

2.3 Activities, Accomplishments, and Issues

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This section further describes DOE's progress in meeting its mission at the Hanford Site. Section 2.2, "Compliance Status," described activities relating to compliance with regulations. This section describes other major ongoing activities. Ongoing compliance self-assessments, knowledge gained in implementing Tri-Party Agreement milestones, and communications with stakeholders continue to identify environmental compliance issues. Relevant issues are discussed openly with the regulatory agencies and with the public to ensure that all environmental compliance issues are addressed.

2.3.1 Hanford Federal Facility Agreement and Consent Order

Fifty-seven Tri-Party Agreement milestones scheduled for 1997 were completed, along with 3 scheduled for 1998. Highlights of physical work accomplished (documents not included), with the associated milestone numbers, include the following:

- restarted the 200-ZP-2 carbon tetrachloride vapor extraction system in the 200-West Area (Milestone M-15-36)
- initiated remedial action for the 300-FF-1 Operable Unit in the 300 Area (Milestone M-16-03B)
- completed 200-ZP-1 Operable Unit treatment system upgrades in the 200-West Area (Milestone M-16-04B)
- began system operations at the 100-HR-3 Operable Unit in the 100-H Area (Milestone M-16-06B) and at the 100-KR-4 Operable Unit in the 100-K Area (Milestone M-16-11)
- completed implementation of "best available technology/all known, available, and reasonable methods of prevention, control, and treatment" for all Phase II liquid effluent streams at the Hanford Site (Milestone M-17-00B)
- replaced the piping from the 300 Area process sewer to the 300 Area Treated Effluent Disposal Facility (Milestone M-17-06K)
- completed construction and initiated operations of the Waste Receiving and Processing Facility in the 200-West Area (see Figure 1.0.2) (Milestone M-18-00)
- awarded a commercial contract for stabilization of low-level mixed waste stored at the Central Waste Complex in the 200-West Area (see Figure 1.0.2) (Milestone M-19-01-T02)
- obtained a Washington State Department of Ecology decision accepting the existing solidification treatment at the 183-H Solar Evaporation Basins in the 100-H Area (Milestone M-19-03)
- completed construction upgrades to existing underground waste transfer lines in the 200 Areas (Milestone M-32-02-T02)
- completed vapor space monitoring of underground tanks in the 200 Areas that generate flammable gas (Milestone M-40-10)
- started interim stabilization of 8 underground single-shell tanks in the 200 Areas (Milestones M-41-21 and -22) and completed salt well pumping of 4 single-shell tanks (Milestone M-41-27-T-02)
- completed construction of the cross-site transfer line between underground tanks in the 200-West and 200-East Areas (Milestone M-43-07B)
- started the definitive design phase for underground storage tank system upgrades (Milestone M-43-10)
- completed conceptual design for the initial single-shell underground tank waste retrieval systems (Milestone M-45-04A)

- established the criteria for determining allowable leakage volumes and acceptable leak monitoring/detection and mitigation measures necessary to permit underground waste tank sluicing operations (Milestone M-41-27-T01)
- awarded two design-only privatization contracts for Phase I low-activity waste pretreatment and immobilization for underground tank waste (Milestone M-60-08)
- completed data quality objectives that identify the underground tank waste characterization information needs in support of Phase I privatization contracts (Milestone M-60-14-T01)
- completed deactivation of the Plutonium-Uranium Extraction Plant canyon in the 200-East Area (see Figure 1.0.2) (Milestone M-80-06)
- initiated operations at the Central Waste Complex storage facilities in the 200-West Area (see Figure 1.0.2) (Milestone M-91-01)
- submitted a recommendation for the final disposition of the 105-C fuel storage basin in the 100-B,C Area (Milestone M-93-01).

Since the last issue of this report, new negotiated changes to the Tri-Party Agreement established 40 new enforceable milestones and 14 new unenforceable target dates.

A summary of the significant approved changes to the Tri-Party Agreement follows.

2.3.1.1 Waste Management

There was one approved change request related to facility transition during 1997.

Target milestones for the M-32-02 series, "Completion of 219-S Tank Interim Status Actions," in the 200-West Area were changed. During construction of project W-178, "219-S Secondary Containment Upgrade," higher than anticipated contamination levels were encountered. The contamination and radiological dose rate levels significantly exceeded the budget estimate assumptions. Levels of this magnitude required the decontamination of the 219-S facility A and B cells to minimize exposure to workers. As a result, the project's work scope was separated into two phases. Phase I, integral to transfer line

replacement, was completed in early 1997 with all available funding consumed. Phase II, the balance of the project, was placed on hold until additional funding could be obtained. Phase II funding has been budgeted.

2.3.1.2 Environmental Restoration Program

The M-93-00 series of milestones was negotiated to create schedules for the cleanup and removal of eight of Hanford's surplus production reactors. DOE has considered the environmental impacts, risks, costs, benefits, and institutional and programmatic needs associated with decommissioning the B,C, D, DR, F, H, KE, and KW Reactors in the 100 Areas. The selected final disposition alternative, in a phased approach, is interim safe storage followed by deferred one-piece removal of the eight surplus reactors. (Because of interest in a B Reactor engineering accomplishment museum and/or landmark, it was recognized that cleanup activities at B Reactor might take a different course.)

DOE will prepare and present for public comment appropriate environmental documentation for N Reactor. N Reactor had not been shut down when the environmental documentation for the other eight reactors was prepared in 1993. N Reactor is expected to follow a disposition path similar to the other surplus reactors, and its disposition is within the scope of the new M-93 series of milestones.

A change request approved in March 1997 also established 3 new milestones in the M-16 series for remedial action and disposal of waste sites in the 300-FF-1 Operable Unit in the 300 Area.

2.3.1.3 Tank Waste Remediation System

A change was made to revise the strategy for existing milestone M-44-00, Tank Waste Characterization. The change resulted from an extensive review of progress on the milestone through a partnering effort between the Washington State Department of Ecology and DOE Richland Operations Office. As tank projects have matured, their waste information needs have been refined. The milestone change allows characterization sampling and analysis efforts to be tailored to meet these needs. The change removes the requirement for sampling a

predetermined number of tanks and links the sampling and analysis activities directly to the project's tank waste information needs.

Three new target dates were also created to submit data quality objectives for tank waste retrieval and high-level waste feed to the treatment system. This was done in support of the tank waste remediation system privatization contracts.

2.3.2 Pollution Prevention Program

Pollution prevention is DOE's preferred approach to environmental management. The Hanford Site Pollution Prevention Program is an organized and continuing effort to reduce systematically the quantity and toxicity of hazardous, radioactive, mixed, and sanitary wastes. The program fosters the conservation of resources and energy, the reduction of hazardous substance use, and the prevention or minimization of pollutant releases to all environmental media from all operations and site cleanup activities.

The program is designed to satisfy DOE requirements, executive orders, and state and federal regulations and requirements. In accordance with sound environmental management, preventing pollution through source reduction is the first priority in this program; the second priority is environmentally safe recycling. Waste treatment to reduce quantity, toxicity, or mobility (or a combination of these) will be considered only when prevention and recycling are not possible or practical. Disposal to the environment is the last option.

