# WASTE MINIMIZATION ACTIVITIES IN THE NUCLEAR WEAPONS COMPLEX

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## ABSTRACT

The waste minimization activities that have taken place in the Nuclear Weapons Complex production plants and laboratories are described and summarized. The facilities treated are the Kansas City Plant, the Pinellas Plant, the Savannah River Site, the Y-12 Plant, the Pantex Plant, the Rocky Flats Plant, the Mound Plant, and the Lawrence Livermore, Sandia Livermore, Sandia Albuquerque, and Los Alamos laboratories. The commonalities in waste minimization in both plants and laboratories are discussed, along with future directions in waste minimization activities in both sectors of the Weapons Complex.

## BACKGROUND

More than a score of laws were enacted by Congress between 1970 and 1980 to protect against the intrusion of harmful substances or pollutants into the environment.(1) All of those laws focused on the control of pollution rather than its prevention. Even though Congress was aware by the mid-70s that the new laws it was creating were often causing additional pollution, it was not until the next decade that it began to address prevention of pollution at its source.(2)

In 1978, President Carter issued Executive Order 12088 which makes the head of each agency responsible for ensuring that all necessary action is taken for the prevention of environmental pollution at federal facilities and activities under the control of the agency.(3) Until the Resource Conservation and Recovery Act (RCRA) was amended in 1984, Executive Order 12088 was the only legal requirement imposed on federal agencies to minimize waste.

The 1984 Hazardous and Solid Waste Amendments (HSWA) amended RCRA to make one of its objectives "minimizing the generation of hazardous waste and the land disposal of hazardous waste by encouraging process substitution, materials recovery, properly conducted recycling and reuse, and treatment."(4) HSWA added a "self-certification" program to RCRA. When treating, disposing, or storing hazardous waste off-site, the waste generator must certify on the manifest which accompanies the hazardous waste that it has a "program in place" to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to be "economically practicable."(5) HSWA also added a provision which requires hazardous waste generators to identify in their biennial reports to EPA (or a state) the efforts undertaken during the year to reduce the volume and toxicity of waste generated and the changes in volume and toxicity actually achieved.(6)

In the recently enacted Pollution Prevention Act of 1990 (the Act), Congress has broadened the RCRA/HSWA waste minimization policy to cover all forms of waste which cause pollution. The Act states that it is national policy to prevent pollution at the source and to recycle pollution in an environmentally safe manner whenever feasible. Disposal or other release into the environment is to be employed only as a last resort and conducted in an environmentally safe manner. The statute establishes a national policy on pollution prevention, directs EPA to conduct pollution prevention activities, provides for matching grants to states for technical assistance programs, establishes a source reduction clearinghouse, requires businesses to report source reduction and recycling data in their annual toxic chemical release reports, and requires biennial reports by EPA to Congress on pollution prevention activities and results. After the enactment of the Emergency Planning and Community Right-to-Know Act (EPCRA) in 1986, EPA provided for the optional reporting of waste minimization efforts by owners and operators of certain facilities in their annual submission of toxic chemical release inventories to EPA.(7) The Pollution Prevention Act of 1990 makes such reporting mandatory.

## DOE'S WASTE MINIMIZATION PROGRAM

The Department of Energy has developed a waste minimization program that is broader in scope than that required by RCRA. Its program, which is found in a series of DOE orders, internal directives, and plans, applies to nonhazardous, hazardous, radioactive, and radioactive mixed (radioactive + hazardous) waste. DOE Orders 5400.1, 5400.3, and 5820.2A mandate that the management of radioactive wastes and other pollutants shall be accomplished in a manner that minimizes the generation of such wastes.(8) In 1988, the Acting Assistant Secretary for Defense Programs established a waste minimization policy for Defense Programs operations. The policy requires a hierarchical approach to waste minimization: avoidance, "as far as practicable," of the generation of low-level, transuranic, hazardous, and mixed wastes; recycling or reuse of all or part of waste stream components of wastes which are unavoidably

generated; and treatment of non-reusable wastes to further reduce toxicity or volume.(9) The policy calls for consideration of waste minimization in planning for future activities, such as new facility design, decontamination and decommissioning of nuclear facilities, and site environmental remedial actions.

