CFC-114 from \$22 million to \$2 million.

Reducing the volume of hazardous materials used to support fielded weapon systems is an important element of DoD's weapon systems pollution prevention program. Demonstrated successes include Robins AFB, Georgia. The AFB used over 35,000 lbs. of methylene chloride per year to strip F-15s for repainting in 1994. By the end of 1996, methylene chloride use was eliminated and replaced with a closed loop plastic media blasting system in which the spent plastic media is completely recycled. In 1996, over 80 F-15s were stripped and almost no waste was generated. Over 80,000 lbs. of the used plastic media were recycled into bathroom fixtures and highway pavement.

A medium pressure/bicarbonate of soda stripping (BOSS) system being used by the C-141 Aircraft Directorate at Robins AFB reduced the use of methylene chloride by an estimated 1.5 million lbs. for paint stripping of these aircraft. The number of barrels of methylene chloride per aircraft has been reduced from 54 to near zero with a resulting annual savings of about \$750,000. Robins AFB won the 1997 Secretary of Defense Pollution Prevention - Industrial Installation Award.

The Army's Tank-Automotive Research, Development, and Engineering Center (TARDEC) conducted a test program to identify halon-1301 alternatives for use in the fire suppression systems of the engine compartments of seven combat vehicles. The program is expected to eliminate the need for 1 million lbs. of halon used in 15,000 combat vehicles. TARDEC was awarded a 1996 International Stratospheric Ozone Protection Award for its work.

The development of tools and models for improving decision making is an important component of DoD's efforts to incorporate pollution prevention into weapon system programs. To facilitate better understanding of life-cycle costs associated with weapon systems, the Army's Sense and Destroy Armor (SADARM) program undertook an activity-based costing study that estimates system life-cycle environmental costs. The study used activity-based costing to collect environmental cost data in three major phases of the program: production,

testing, and O&S. The study showed that 10% of production, 16% of testing, and 30% of O&S costs for the system are related to environmental requirements. By understanding the costs and knowing the factors from which they arise, program managers are better able to reduce these costs during the design of new systems or modification of existing systems.

15.6

Future DoD pollution prevention initiatives

The DoD has been increasing its emphasis on promoting investments in pollution prevention to meet regulatory and legal requirements. DoD's long-range strategy is to focus on pollution prevention opportunities that demonstrate the best short-term and long-term ROI. At the same time, DoD is faced with decreasing or flat environmental budgets and increasing regulatory and legal requirements. The DoD's challenge is to continue to protect human health and minimize the impact of its activities on the environment given these real world constraints. Over the past several years, DoD has revised its budget and programming policies, metrics, strategic plans, and oversight approach to meet this challenge.

The future direction for DoD's pollution prevention program is expected to focus on smart business decisions and the exploitation of the most promising pollution prevention opportunities, not simply meeting regulatory and legal requirements and waste reduction quotas. Additionally, to make pollution prevention a DoD-wide investment strategy, DoD will be engaging in an intensive effort to achieve total and committed buy-in of its pollution prevention vision from senior management to shop-level personnel.

Pollution prevention adopted metrics have yielded DoD enormous benefits in achieving its pollution prevention goals. DoD recognizes that metrics need to be evolutionary and visionary or otherwise programs lose momentum as their goals are achieved. Furthermore, these indicators must provide better incentives to focus on potentially higher return on pollution prevention investments; consider pollution prevention as the first choice in meeting regulatory and legal requirements; and address DoD's most significant environmental risks first. Future metrics could be integrated with performance criteria for management and functional organizations, so there is a connection between personnel actions and pollution prevention goals, costs and benefits. The DoD is currently considering such improvements for its indicators. For example, a waste diversion goal instead of a waste disposal goal to better encourage source reduction and recycling efforts; a clean air metric based on the DoD's highest toxic air releases; and an economic metric which would demonstrate ROI from source reduction and recycling initiatives.

All DoD installations have pollution prevention plans. These plans are intended to assist an installation commander in identifying funding and technology requirements. Many installations, however, need tools and/or technical assistance to

make these plans meet operational requirements on an annual basis. One tool that DoD is developing and promoting is a consistent methodology to identify life-cycle costs and benefits for individual pollution prevention projects. Such a tool would ensure that pollution prevention projects are competitive with end-of-pipe solutions in the budget process and enable installations to implement the most cost-effective and best performing environmental management programs.

Technical assistance is also an important resource element for many installations. DoD intends to expand to other state regulatory agencies, a similar partnership it began in 1995 with the Texas Natural Resource Conservation Commission. This partnership involves state regulators in nonregulatory pollution prevention Site Assistance Visits (SAV) at DoD installations along with staffs from other participating DoD components.

The Acquisition Pollution Prevention Initiative (AP2I) will further streamline the ability of acquisition programs to adopt new materials and processes that can reduce the use of hazardous materials at manufacturing facilities. The AP2I will be based on the joint acquisition pollution prevention process that was developed and validated by the JG-APP. The AP2I will expand DoD's SPI by encouraging contractors and the government to partner in identifying and evaluating alternative materials and processes that can be used at both contractor facilities and DoD installations.

The greatest opportunity to identify and implement pollution prevention projects may lie with the shop-level personnel. However, they generally do not have the appropriate level of knowledge about environmental requirements, costs and benefits, or how to implement new pollution prevention options. The Air Education and Training Command at Randolph AFB, Texas, is piloting a new means for bringing pollution prevention training to the shop level. As discussed previously, the Air Force has developed "Model Shop Reports," or prototype opportunity assessments for specific operations, such as aerospace systems and components. The training initiative is intended to help shop-level personnel understand basic pollution prevention concepts, regulatory and legal requirements, how to identify existing or generate new pollution prevention options, and how to acquire project funding.

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