Overall responsibility for the Hanford Site Pollution Prevention Program resides with DOE Richland Operations Office. The office defines overall program requirements that each prime contractor is responsible for meeting.

Hanford Site pollution prevention efforts in 1997 helped to prevent the generation of an estimated 9,300 m³ (12,200 yd³) of radioactive mixed waste, 440 metric tons (480 tons) of Resource Conservation and Recovery Act hazardous/dangerous waste, 2.5 billion L (660 million gal) of process wastewater, and 6,800 metric tons

(7,500 tons) of sanitary waste. Total savings in 1997 exceeded \$14,700,000 for these activities.

During 1997, the Hanford Site recycled 510 metric tons (560 tons) of office paper, 45 metric tons (50 tons) of cardboard, 3,700 metric tons (4,100 tons) of ferrous metal, 145 metric tons (160 tons) of nonferrous metal, 12 metric tons (13 tons) of lead, 2.2 metric tons (2.4 tons) of solid chemicals, 0.68 metric ton (0.75 ton) of aerosol cans, 14 metric tons (15 tons) of fluorescent light tubes, 37.7 metric tons (41.5 tons) of lead acid/gel cell batteries, and 1,100 metric tons (1,200 tons) of miscellaneous materials. Savings in 1997 exceeded \$1,500,000.

Numerous generator-specific initiatives were put into place that enabled these waste reductions and cost savings. To celebrate these pollution prevention activities, the *Hanford Site Pollution Prevention Accomplishments* (HNF-1740) was published in October 1997. The book outlines 56 initiatives that were implemented and are now in use at locations throughout the Hanford Site.

2.3.3 Environmental and Molecular Sciences Laboratory

The William E. Wiley Molecular Sciences Laboratory, an 18,600 m² (200,200 ft²) facility in the Richland North Area, was completed and DOE Headquarters authorized full operation in October 1997. Over 179 permanent staff members have been moved into the laboratory from other facilities.

The city of Richland issued an industrial wastewater permit (CR-IU005) to DOE that allows for process wastewater from this laboratory to be discharged to the city of Richland's publicly owned treatment works. The permit was issued in accordance with the provisions of city ordinances in October 1996 and expires in October 2001. The discharge permit requires monthly effluent monitoring and reporting of the analytical data to the city. Routine discharges under this permit have begun. Additionally, as required by the permit, an accidental spill prevention plan was developed and submitted to the city (PNNL-11311). That plan describes measures taken to prevent, control, and mitigate the effects of accidental releases of hazardous materials from the laboratory to the city.

2.3.4 Spent Fuel Project Activities

In February 1994, the Spent Nuclear Fuel Project was established to provide safe, economic, and environmentally sound management of Hanford Site spent nuclear fuel in a manner that readies it for final disposition.

The Hanford Site spent nuclear fuel inventory constitutes approximately 80% of the inventory currently stored across the national DOE complex. The majority of the site's inventory consists of approximately 2,100 metric tons (2,300 tons) of irradiated N Reactor fuel stored in the KE and KW Fuel Storage Basins.

In 1997, the project continued to make progress on its accelerated strategy for moving the wet-stored K Basin fuel away from the Columbia River and into a new dry storage facility in the 200-East Area (the Canister Storage Building; see Figure 1.0.2). Construction of the building is nearly complete, and during finalization, the project is completing design activities and fabricating process-related equipment on other parts of the project. In addition, construction of the cold vacuum drying facility is in progress at the 100-K Area. This facility will condition the fuel following removal from wet storage to stabilize it for dry storage at the Canister Storage Building.

2.3.5 Facility Stabilization Project

This project's mission is to transition those Hanford Site facilities for which it has responsibility from an operating mode to a long-term surveillance and maintenance mode. This includes maintaining facilities in a safe and compliant status, providing for the safe storage of nuclear materials, and reducing risks from hazardous materials and contamination. Under the project, the deactivation of primary systems to effectively reduce risks to human health and the environment will also be conducted. These activities will allow the lowest surveillance and maintenance costs to be attained while awaiting determination of a facility's final disposition and possible turnover to the DOE Environmental Restoration Program.

Currently, the Facility Stabilization Project is engaged in five major deactivation efforts at the Hanford Site. The major efforts are the Plutonium-Uranium Extraction Plant, the Facility Stabilization and Environmental Restoration

Team, the 300 Area Stabilization Project, the B Plant/Waste Encapsulation and Storage Facility, and the Plutonium Finishing Plant. The mission of each project and related accomplishments during 1997 are summarized below.

2.3.5.1 Plutonium-Uranium Extraction Plant

The mission of the Plutonium-Uranium Extraction Plant deactivation project is to transition the facility to a long-term, low-cost, surveillance and maintenance state that is safe and environmentally secure. The plant was constructed to obtain plutonium for national defense needs. With no further need for plutonium, DOE provided a deactivation order for the facility in December 1992.

Plant deactivation was completed in May 1997; more than \$75 million under budget and 14 months ahead of schedule. This was the first facility of this complexity and size to be deactivated under the current-day regulations and requirements. The facility, which required approximately \$35 million annually to maintain a standby condition, now requires less than \$1 million per year to maintain the surveillance and maintenance phase until the final disposition of the facility is determined.

The deactivation of the plant involved the removal, reduction, and/or stabilization of radioactive sources and hazardous substances in a safe, cost-effective manner. The deactivation project was also marked by a concerted recycling effort to reduce waste and maximize the reuse of resources. The plant is currently unoccupied and locked, and is being maintained under surveillance while awaiting eventual decontamination and decommissioning.

2.3.5.2 Facility Stabilization and Environmental Restoration

The Facility Stabilization and Environmental Restoration Team (always referred to by its acronym FASTER) is a group organized in 1997 to share comprehensive cleanup experience and lessons learned from the Uranium TriOxide Plant and Plutonium-Uranium Extraction Plant deactivation projects with similar projects at other DOE sites nationwide.

The FASTER Team is supporting the deactivation of several facilities at the Hanford Site, primarily isolated facilities without associated staff. The team is also involved with deactivation planning for facilities at the

Rocky Flats Plant in Colorado, the Savannah River Site in South Carolina, and the Brookhaven National Laboratory in New York.

2.3.5.3 300 Area Stabilization Project

This project currently has two subprojects: 1) 300 Area Fuel Supply Shutdown Subproject and 2) 324/327 Building Transition Subproject.

The 300 Area subproject includes buildings dating back to 1943 that housed manufacturing equipment for production of fuel for Hanford Site reactors. These processing operations were discontinued in 1987 when the last of the Hanford Site reactors (N Reactor) was shut down and placed in a standby mode.

The transition subproject includes the 324 and 327 Buildings, which were constructed in 1966 and 1953, respectively. These buildings house hot cells that were utilized for radiological research and development work. Both facilities were transferred to the Facility Stabilization Project in 1996.