Waste reduction guidance was published in early 1989. The guidance, citing a need for consistency with EPA definitions, defines "waste minimization" as: "any action that minimizes the volume or toxicity of waste by avoiding its generation, or recycling.(10) The guidance also defines "waste reduction" as:"waste minimization plus treatment to reduce either the volume or toxicity of waste requiring disposal."(11)

In March of 1989, the Secretary of Energy announced that he was initiating the preparation of an "Environmental Waste Cleanup 5-Year Plan." The Department of Energy published the Five-Year Plan in the fall of 1989.(12) The plan indicates that waste minimization is an integral part of the Department's environmental restoration and cleanup strategy.

The major DOE offices subsequently agreed to criteria for dividing waste management operations and facilities.(13) In the area of waste minimization, Principal Secretarial Offices (PSOs) were charged with assuring that waste is minimized during the execution of line waste management operations associated with production and research.

The Department of Energy issued a "Waste Reduction Policy Statement" in June 1990. The policy requires all DOE Program Offices and Field Operations to "institute a waste reduction policy to reduce the total amount of waste that is generated and disposed of by DOE Operating facilities through waste minimization (source reduction and recycling) and waste treatment."(14)

## THE NUCLEAR WEAPONS COMPLEX

DOE's Nuclear Weapons Complex is that part of the agency which is involved with the design, production, and decommissioning of nuclear weapons. The Weapons Complex, which is part of Defense Programs, is made up of several installations, each of which has specific responsibilities within the overall process.

Los Alamos National Laboratory carries out development of nuclear warheads, design and testing of advanced technology concepts, design of advanced nuclear reactors, nuclear science research, and research in conservation, environmental safety and health, fossil energy, geothermal energy, and solar heating and cooling.

Lawrence Livermore National Laboratory, located about 40 miles east of San Francisco, California, has major programs in nuclear weapon design, in inertial confinement fusion, in magnetic mirror fusion, and in the biological, ecological, and atmospheric aspects of energy and weapon technologies, and provides support to the U.S. intelligence community.

Sandia National Laboratories carry out R&D in nuclear ordnance engineering, other related defense R&D, and energy R&D. The main laboratory is in Albuquerque, New Mexico; a smaller laboratory is in Livermore, California; and a test range is near Tonopah, Nevada.

The Pinellas Plant, in Clearwater, Florida, fabricates and assembles neutron generators, lightning arrester connectors, special capacitors and switches, product testers, and other small weapon components. They also fabricate thermal batteries.

The Mound Plant, in Miamisburg, Ohio, manufactures and evaluates pyrotechnic components for weapons and carries out surveillance testing of explosive and electrical components drawn from weapons in the stockpile. Components manufactured and tested include detonators, timers, transducers, firing sets, and actuators.

The Kansas City Plant is the largest production facility in the Weapons Complex. It produces and procures nonnuclear electrical, mechanical, and plastic materials and components for weapons.

The Y-12 Plant, in Oak Ridge, Tennessee, processes enriched and depleted uranium and fabricates uranium components. It also assembles lithium parts, performs precision machining, and does specialty subassembly of structural components.

The Rocky Flats Plant fabricates and assembles components made of plutonium, uranium, beryllium, stainless steel, and other alloys, and carries out plutonium recovery and reprocessing.

The Savannah River Site, located about 30 miles southeast of Augusta, Georgia, produces plutonium, tritium, and other special nuclear materials.

The Pantex Plant, in Amarillo, Texas, fabricates chemical high explosives, and carries out final assembly of weapons, weapon modifications, weapons disassembly and retirement, and stockpile evaluation and testing.