The current mission of the 300 Area Stabilization Project is to complete deactivation and closure activities, while maintaining the facilities in a safe and compliant status until eventual decontamination and decommissioning.

During 1997, the following significant accomplishments were achieved:

- completed transfer of the 308 Building plutonium fuels development and fabrication facility to the Hanford Site environmental restoration contractor
- completed 313 Building Phase I cleanout activities in support of Resource Conservation and Recovery Act closure of the Waste Acid Treatment System in the 300 Area
- transferred 10 million Ci of radioactive materials from the 324 Building to safe storage at the plutonium-uranium extraction facility
- completed shipment of 327 Building legacy fuel pins and pieces from past research activities to the Central Waste Complex in the 200-West Area ahead of schedule.

2.3.5.4 B Plant/Waste Encapsulation and Storage Facility

B Plant went into service in 1944 to recover plutonium by a chemical separation process. Following the advent of the more efficient Plutonium-Uranium Extraction Plant process, B Plant's mission was modified to recover the high-heat isotopes (primarily cesium-137 and strontium-90) from highly radioactive waste. In October 1995, DOE directed that B Plant be deactivated. The current mission is to place it into a configuration suitable for long-term surveillance, pending final disposition.

The Waste Encapsulation and Storage Facility project's mission is to provide safe interim storage of encapsulated radioactive material (cesium and strontium). This facility has not received a deactivation order and will remain in service following the shutdown and deactivation of B Plant.

The B Plant deactivation schedule has been accelerated with a goal for completion by the end of September 1998, which is 4 years ahead of schedule. This accelerated schedule is expected to save more than \$100 million.

Significant accomplishments achieved during the accelerated 1997 deactivation effort include the following:

- All 1997 Tri-Party Agreement milestones associated with facility deactivation at B Plant were completed on or ahead of schedule.
- The final 15,000 L (4,000 gal) of highly radioactive organic solvent waste from past B Plant processing operations were removed from the facility and shipped to an offsite Resource Conservation and Recovery Act-permitted mixed waste treatment, storage, and disposal facility for final disposition.
- B Plant effluent systems were deactivated, eliminating all liquid discharges to the soil and the 200 Areas Treated Effluent Disposal Facility from B Plant. In addition, work began on construction and installation of a new ventilation system that will replace the existing main stack during long-term surveillance of the facility. Included as part of this overall effort was the isolation of the original B Plant sand filter and contaminated high-efficiency particulate air filters.

- Over 370 m² (4,000 ft²) of radiologically contaminated area were decontaminated and released for unconditional use during 1997. In addition, over 1,900 L (500 gal) of excess chemical and hazardous products were recycled or excessed, as were over 3,000 kg (6,600 lb) of lead.
- The B Plant/Waste Encapsulation and Storage Facility project received a DOE 1997 Pollution Prevention Award. This award recognized the continued successful reduction of hazardous material inventory in 1997, finishing with a total of 193 products in use at the project. This was down from 236 at the start of 1997, and down over 80% from a high of over 1,100 in 1993.
- A significant effort has been the separation of those systems common to both B Plant and the Waste Encapsulation and Storage Facility. Waste Encapsulation and Storage Facility systems and structures continue to be upgraded to ensure their future operability. Systems upgraded in 1997 included pool cell cooling, liquid effluent monitoring, and solid waste handling. The Waste Encapsulation and Storage Facility closed-loop cooling system reduced the pool cell cooling water discharge from approximately 4,900 L/min (1,300 gal/min) to less than 19 L/min (5 gal/min); a total reduction of over 2.6 billion L (680 million gal) annually. Previously discharged to the ground via the B Pond system, this effluent stream, as well as all others from the Waste Encapsulation and Storage Facility, have been rerouted to the 200 Areas Treated Effluent Disposal Facility.
- The last cesium capsules being stored in the 300 Area were returned to the Waste Encapsulation and Storage Facility for storage in 1997, and remaining unencapsulated cesium salts are expected to follow in 1998. A Resource Conservation and Recovery Act Part A permit application was submitted to the Washington State Department of Ecology for the storage of all Hanford Site cesium and strontium capsules and unencapsulated salts at the Waste Encapsulation and Storage Facility. This was done to satisfy the conditions of a Tri-Party Agreement milestone and will result in the regulated storage of cesium and strontium capsules and operation of Waste Encapsulation and Storage Facility as a Resource Conservation and Recovery Act treatment, storage, and disposal facility.

2.3.5.5 Plutonium Finishing Plant

The Plutonium Finishing Plant went into service in 1949 to process plutonium nitrate solutions into metallic forms for the production of nuclear weapons. Operation of this plant continued into the late 1980s when the processes were shut down. In 1996, DOE issued a shutdown order for the plant, authorizing deactivation and transition of the plutonium processing portions of the facility in preparation for decommissioning. The current mission is to stabilize, repackage, immobilize, and/or properly dispose of plutonium-bearing materials in the plant; to deactivate the processing facilities; and to provide for the safe and secure storage of special nuclear materials until final disposition.

The plant's stabilization plans were established with the approval of a 1996 final environmental impact statement record of decision (61 FR 36352). This established the alternatives for removing readily retrievable material that remained in equipment and piping at the facility and for stabilizing or cementing stored and retrievable plutonium-bearing material. A supplemental analysis provided an alternate packaging method for immobilized plutonium-bearing materials. This analysis was approved in 1997 as a supplement to the Plutonium Finishing Plant final environmental impact statement (DOE/EIS-0244-FS/SA1).

In May 1997, a chemical overpressurization occurred at the Plutonium Reclamation Facility, a building within the Plutonium Finishing Plant complex. The incident occurred in a tank containing a solution of hydroxylamine nitrate and nitric acid. Because the tank was vented, evaporation of water caused the concentration of the reactants to increase. A spontaneous reaction of the two chemicals generated large quantities of steam and gas that overpressurized the tank. The pressure blew the lid off the tank, causing structural damage to the room and cutting a small fire suppression water line.

Subsequent to this incident, a significant effort was undertaken to review and improve the emergency management and response system, not only at the Plutonium Finishing Plant, but across the entire Hanford Site. In addition, an extensive chemical vulnerability assessment was conducted to identify and correct other potentially hazardous situations that may exist.

Significant items completed during 1997 to prepare the Plutonium Finishing Plant to continue the plutonium-bearing material stabilization and immobilization processes and to deactivate the processing buildings included the following:

- A notice of intent to submit a Resource Conservation and Recovery Act permit application requesting expansion of interim status for the Plutonium Finishing Plant treatment and storage unit was issued in July 1997. The notice of intent was prepared in support of agreements reached between DOE, Washington State Department of Ecology, Fluor Daniel Hanford Inc., and B&W Hanford Company. The notice of intent provides details for proposed treatment and storage of mixed waste at the Plutonium Finishing Plant in support of transition activities. The Resource Conservation and Recovery Act permit application will be prepared and submitted in 1998.
- A deactivation program management plan for the Plutonium Finishing Plant (excluding the storage vaults) was completed in July 1997 (HNF-SD-CP-PMP-008).
- Installation of a full-scale, direct denitration calciner was completed in December 1997. This equipment will be used at the Plutonium Finishing Plant for plutonium stabilization (converting plutonium nitrate to plutonium oxide or plutonium).
- Stakeholders expressed an interest in expediting the deactivation of the Plutonium Finishing Plant complex and moving forward to facility dismantlement. Through discussions with stakeholders, the *Plutonium Finishing Plant Vision 2006* (HNF-2902), which states the majority of the complex would be dismantled by an integrated project team to a “clean-slab-on-grade,” was devised. Studies of this concept are being undertaken to evaluate the feasibility and potential cost savings of dismantlement. In addition, preparation of a plan, providing details of this concept, was initiated and will be completed in 1998.

2.3.6 Fast Flux Test Facility

2.3.6.1 History and Possible Future Missions

The Fast Flux Test Facility, a 400-MW thermal reactor cooled by liquid sodium, located in the 400 Area, was

built in 1978 to test plant equipment and fuel for the liquid metal reactor development program. Although the facility is not a breeder reactor, this program demonstrated the technology of commercial breeder reactors. Breeder reactors are so termed because they can produce both power and nuclear fuel to supply other reactors.

In January 1997, the Secretary of Energy directed that the facility be maintained in “standby” condition until DOE could evaluate and decide whether it should be part of the nation’s tritium production strategy. Studies and analyses to address safety issues, environmental impacts, and economic viability of producing tritium and medical isotopes at the facility have been conducted in support of a final decision on its future by the Secretary of Energy.

Meanwhile, deactivation activities that do not preclude a restart are continuing. Fuel has been taken out of the reactor vessel, and fuel assemblies (sealed metal tubes that hold fuel pellets) are being stored in aboveground, dry storage casks. Twenty-three of the facility’s 100 plant systems are currently deactivated. The facility continues to be maintained in accordance with state and federal requirements.

The facility is being considered for at least three possible uses: tritium production, plutonium disposition, and medical isotope production.

Tritium Production. Tritium is an essential part of nuclear weapons produced by the United States. An isotope of hydrogen, tritium has a half-life of 12.3 years; meaning that half the existing material is lost every 12.3 years through radioactive decay. The President of the United States has decided that new tritium must be produced to maintain the effectiveness of its nuclear weapons stockpile. DOE is responsible for supplying tritium to the weapons stockpile.

All of DOE’s tritium-producing reactors (located at the Savannah River Site in South Carolina) have been shut down since 1988. Because of their age and condition, there are no practical means to restart these reactors. Currently, DOE is studying two options for tritium: one is to build an accelerator at the Savannah River Site and the other is to use a commercial nuclear plant. The Fast Flux Test Facility is not being evaluated in competition with these two technologies. Instead, its restart would be considered an “insurance policy” for the DOE, as the reactor could be brought on line more quickly than the two potential long-term options and at a substantially lower cost.

If the Fast Flux Test Facility were called on to produce tritium, it could also produce medical isotopes and burn surplus weapons plutonium. These two activities would be secondary missions.

Plutonium Disposition. With the end of the Cold War, the United States is faced with the task of safe storage and disposition of approximately 50 metric tons (55 tons) of plutonium no longer needed for national defense, including approximately 4 metric tons (4.4 tons) at Hanford. DOE selected two options for the disposition of this surplus material: immobilization in ceramic or glass forms and incorporation of the plutonium into mixed oxide fuel to be burned by existing commercial reactors. The Fuels and Materials Examination Facility, adjacent to the Fast Flux Test Facility, is one candidate site for fabricating the mixed oxide fuel.

Medical Isotope Production. Medical isotopes are produced in accelerators or reactors or by extracting them from byproduct materials created by the weapons program. Dozens of different isotopes can be created, each with unique characteristics and potential uses. These isotopes can be used for diagnosis or therapy. Diagnostic isotopes are used for imaging internal organs, similar to the result of an x-ray. Therapeutic isotopes can be injected directly into a tumor or attached to an antibody that seeks out and locates the tumor. In this manner, the cancer cells are destroyed with little or no damage to the surrounding healthy cells.

New therapeutic applications for radioisotopes are showing great promise in clinical trials, but only small quantities are available for research. If clinical trials are successful and there is subsequent Food and Drug Administration approval, the number and size of current operating reactors in the United States would not be able to meet the expected medical need. The Fast Flux Test Facility is capable of producing a wide variety of isotopes. Over the reactor's 10-year life, approximately 60 different medical and industrial isotopes were created for researchers and medical practitioners.

The Decision Process. In, or before, December 1998, DOE is expected to make a decision on whether the Fast Flux Test Facility could play a role in tritium production for the nation's nuclear weapons stockpile. That decision will be based on studies, analyses, and public input. A decision to further consider restart as an option would trigger a full National Environmental Policy Act review.

2.3.7 Advanced Reactors Transition Project

This project includes the Fast Flux Test Facility reactor complex, the Fuels and Materials Examination Facility, nuclear energy legacy facilities, and the 309/Plutonium Recycle Test Reactor facility. The mission of this project is to maintain the Fast Flux Test Facility and its associated support facilities in a safe and stable condition.

Fast Flux Test Facility deactivation activities completed in 1997 included removal of 56 highly radioactive fuel components, washing and placing the components in interim storage casks, and transporting the casks to the 400 Area interim storage area. Additionally, work began to replace the Freon 12 refrigerant in the eight Fast Flux Test Facility chiller units with non-ozone-depleting R-134a refrigerant.

Nuclear fuel was removed from the 308 Building (a DOE Nuclear Energy Program subproject) in the 300 Area, and deactivation activities for this building were completed. Cleanout of the rupture loop ion exchange vault in the 309 Building, which housed the Plutonium Recycle Test Reactor, was completed, and characterization was performed on the rupture loop annex.

A Resource Conservation and Recovery Act clean-closure certification for the 4843 Alkali Metal Storage Facility in the 400 Area was accepted by the Washington State Department of Ecology in 1997. Efforts are ongoing to complete Resource Conservation and Recovery Act clean closure for the 3718-F Alkali Metal Treatment and Storage Facility in the 300 Area.

As part of the nuclear energy legacy facility deactivation program, approximately 150,000 L (40,000 gal) of non-radioactive sodium from the 1720-DR and 3718-M tanks (in the 100-D and 300 Areas, respectively), were transferred to railroad tank cars and sold to an offsite vendor.