The Nevada Test Site (NTS), which is an on-continent site for testing nuclear weapons, also manages the scientific and technical resources necessary to respond to nuclear extortion threats having to do with lost or stolen nuclear weapons, dispersal devices, or improvised nuclear devices. NTS also conducts R&D, such as the Nevada nuclear waste storage program, the liquid gaseous fuels program, and the laser fusion program. NTS was not analyzed as part of this paper.

## WEAPONS COMPLEX WASTE MINIMIZATION ACTIVITIES

In all of the weapons complex facilities, waste minimization and avoidance have been practiced for many years in an ad hoc fashion. The waste minimization activities are reflections of each site's interpretations of RCRA, HSWA, Executive Order 12088, DOE policy statements, and the Five-Year Plan.

In 1988, DOE Headquarters began to establish an agencywide waste minimization program. As Headquarters' focused program has materialized, site activities have begun to assume more consistency. The implementation guidance for DOE Order 5400.1 issued by Headquarters, required the submission of site waste minimization plans and specified the major components those plans should contain. Headquarters subsequently issued a "model" waste minimization plan, to bring further consistency to the next iteration of the facility waste minimization plans, which are to be submitted in May of this year. Headquarters has also developed guidance for the conduct of Process Waste Assessments (waste minimization opportunity assessments, or PWAs), and a "model" implementation plan for PWAs. All this has served to begin to establish consistency across the agency in the orientation and direction of waste minimization activities.

## SITE WASTE MINIMIZATION ACTIVITIES

The waste minimization activities of each of the Complex sites are described in the following section. Because most of what has gone on has been ad hoc, there has been no coordinated or consistent tracking or reporting. As a result, finding out what has actually happened has been dependent on networking and finding the key people involved. We are convinced that there are activities we did not uncover, but feel that the picture of activity within the Complex that we have drawn is reasonably accurate.

### Kansas City Plant (KCP)

Several procedural steps have been taken by the Kansas City Plant to accomplish waste minimization. Among these are the following: Waste minimization is considered as part of the design and production of new weapon systems. Waste minimization has been developed into a plantwide focus by the extensive use of employee training programs and newsletters. A hazardous materials tracking system has been designed and is being implemented. Inventory reduction practices have been implemented. Several source reduction options have been implemented at KCP. By shifting to high flash point mineral spirits for degreasing, shifting to aqueous-base cleaners and terpenes in cleaning operations, and making equipment modifications, plantwide use of chlorofluorocarbons (CFCs) and chlorinated hydrocarbons (CHCs) has dropped about 60% over the past three years. Waste solvent segregation has been implemented in some processes. In plating processes, alternative coating processes (spray coating, vacuum deposition, and electrophoresis are being developed as substitutes for cadmium, chromium and cyanide bath-type plating processes. In polymer processing, waste minimization is focussed on trying to find substitutes for two materials; methylene dianiline (MDA), and toluene diisocyanate. Alternatives to these two polymer components are being tested, and alternative laminates are being evaluated. Also, #2 fuel oil has been substituted for #6 in plant boilers, to allow cleaner stack gas. Methylene chloride has been replaced in a wire-stripping operation by a burnout oven. Hydrochloric acid usage has been substantially reduced by the use of a central reverse osmosis/deionized water system. Recycle has been a smaller component of the waste minimization effort at KCP. A CFC recycle unit has been installed as a part of refrigeration unit maintenance. A paper recycling program has been initiated. Planned future waste minimization activities at KCP include the following: A precision cleaning facility (to carry out research, development, and demonstration of new cleaning technologies) will be installed. Six process-specific PWAs will be completed by April 1991. The hazardous waste information system will see limited implementation by September 1991. An environmentally-conscious manufacturing R&D program is being undertaken in cooperation with Sandia National Laboratory. Waste minimization is being incorporated into the plant's Operational Surety (manufacturing management) system.

### Pantex Plant

Several procedural options have been implemented at Pantex. Among these are the following: A quarterly newsletter is being published. A training program has been instituted. Three PWAs have been completed. A waste minimization coordinator has been named for each of the plant's 10 divisions, and a central waste minimization committee has been established. An employee award system has been established. An overall goal for waste reduction has been established. An internal technology and information transfer mechanism (monthly meetings) has been established. A procedural control system has been established to encourage waste segregation, reduce waste generation, and guide waste management. The source reduction options that have been implemented at Pantex include the following. Waste stream segregation has been instituted in some operations, for both hazardous and radioactive waste. MOCA [4,4,-methylene bis (2-chloro) aniline] has been replaced by a less hazardous material. Solvent substitution has been carried out in several processes. Recycling options that have been implemented at Pantex include silver recovery from photographic liquids, freon reclamation from air condition system maintenance,

explosives recovery from and reuse of wastewater, lead reuse, a battery recycle program, vehicle antifreeze reclamation, and used crankcase oil reuse as a diesel fuel component. Future waste minimization activities at Pantex will include: expanded and continued conduct of PWAs, expanded employee training, and the institution of a chemical and waste tracking program.

**Pinellas Plant**

Several procedural options have been implemented at the Pinellas Plant. Waste minimization training is provided to all employees annually. An on-time buying policy has been implemented for chemicals not directly related to production. An employee awareness and award system are in place. Incoming hazardous materials are labelled to facilitate waste segregation. Bulk solvent purchases are prohibited. Pinellas employees actively participate in a regional waste exchange. Engineering drawings and equipment and service procurements are reviewed for waste minimization. Decommissioning and demolition projects are reviewed by the plant Environmental Safety and Health (ES&H) group for waste minimization opportunities. New processes are evaluated for waste minimization opportunities. Several source reduction options have been implemented at Pinellas. CFCs have been replaced by detergents for some cleaning operations. Encapsulant molds have been replaced with teflon-lined models which do not require methylene chloride cleaning. Trichloroethylene (TCE) has been replaced by aqueous cleaning in machine shop degreasing operations. Metal scrap has been segregated to facilitate off-site disposal and recycle. Processes using MDA have been modified to avoid the generation of a listed hazardous waste. Biological testing of trim coolant has been instituted to reduce trim coolant waste generation by 90%. Several recycling options have been implemented at Pinellas. Methylene chloride is recycled in encapsulant mold cleaning operations. The Seven-Point Reuse Program has been developed to facilitate off-site recycle and reuse. Successes to date include: Used petroleum-based oils are reused in the production of asphalt. A specific solvent segregation cart is used to ensure proper segregation for off-site recycling of freon, methylene chloride, and miscellaneous other solvents as well as ignitable solvents, such as alcohols, toluene, and amyl acetate used for energy recovery. Empty drums are sold to a drum refurbisher. Metal scrap and old excess equipment and furniture are sold for recycle and reuse. Lead-acid batteries and baled cardboard are sent off-site for recycling. Absorbents (pigs) are segregated based on waste absorbed to minimize waste sent for incineration. Several activities are planned for the near future at Pinellas. Gold will be recovered on-site from plating solutions. Alternative uses for iron disulfide (to avoid the need for disposal) are being explored. Process modifications are being developed to replace the epoxy hardener MDA with a nontoxic substitute. Chromium-containing plating baths are scheduled to be replaced with electrodeless nickel baths. Offsite plastic, aluminum, and paper recycling options are being developed.