2.3.8 Tank Waste Remediation System Activities

2.3.8.1 Waste Tank Status

The status of the 177 waste tanks as of December 1997 was reported in HNF-EP-0182-117. This report is

published monthly; the December report provided the following:

- number of waste tanks
 - 149 single-shell tanks
 - 28 double-shell tanks
- number of tanks listed as “assumed leaker” tanks^(a)
 - 67 single-shell tanks
 - 0 double-shell tanks
- chronology of single-shell tank leaks
 - 1956: first tank reported as suspected of leaking (Tank 241-U-104)
 - 1973: largest estimated leak reported (Tank 241-T-106; 435,000 L [115,000 gal])
 - 1988: Tanks 241-AX-102, -C-201, -C-202, -C-204, and -SX-104 reported as confirmed leakers
 - 1992: latest tank (241-T-101) added to assumed leaker list, bringing total to 67 single-shell tanks
 - 1994: Tank 241-T-111 declared an assumed re-leaker
- number of ferrocyanide tanks on the Watch List
 - 0 (all 18 single-shell tanks were removed from the Watch List in 1996)
- number of flammable gas tanks on the Watch List
 - 19 single-shell tanks
 - 6 double-shell tanks
- number of organic tanks on the Watch List
 - 20 single-shell tanks.

So far, 119 single-shell tanks have been stabilized, with the tank stabilization program to be completed in 2000. At the end of 1997, 108 single-shell tanks had intrusion prevention devices completed, and 51 single-shell tanks were disconnected and capped to avoid inadvertent liquid additions to the tanks.

The total estimated volume to date of radioactive waste leakage from single-shell tanks is 2.3 million to 3.4 million L (600,000 to 900,000 gal).

During 1997, pumping to double-shell tanks was performed on six single-shell tanks. Portions of Tanks 241-T-104, T-110, and SX-104 were pumped. Tanks 241-BY-109, BY-103, and S-110 were pumped and declared stabilized.

2.3.8.2 Waste Tank Safety Issues

The Waste Tank Safety Program, now called Safety Issue Resolution Projects, was established in 1990 to address the hazards associated with storage of radioactive mixed waste in the 177 underground storage tanks at the Hanford Site. The projects serve as the focal point for identification and resolution of selected high-priority waste tank safety issues, with resolutions being completed in priority order. Tanks with the highest risk are being evaluated and mitigated first. The tasks to resolve safety issues are planned and implemented in the following logic sequence: 1) evaluate and define the associated safety issue, 2) identify and close any associated unreviewed safety questions (DOE/EH-0173T), 3) mitigate any hazardous conditions to ensure safe storage of the waste, 4) monitor waste storage conditions, and 5) resolve the respective safety issues. Each of these steps has supporting functions of some combination of monitoring, mathematical analyses, laboratory studies, and in-tank sampling or testing. The path followed depends on whether the waste requires treatment or can be stored safely by implementing strict controls.

Safety Issue Resolution Projects is currently focusing on resolution of flammable gas, organic, high-heat, and criticality safety issues as described below. The tanks of concern are placed on a Watch List and categorized by safety issue. In 1996, all 24 ferrocyanide tanks had been removed from the Watch List, and the issue was deemed resolved by DOE and the Defense Nuclear Facilities Safety Board. At the end of 1997, there were 38 tanks remaining on the Watch List: 25 flammable gas tanks, 20 organic tanks, and 1 high-heat tank (some of the tanks are included under more than one category). These tanks were identified in accordance with the Defense Authorization Act, Section 3137, “Safety Measures for Waste Tanks at Hanford Nuclear Reservation” (1990).

2.3.8.3 Watch List Tanks

In early 1991, all Hanford Site high-level waste tanks were evaluated and organized into categories to ensure

(a) “Assumed leaker” refers to tanks that have leaked or are assumed to have leaked. No tanks are known to be currently leaking.

increased attention and monitoring. Other safety concerns, including the possibility of nuclear criticality in a waste tank, have also been addressed.

Ferrocyanide. The ferrocyanide safety issue, which was an earlier concern, involved the potential for uncontrolled exothermic reactions of ferrocyanide and nitrate/nitrite mixtures (WHC-EP-0691). If ferrocyanide is present, laboratory studies show that temperatures must exceed 250°C (482°F) for a reaction to propagate. The hottest temperature in ferrocyanide tanks formerly on the Watch List is 53°C (127°F) and decreasing. In October 1990, an unreviewed safety question was declared for the former ferrocyanide tanks because safety was not adequately defined by existing analyses. However, the unreviewed safety question was closed by DOE in March 1994 as a result of significant knowledge gained from simulant studies, conservative theoretical analyses, and analyses of actual waste samples that allowed bounding safety criteria to be defined and applied to each tank (WHC-EP-0691). There were originally 24 ferrocyanide tanks on the Watch List: 4 were removed in 1993, 2 in 1994, and 18 in 1996. The ferrocyanide levels have decreased by at least 90%, and in some cases by 99%, over what was originally in the tanks. Experimental studies (PNNL-12111) and core samples from 10 of the ferrocyanide tanks show that hydrolysis and radiolysis of the ferrocyanide occurred and sufficient fuel to be of concern is no longer present (WHC-SD-WM-SARR-038, Rev. 1). DOE approved resolution of the ferrocyanide safety issue in December 1996.

Flammable Gas. The flammable gas safety issue involves the generation, retention, and potential release of flammable gases by the waste. Twenty-five tanks have been identified and placed on the Watch List. In prior years, work controls were instituted to prevent introduction of spark sources into these tanks, and evaluations were completed to ensure that installed equipment was intrinsically safe.

The worst-case tank (241-SY-101) was successfully mitigated in 1994 with the installation of a mixing pump. The pump is operated up to three times a week to mix the waste and release gases that are generated and retained in the waste. This mitigation technique has been completely successful, and no episodic releases of gas have occurred since the pump was installed. Two spare mixer pumps are available in the event the original pump should fail.

In November 1995, more stringent flammable gas controls were placed on all 177 high-level waste storage tanks after several events occurred where hydrogen gas

was found during several waste intrusive activities. All rotary-mode sampling using the sampling trucks was suspended until a safety assessment of this sampling method could be approved for tanks because they might be retaining pockets of gas within the waste matrix.

Hydrogen monitors have been installed on all 25 flammable gas tanks. These monitors, called standard hydrogen monitoring systems, consist of a cabinet equipped with piping and instrumentation that support an on-line hydrogen detector and a "grab" sampler. The unreviewed safety question for Tank 241-SY-101 was closed in June 1996. In November 1996, the unreviewed safety question for the other tanks was expanded to cover 176 underground waste tanks (241-SY-101 is not included) and all auxiliary tank farm tanks. Standard hydrogen monitoring systems are being added to a number of these waste tanks.

Additional instrumentation for determining waste properties and tank behavior has been developed for use in the flammable gas tanks. These instruments include viscometers to measure the viscosity of the waste in the tanks, in-tank void fraction meters that determine the amount of gas in a given volume of waste, retained gas samplers that capture a waste sample in a gas-tight chamber and allows the gas composition and volume to be measured after the apparatus is brought into a hot cell, and gas characterization systems that allow a broad spectrum of dome-space gases (including hydrogen, ammonia, and nitrous oxide) to be continuously monitored in selected tanks. All of these devices became operational in 1996.

The Tri-Party Agreement milestone for resolution of the flammable gas safety issue is scheduled for September 2001.