**Y-12 Plant**

Several procedural waste minimization options have been implemented at the Y-12 Plant. Waste minimization goals have been set and will be refined based on ongoing experience. A hazardous material and waste tracking system has been implemented and is currently undergoing upgrade. An extensive sampling protocol has been developed for PCB spill sites; which has the effect of minimizing soil and material removal. A detailed PWA of the depleted uranium processing operation has been carried out as part of an extensive development-demonstration project in waste minimization. A number of source reduction options have been implemented in a variety of processes at Y-12. While implementation of these options has not been carried out in all areas of the plant, many of the plant's processes have been modified in the following ways. Transformer maintenance procedures have been modified to eliminate PCB spills. Chlorinated solvent degreasers have been replaced with ultrasonic cleaners. Cleaning techniques have been modified to reduce the use of solvents. Chlorinated solvents have been replaced with petroleum distillate solvents. Hazardous waste segregation practices have been implemented. PCB-containing transformers have been replaced with dry-type units. A low-level radioactive trash segregation program has been implemented. Several recycle options have been implemented at Y-12. Solvent recycling stills have been installed. PCB-contaminated mineral oil is recycled. Uranium is recycled in some processes. Nitric acid is recycled in pickling operations. Planned future activities at Y-12 include the following. Plant-wide Performance Improvement Program (PIP) teams will investigate waste minimization opportunities. Ultrasonic cleaners will be procured to further reduce the use of chlorinated solvents. Housekeeping and work procedures will be modified to reduce generation of contaminated rags. The ongoing and extensive depleted uranium waste minimization project will be continued. A demonstration-development project in enriched uranium process waste minimization will be initiated. Superfluous packaging materials will be eliminated from radioactively contaminated areas. Nine PWAs will be carried out by June 1992.

**Savannah River Site (SRS)**

Several procedural waste minimization options have been implemented at SRS. An "affirmative procurement" program is being implemented. This program gives preference to suppliers with waste minimization programs in place. An "accelerated vendor" system has been developed,

reducing onsite inventories and shelf-life expiration problems. Unpacking operations have been shifted to outside of regulated areas, reducing the amount of contaminated packaging material. A Resource and Material Review Task Team has been formed to facilitate purchase of recycled products, improve inventory controls, and enhance the plant's waste minimization focus. Clean waste areas have been established to aid in segregating radioactive waste at the point of generation. Several source reduction options have been implemented. Among these are the following: reduction of sampling waste by using on-line monitors; substitution of tin oil for lead oil as a lubricant in extruders; replacement of lead counterweights with stainless steel in the Separations area; radioactive waste segregation; substitution of nonhazardous for hazardous scintillation cocktails; replacement of cadmium-plated high efficiency air filters with stainless steel; substitution of plastic bags for cardboard boxes in Separations area subpackaging; reductions in the use of ferrous sulfamate; and the replacement of trichloroethane with nitric acid in degreasing operations. Several recycling options have been instituted at SRS. An aluminum can recycling program has been initiated, along with a scrap metal recycling program. A lead-acid battery recycle program is operating. Sandblasting media is recycled. A mercury recycle program has been set up with local universities. Waste oil is burned for energy recovery. An ethylene glycol recycle program has been instituted, and an excess construction-material reuse program has been instituted. Future waste minimization actions at SRS will include substitution of polyester for cloth cleanup wipes, a paper/cardboard recycling program, a wood, cafeteria waste, and sewage composting program, incorporation of waste minimization into the New Production Reactor design, the use of removable coating for lead bricks, the use of excess ferric and zinc nitrate as fertilizer for trees on the reservation, incorporation of waste minimization into cleanup activities, recycle (by distillation) of solvents, development of a waste tracking system, and the conduct of PWAs.

**Rocky Flats Plant (RFP)**

The procedural waste minimization activities that have taken place at RFP include a plant-wide waste minimization assessment (done in 1989), a waste minimization policy statement that has been issued, and the implementation of a training program oriented around regulatory requirements. The source reduction activities carried out at RFP include the following. CFCs have been replaced with ultrasonic aqueous cleaning in some plutonium machining operations. CFCs have been replaced with petroleum distillate solvents in some degreasing operations. Methylene chloride has been eliminated as a paint stripper. There has been a decrease in use of carbon tetrachloride in machining due to improved work practices. Recycle activities that have taken place at RFP include silver recovery from photographic and acid plating operations and a paper recycling program. Future waste minimization activity at RFP will include goal definition for Land Disposal Restricted wastes during FY 1991; one process-specific PWA to be carried out in FY 1991; and R&D efforts in advanced plutonium-forming techniques, liquid carbon dioxide cleaning, and beryllium powder technology.