High-Heat Tank. This safety issue concerns Tank 241-C-106, a single-shell tank that requires water additions and forced ventilation for evaporative cooling. Without the water additions, which would have to be severely restricted in the event of a tank leak, the tank could exceed structural temperature limits, resulting in potential concrete degradation and possible tank collapse. This tank is scheduled for retrieval, starting in 1998, and transfer of the waste to a double-shell tank. Double-shell tanks are designed to better handle heat-bearing materials than single-shell tanks. As part of the retrieval program, a refrigerated chiller system has been installed to remove radioactive decay heat and the heat generated by the waste transfer pumps. The chiller is scheduled to come on-line in 1998.

The Tri-Party Agreement milestone for resolution of the high-heat safety issue is scheduled for September 2001, with an interim milestone to start retrieval of the waste in Tank 241-C-106 by October 1997. This interim milestone is being renegotiated and a hearing is scheduled for June 1998.

Organic Tanks. The organic tanks safety issue involves the potential for uncontrolled exothermic reactions of organic chemicals and nitrates/nitrites or organic solvents also present in some of the tanks. During 1995, as part of the vapor sampling program, it was shown that organic vapors in the organic tanks are too low in concentration to exceed even 25% of their lower flammability limits. Criteria to screen tanks for possible organic compounds were also established based on analyses and simulant testing. Tank waste was screened against these criteria, using historic and recent sampling data (WHC-SD-WM-SARR-033, Rev. 1). Concentrations and temperatures required to support propagating exothermic reactions are comparable to those for ferrocyanide (WHC-SD-WM-ER-496). In addition, moisture levels of 20 weight percent, and less in some cases, will prevent reactions from propagating regardless of the fuel concentration. To determine if adequate moisture is present in the waste, special surface monitoring instrumentation was developed, and full-depth core sampling of waste in organic tanks is continuing.

Work controls were implemented in 1990 to prevent the introduction of ignition sources into these tanks. In May 1994, vapor sampling and safety analyses were completed that provided the technical basis for closing the unreviewed safety question on the flammability of the floating organic layer in Tank 241-C-103 (WHC-SD-WM-SARR-001). Ten tanks that contained organic complexants were added to the Watch List following a review of sampling data and waste transfer records (WHC-EP-0182-79).

Other work indicates that aging processes have destroyed or significantly lowered the energy content of the organic tanks (WHC-EP-0823, WHC-SD-WM-SARR-033, Rev. 1), making them less hazardous. In addition, WHC-EP-0899-1 shows that most organic complexants used during nuclear fuel reprocessing at the Hanford Site and the primary degradation products of tributyl phosphate are water soluble in nitrate/nitrite salt solutions. Thus, a high percentage of reactive organic chemicals is removed from the single-shell tanks when their pumpable liquid supernatant is pumped out as part of the interim stabilization process for the single-shell tanks.

During 1995 through 1997, waste samples from the organic tanks were taken to determine the quantities of organic constituents present in each tank. Most of the organics found have been of low energy. None of the samples show any tendency to propagate when tested in a special tube propagation calorimeter (FAI/96-45, FAI/96-48). Tank characterization reports have been or are being prepared for each of the sampling events. The Tri-Party Agreement milestone for resolution of the organic tanks safety issue is scheduled for September 2001.

Criticality. The unreviewed safety question on the potential for criticality in the high-level waste tanks was closed in 1994 by completing additional analyses, strengthening tank criticality prevention controls, and improving administrative procedures and training (WHC-SD-WM-SARR-003). In 1996, an extensive effort was put forth to provide the technical basis for resolving the criticality safety issue. Technical studies were completed that showed a criticality event within a high-level waste tank is not likely during storage (WHC-SD-WM-TI-725). All of the single- and double-shell tanks at the Hanford Site contain sufficient neutron absorbers to ensure safe storage; however, additional sampling and controls will be required for retrieval- and pretreatment-related activities. Verification of the criticality safety program controls will be completed in May/June 1998. Successful completion of this review will enable DOE to close the criticality safety issue and satisfy the related Tri-Party Agreement milestone. The Tri-Party Agreement milestone for resolution of the criticality safety issue is scheduled for September 1999.

2.3.8.4 Vadose Zone Characterization Near Single-Shell Underground Waste Storage Tanks

Since 1995, the DOE Grand Junction Office has been performing a baseline spectral gamma borehole logging characterization of the vadose zone around the single-shell underground waste storage tanks at Hanford. This characterization work is being done in part to comply with Resource Conservation and Recovery Act requirements to identify contamination sources and to determine the nature and extent of the contamination from the single-shell tanks. The work will also assist with closure of the tanks under the Act.

The characterization program involves establishing a baseline of the contamination distribution of gamma-emitting radionuclides in the vadose zone by logging the

existing boreholes surrounding the tanks with spectral gamma-ray logging systems. Once the concentrations of the subsurface radionuclides are determined at a single borehole, these data or logs are correlated with other borehole log data to produce three-dimensional representations of the contamination plumes in the vadose zone. The logs and the visual representations provide a basic understanding of the contamination distribution; they can be used to guide more comprehensive characterization and provide a baseline for future data comparisons such as assessing at what rate certain contaminants have or are migrating.

This project, as planned, has inherent limitations. These limitations were understood in the original planning; however, as designed, the project serves as the initial investigation needed prior to beginning a thorough vadose zone characterization. First, the gamma-emitting radionuclides are assayed because they are much easier to detect and quantify, whereas many of the radionuclides and hazardous constituents that pose health and safety risks are not detected. The project is also limited to providing log assays of the contamination in existing boreholes. No new boreholes are being drilled for logging alone, though the equipment has been used to log three new characterization boreholes put in the SX Tank Farm in the 200-West Area. This includes the extension of borehole 41-09-39 to groundwater, results of which will be reported in next year's Hanford Site environmental report. Another limitation relates to questions about the representativeness of the three-dimensional contamination plume visualizations. The accurate determination of the distributions and quantification of contaminants is just beginning. Statistically rigorous cross-borehole correlations are not yet developed, thereby making the representativeness of portions of some visualizations questionable.

The baseline characterization program has been successful in its original objective by identifying the nature of the vadose zone contamination problem and locating areas needing further and more comprehensive characterization. The utility of the baseline characterization has been shown by the discovery of cesium-137 deeper in the vadose zone than previously predicted, thereby questioning the understanding of the mobility of cesium-137 at the Hanford Site.

The first step of the baseline characterization is to log the boreholes. The log data are then analyzed, interpreted, and reported in a tank summary data report for each tank. Once all tank summary data reports are complete for a particular tank farm, a more comprehensive tank farm

report is prepared. The tank farm report provides a correlation of the data from all boreholes in the farm to produce an understanding of the distribution of contamination around the farm.

The logging operations for the baseline characterization began in 1995 and should be completed in early 1999. During 1997, 211 additional boreholes were logged surrounding tanks in the A, B, BX, and C Tank Farms in the 200-East Area.