**The Mound Plant**

The procedural activity related to waste minimization at Mound includes the following. The waste management officer at the plant checks purchase orders for hazardous materials. A waste minimization policy statement has been issued. Waste minimization has been publicized by in-plant bulletins. Training in waste minimization has been incorporated into training programs for all waste generators. We were not able to identify any source reduction or recycle actions that have been taken at the plant. Likewise, future waste minimization activities at Mound are undefined.

**Lawrence Livermore National Laboratory (LLNL)**

Several procedural waste minimization activities have taken place at LLNL. A waste minimization program office has been established, staffed, and provided with direct line funding. Waste minimization committees have been established in several of the lab's departments. Tentative goals have been established by 5 of the lab's 13 directorates. PWAs have been accomplished for some individual chemicals (mainly solvents). A pollution prevention awareness bulletin is published periodically. Hazardous materials procurement review procedures have been established. New processes, process modifications, D&D, and remedial actions are reviewed for waste minimization opportunities. Cost-benefit analysis of pollution prevention options is carried out prior to implementation. A solvent allocation system has been implemented. Several source reduction options have been implemented at LLNL. Solvent reduction and elimination has been carried out in some processes. Oil waste has been reduced by substituting vacuum pumps for oil-type pumps. Solvent substitution has been carried out in some processes. Freon has been replaced by less volatile material in coolant applications. Water usage has been reduced in some ongoing projects and in project closeout. The recycling options implemented at LLNL include: recycle of machining coolant, paint shop water curtain recycle, and ion exchange and filtration of cooling tower liquids. Future waste minimization activity at LLNL will be extensive. PWAs will be carried out for all waste streams amounting to more than 5% of the lab total. A chargeback system will be instituted. Equipment changes will be made in liquid scintillation counting to reduce cocktail usage. Plating equipment will be replaced. Stainless steel bricks will be substituted for lead bricks. Combined uv/supercrit-

ical oxidation of contaminated groundwater will be carried out. A soil and gravel separator will be used for low-level contamination cleanup. Reusable containers will be used for Freon.

**Los Alamos National Laboratory (LANL)**

Several procedural waste minimization actions have taken place at LANL. A Laboratory-wide policy statement has been issued. A training program (with waste minimization goals and objectives) has been instituted. A "Waste Generator Interface Team" (three people) manages the laboratory-wide program. 85 organization-specific coordinators have been named. A hazardous material database and tracking system has been established. A few source reduction waste minimization options have been implemented. Hazardous scintillation cocktail components have been replaced by non-hazardous ones. Halogenated solvent substitution has been accomplished in about 50% of cleaning and stripping operations. An internal waste exchange has been developed at LANL. We were unable to define the scope or direction of future waste minimization activity at the Laboratory.

**Sandia National Laboratory at Albuquerque (SNLA)**

The procedural waste minimization activities at SNLA are relatively undeveloped. A program plan has been developed, but is not yet approved. One PWA has been completed. Tentative goals have been set, but baselines are not established. Source reduction activities at SNLA are limited to solvent substitution in some programs. Recycling at SNLA is beginning. A chemical exchange program has been instituted, and a paper recycling program has been implemented. The future of waste minimization at SNLA is undefined at present.

**Sandia National Laboratory at Livermore (SNLL)**

Several procedural waste minimization activities have taken place at SNLL. PWAs have been performed on the laboratory's four main waste generating activities. A waste tracking system has been implemented. A waste reduction analysis is carried out on all process modifications and new projects. Hazardous materials purchase review procedures have been developed and implemented. Waste minimization training is provided for new employees. Hazardous materials purchase orders are subjected to review and approval. Waste minimization is considered during Safe Operating Procedure reviews. Some waste stream segregation has been implemented at SNLL. Several recycling options have been implemented at the Laboratory. A used oil recycling program has been implemented. A solvent recycling program has been implemented, as have a steel drum recycling program and a lead recycling program. In the future, silver will be recovered from photographic operations.