Preparation of tank summary data reports also began in 1995. During 1997, 42 additional reports were prepared using data from boreholes logged in 1996 and 1997.

The first tank farm report was prepared in 1996. During 1997, tank farm reports were prepared for the AX Tank Farm in the 200-East Area and the TX, TY, and U Tank Farms in the 200-West Area. The BY Tank Farm report was primarily prepared in 1996 and was published in January 1997. It was discussed in last year's environmental report, so it will not be discussed here.

Also during 1997, improvements were made to the visualizations of the contamination. It was determined, with the help of the SX Tank Farm expert panel, that the amount of contamination carry-down during drilling could be significant. As a result, modifications were made to the visualizations to remove contamination that was thought to be due to contamination carry-down during drilling. Some borehole log data, showing isolated regions of contamination deep in the vadose zone that could not be correlated with similar regions in other boreholes, were attributed to contamination carry-down and those data were removed from the visualization database. Additionally, a gamma-ray spectrum shape factor analysis method was implemented, beginning with the logging done in fiscal year 1997. This analytical method was developed during 1996 and 1997 to provide information on the radial distribution of contamination around the boreholes. This method basically allows a qualitative assessment of the gamma-ray spectra to help differentiate between regions in the borehole where contamination is located adjacent to the casing versus regions where contamination is distributed uniformly in the formation or remote to the borehole. When used in conjunction with other analysis and interpretation methods, shape factor analysis helps in the identification of regions of contamination carry-down. Since implementation, the shape factor analytical method has resulted in additional improvements to the quality and accuracy of the visualizations.

The baseline characterization work in 1997 helped to identify several areas of concern that will require additional and more comprehensive characterization. This work also identified potential sources for suspected and known groundwater contamination plumes, providing a starting point for the more comprehensive vadose zone characterization work.

For a more comprehensive description of the single-shell tank vadose zone spectral gamma logging program and references to detailed reports, the reader is referred to Section 6.2, "Vadose Zone Characterization and Monitoring."

2.3.8.5 Waste Immobilization

Approximately 215 million L (55 million gal) of radioactive and hazardous wastes accumulated from over 40 years of plutonium production operations are stored in 149 underground single-shell tanks and 28 underground double-shell tanks. Current plans are to pretreat the waste and then solidify it into a glass matrix. Pretreatment will separate the wastes into a low-radioactivity fraction and a high-radioactivity and transuranic fraction. In separate facilities, both fractions will be vitrified in a process that will destroy or extract organic constituents, neutralize or deactivate dangerous waste characteristics and immobilize toxic metals. The immobilized low-radioactivity fraction will be disposed of in a near-surface facility on the Hanford Site in a retrievable form. The immobilized high-radioactivity fraction will be stored onsite until a geologic repository is available offsite for permanent disposal. Tri-Party Agreement milestones specify December 2028 for completion of pretreatment and immobilization of the tank wastes.

During 1996, a change request to Tri-Party Agreement milestones was approved, allowing DOE to proceed with the planned privatization of the initial pretreatment and immobilization function of the Tank Waste Remediation Program. The approach to privatization will be conducted in two phases.

Phase I will be a proof-of-concept/commercial demonstration phase. This phase will involve pretreatment and vitrification of the low-level waste. High-level waste separated in the pretreatment process would either be stored on an interim basis until sufficient quantities are collected to make it cost effective to process or vitrify as an option in this phase. The objectives of this phase are to 1) demonstrate technologies and processes in a production-level environment; 2) treat and immobilize sufficient waste to demonstrate early progress in remediating

the tank situation to the stakeholders; 3) better understand the costs, risks, and benefits of the fixed-price privatization framework; 4) ascertain the financial viability of the private marketplace to accomplish the mission; 5) establish conditions for DOE to be a "smart buyer" and for private companies to be "smart providers" of treated waste products for Phase II; and 6) balance the private companies' objectives with DOE's objectives.

Phase I will be divided into two subparts. Subpart A includes a 20-month period for establishing the technical, operational, regulatory, and financial elements required by the contractors to provide waste treatment services at fixed unit prices. DOE selected two companies in 1997 to establish these requirements. Contracts were awarded to British Nuclear Fuels Ltd. and Lockheed Martin Advanced Environmental Systems to work on this part of Phase I. Both companies provided a proposal to DOE in 1997 to continue work on Phase I. In May 1998, DOE authorized British Nuclear Fuels Ltd. to proceed with Phase I, Subpart B, which consists of a 10- to 14-year period for providing waste treatment services in privatized facilities. DOE will order a minimum quantity of waste treatment services during this phase and may provide additional orders.

Phase II will be the full-scale production phase. Facilities will be sized so all of the remaining waste can be processed and immobilized on a schedule that will accommodate removing the waste in single-shell tanks by 2018. Objectives of the full-scale production phase are to 1) implement the lessons learned from Phase I; 2) process all tank waste into forms suitable for final disposal while meeting environmental, health, and safety requirements; 3) meet or exceed the Tri-Party Agreement benchmark performance milestones; and 4) as in Phase I, balance the private vendor's objectives with DOE's objectives. At the end of any contract, the contractor will deactivate all contractor-provided facilities.

2.3.9 Solid Waste Management Activities

2.3.9.1 Waste Receiving and Processing Facility

During 1994, construction was started on the first major solid waste processing facility associated with cleanup of the Hanford Site. Having started operation in March

1997, the Waste Receiving and Processing Facility is staffed to analyze, characterize, and prepare drums for disposal of waste resulting from plutonium operations at Hanford. The 4,800-m² (52,000-ft²) facility is near the Central Waste Complex in the 200-West Area (see Figure 1.0.2). The facility is designed to process approximately 6,800 drums and 80 boxes of waste annually for 30 years.

Wastes destined for the Waste Receiving and Processing Facility include Hanford's current inventory of more than 37,000 drums of stored waste as well as materials generated by future site cleanup activities across the DOE complex. Consisting primarily of clothing, gloves, face masks, small tools, and particulates suspected of being contaminated with plutonium, waste containers may also contain other radioactive materials and hazardous components. Processed waste that qualifies as low-level waste and meets disposal requirements will be buried directly at the Hanford Site. Low-level waste not meeting burial requirements will be treated in the facility to meet the requirements or will be prepared for future treatment at other onsite or offsite treatment, storage, and disposal facilities. Waste determined in the facility to be transuranic will be certified and packaged for shipment to the Waste Isolation Pilot Plant in Carlsbad, New Mexico for permanent storage. Materials requiring further processing to meet disposal criteria will be retained at Hanford pending treatment.

2.3.9.2 Radioactive Mixed Waste Disposal Facilities

The Radioactive Mixed Waste Disposal Facilities at the Hanford Site are the first in DOE's complex for disposal of radioactive mixed wastes. These facilities are located in the low-level burial grounds in the 200-West Area and are designated Trenches 218-W-5, 31, and 34. Trench 34 is currently operating in a storage mode containing long-length contaminated equipment, macroencapsulated tubes, and a United States Navy reactor core basket. The facilities consist of rectangular landfills with approximate base dimensions of 76 by 30 m (250 by 100 ft). The bottoms of the excavations slope slightly, giving a variable depth of 9 to 12 m (30 to 40 ft).