A summary table of the waste *minimization options* which have been implemented at the Weapons Complex facilities has been developed from the information presented above. The table (Table I) indicates that the full range of currently-understood waste minimization options are applicable to both laboratories and production plants.

## FUTURE ACTIONS

Future pollution prevention activities in the Weapons Complex will reflect the continuing evolution of a DOE-wide pollution prevention program, coordinated and led by Headquarters. Activities will reflect the overall program as well as individual site initiatives. The following list details the activities expected during the remainder of FY 1991 and FY 1992.

1. All sites are developing waste minimization plans based on guidance from Headquarters. This planning effort will bring a measure of consistency to pollution prevention activities across the Complex.
2. All sites will initiate Process Waste Assessments of prioritized waste streams/operations during FY 1991. These PWAs are based on guidance from Headquarters, and will be carried out with a consistent methodology.
3. Needed R&D has been identified and prioritized; some of that R&D is already under way, more of it will be funded during FY 1991.
4. A Complex-wide newsletter (to facilitate technology and information transfer) will be initiated in April 1991.
5. A set of Complex-wide goals for pollution prevention will be developed and promulgated by August 1991.
6. A number of additional waste minimization activities are being initiated or developed at several of the sites, and will be implemented during FY 1991.
7. Hazardous materials/waste tracking systems are being developed at several of the sites. Implementation of these tracking systems is anticipated for late FY 1991 and 1992.

## CONCLUSIONS

A great deal of effective waste minimization activity has gone on in the Weapons Complex. Activities to date have been largely ad hoc, but are becoming increasingly coordinated by DOE's developing Headquarters Program. Due to the ad hoc nature of waste minimization activities to date, some of the laboratories and plants have more highly developed waste minimization programs than others, but experience to date indicates that the full range of waste minimization options is applicable to both laboratory and production situations.

**TABLE I**

Waste Minimization Activities at Weapons Complex Sites

| | |
|---|---|
| **Procedural** | |
| Procurement Procedures: inventory reduction techniques, use review, hazardous materials tracking | Kansas City, Savannah River, Y-12, Pinellas, Sandia-Livermore, Lawrence Livermore, Los Alamos<br>NOT: Rocky Flats, Mound, Pantex, Sandia-Albuquerque |
| Employee Training: any awareness programs, such as newsletters, training programs, and award systems | Rocky Flats, Pantex, Kansas City, Los Alamos, Lawrence Livermore, Pinellas, Mound, Sandia-Albuquerque<br>NOT: Savannah River, Y-12, Sandia-Livermore |
| New Process Evaluations for waste minimization | Pinellas, Kansas City, Lawrence Livermore, Sandia-Livermore<br>NOT: Rocky Flats, Pantex, Mound, Savannah River, Y-12, Los Alamos, Sandia-Albuquerque |
| SOURCE REDUCTION<br>Materials Substitution | Rocky Flats, Pinellas, Pantex, Kansas City, Savannah River, Y-12, Lawrence Livermore, Los Alamos, Sandia-Albuquerque<br>NOT: Mound, Sandia-Livermore |
| Waste Stream Segregation | Pinellas, Pantex, Kansas City, Savannah River, Y-12, Lawrence Livermore, Los Alamos, Sandia-Livermore<br>NOT: Rocky Flats, Mound, Sandia-Albuquerque |
| Process Changes/Equipment Changes | Rocky Flats, Pinellas, Kansas City, Savannah River, Y-12, Lawrence Livermore<br>NOT: Pantex, Mound, Los Alamos, Sandia-Albuquerque, Sandia-Livermore |
| RECYCLING Solvents and Oils | Pinellas, Pantex, Kansas City, Savannah River, Los Alamos, Sandia-Livermore, Sandia-Albuquerque, Lawrence Livermore, Y-12<br>NOT: Rocky Flats, Mound |
| Metals | Rocky Flats, Pinellas, Savannah River, Y-12, Sandia-Albuquerque |
| Paper | Rocky Flats, Pinellas, Savannah River, Sandia-Albuquerque<br>NOT: Pantex, Mound, Kansas City, Y-12, Lawrence Livermore, Los Alamos, Sandia-Livermore |

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## REFERENCES

1. See, e.g., Occupational Safety and Health Act of 1970, Pub. L. No. 91-604, codified at 42 U.S.C. Sec. 7401 et seq. (1988 ed.); Resource Conservation and Recovery Act of 1976, Pub. L. No. 94-550, 90 Stat. 2796 (1976), codified at 42 U.S.C. Sec. 6901 et seq. (1988 ed.); and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ["Superfund"], 42 U.S.C. Sec. 9601
2. In enacting the Resource Conservation and Recovery Act in 1976, Congress found that greater amounts of solid waste were being created as a result of federal and state pollution control laws.
3. Executive Order No. 12088, requires each agency to submit a Pollution Control Plan to the Director, Office of Management and Budget. Each executive agency must "ensure that the plan provides for compliance with all applicable pollution control standards."
4. Pub. L. 98-616, Sec. 101(b)(2), Nov. 8, 1984, 98 Stat. 3224, codified at 42 U.S.C. Sec. 6902(a)(6) (1988 ed.).
5. 42 U.S.C. Sec. 6922(b)(1) (1988 ed.). The manifest is a shipping document which is used for identifying the quantity, composition, origin, routing, and destination of hazardous waste during its transportation from the point of generation to the point of treatment, storage, or disposal. See EPA Form 8700-22.
6. 42 U.S.C. Secs. 6922(a)(6)(C),(D) (1988 ed.). A generator of hazard waste must report biennially on the generator's activities during the previous calendar year using Form GM, Waste Generation and Management, EPA Form 8700-13A/B (Revised 11-89).
7. See 40 CFR Part 372.85 (198), and EPA Form R, Toxic Chemical Release Inventory Reporting Form, EPA Form 93 50-1 (1-88), Part III, Sec. 8.
8. See U.S. Department of Energy, DOE Order 5400.1, General Environmental Protection Program (November 9, 1988); DOE Order 5400.3, Hazardous and Radioactive Mixed Waste Program, (February 22, 1989); DOE Order 5820.2A, Radioactive Waste Management (September 26, 1988).
9. Memorandum from Troy E. Wade, II, Acting Assistant Secretary for Defense Programs to Managers, DOE Operations Offices, October 20, 1988.
10. Memorandum from Thomas B. Hindman, Jr., Director, Office of Defense Waste and Transportation Management, Defense Programs, to Managers of DOE Operations Offices, January 12, 1989.
11. Id.
12. U.S. Department of Energy, Environmental Restoration and Waste Management Five-Year Plan, DOE/S-0070 (1989).
13. U.S. Department of Energy, "Memorandum of Agreement Among DOE Offices with Respect to Environmental Management of DOE Facilities." September 19, 1989. See also Draft Summary Memorandum form Leo P. Duffy, Director, Office of Environmental Restoration and Waste Management, to Under Secretary of Energy, Approval of Addendum to the Memorandum of Agreement Among DOE Offices with Respect to Environmental Management of DOE Facilities, February 1990.
14. Memorandum from John C. Tuck, Under Secretary of Energy, Peter N. Brush, Acting Assistant Secretary, Invironment, Safety and Health, Leo P. Duffy, Director, Office of Environmental Restoration and Waste Management, to Distribution [all elements of the Department of Energy], "Waste Reduction Policy," June 27, 1990.