These facilities are designed to comply with Resource Conservation and Recovery Act requirements for double liners and leachate collection and removal systems. The bottom and sides of the facilities are covered with a 1-m (3-ft)-deep layer of soil to protect the liner system during

fill operations. There is a recessed section at one end of the excavations that houses the sumps for leachate collection. Access to the bottom of the landfills is provided by ramps along the perimeters.

2.3.9.3 T Plant Complex

The function of the T Plant complex in the 200-West Area is to provide waste processing and decontamination services for the Hanford Site. Two facilities are used to provide these services: the T Plant canyon and the 2706-T Building. Other areas around these facilities are also used to support these services. The T Plant complex is a Resource Conservation and Recovery Act-permitted facility, which can store waste for greater than 90 days and perform treatment in tanks and other containers. T Plant's waste handling activities in 1997 included the following:

- performing content verification of wastes being shipped to solid waste facilities for storage or disposal
- repackaging and/or sampling waste to meet solid waste acceptance criteria or to determine acceptability of waste for treatment
- treating dangerous and mixed wastes to meet Resource Conservation and Recovery Act requirements for land disposal
- decontaminating equipment to allow for reuse or disposal as waste
- storing 27 metric tons (30 tons) of Shippingport, Pennsylvania pressurized water reactor spent fuel in a water basin.

Plans for upgrading the 2706-T Building liquid waste storage tank system were finalized in 1996. These upgrades will make the 2706-T tank system fully compliant with the regulations and will allow for improved liquid waste handling capabilities. Construction on this project started in January 1997; completion is expected by September 1998.

2.3.9.4 Radioactive Mixed Waste Treatment and Disposal

After years of accumulating and storing mixed waste at Hanford, emphasis turned to treatment and disposal during 1997. During the year, 490 m³ (640 yd³) of mixed

waste contained in 1,150 drums, boxes, and specialty containers were treated and/or disposed at the Hanford Site. The waste materials were obtained from a number of projects, and included the following:

- Mixed low-level debris (925 drums) was compacted, overpacked, and macroencapsulated in high-density polyethylene tubes using commercially available technology. This technology demonstration was jointly funded by DOE Waste Management Programs and Technology Development organizations.
- Three thermocouples that had been removed from underground radioactive waste storage tanks were macroencapsulated with grout infill and placed in the mixed waste trench for storage and ultimate disposal.
- A 22-m³ (29-yd³) United States Navy core basket was prepared and transported from the Central Waste Complex to the mixed waste trench where it is awaiting final disposal. The core basket contains radioactive debris generated from the decommissioning of nuclear submarine reactors and was encapsulated in a heavy steel shell.
- High-efficiency particulate air filters (196 m³ [256 yd³]) were disposed of.
- Stabilized Battelle Columbus sludge (3 m³ [3.9 yd³]) was disposed of.
- Contaminated soil (28 m³ [36.6 yd³]) was disposed of.
- The cost of mixed waste treatment was avoided altogether on soils and high-efficiency particulate air filters that had been previously designated as mixed waste. The containers were carefully reanalyzed and, with the support of regulators, were redesignated as low-level waste and disposed of.

2.3.9.5 Radioactive Mixed Waste Treatment Contracts

In November 1995, a contract was awarded to Allied Technology Group, Inc. for thermal treatment of mixed waste in accordance with the Resource Conservation and Recovery Act and Toxic Substances Control Act. The contract provides for treating up to 3,585 m³ (4,690 yd³) of mixed waste over 5 years with five 1-year renewal options. Waste processing is scheduled to begin in fiscal year 2001.

During 1997, a competitive procurement was conducted for the processing of mixed waste requiring nonthermal treatment in accordance with the Resource Conservation and Recovery Act. The resulting contract provides for treatment of up to 1,660 m³ (2,170 yd³) of mixed waste debris and up to 200 m³ (260 yd³) of nondebris inorganic mixed waste. The contract, which was also awarded to Allied Technology Group, Inc., runs from fiscal years 1999 through 2001. These contracts, together with follow-on procurements, will provide cost-effective alternatives for continuing to treat mixed waste in the future.

2.3.9.6 Navy Reactor Compartments

Eleven defueled United States Navy reactor compartment disposal packages were received and placed in Trench 94 in the 200-East Area during 1997. This brings the total number received to 71. The compartments originate from decommissioned nuclear-powered submarines.

The reactor compartment disposal packages are being regulated by Washington State as dangerous waste because of the presence of lead used as shielding and by EPA because of the presence of small amounts of polychlorinated biphenyls tightly bound within the composition of solid materials such as thermal insulation, cable coverings, and rubber. Also, the compartments are regulated as mixed waste because of radioactivity in addition to dangerous waste.

2.3.9.7 325 Building Hazardous Waste Treatment Units

The 325 Building hazardous waste treatment units in the 300 Area receive, store, and treat mixed and hazardous waste generated by Pacific Northwest National Laboratory programs. The units consist of the Shielded Analytical Laboratory and the Hazardous Waste Treatment Unit. These units are operating under final status granted in February 1998.

The Shielded Analytical Laboratory is a facility that has a dual role as an analytical laboratory and a treatment facility. The laboratory performs tank treatment and bench-scale treatment of high dose rate laboratory waste (2,000 rem/h capability).

The Hazardous Waste Treatment Unit is a treatment facility that contains fume hoods and gloveboxes for mixed waste treatment. The facility is used for bench-scale treatment of mixed and dangerous waste from various

Pacific Northwest National Laboratory programs and for treating transuranic and transuranic mixed waste by neutralization and stabilization.

2.3.9.8 Underground Storage Tanks

There are 15 underground storage tanks on the Hanford Site registered with the Washington State Department of Ecology (WAC 173-360). Four of the tanks contain gasoline or diesel fuel (two each) for vehicles and the remaining 11 are diesel storage tanks for supplying emergency diesel generators. Six of the 15 tanks (emergency diesel generator tanks) will be modified, replaced, or eliminated to meet new compliance standards for leak detection and inventory control that go into effect on December 22, 1998.

2.3.10 Liquid Effluent Activities

2.3.10.1 242-A Evaporator

Available storage space to support remediation of tank waste and cleanup of the Hanford Site is limited in the double-shell tanks. The 242-A Evaporator in the 200-East Area processes double-shell tank waste into a concentrate (that is returned to the tanks) and a process condensate stream. The evaporator had two processing campaigns in 1997. Dilute waste from the double-shell tanks was processed, resulting in a waste volume reduction of 3.98 million L (1.05 million gal) while producing 4.72 million L (1.25 million gal) of process condensate. One campaign is scheduled for 1998.

Effluent treatment and disposal capabilities are available to support the continued operation of the evaporator. The 200 Areas Effluent Treatment Facility near the 200-East Area was constructed to treat the process condensate. Process condensate is temporarily stored in the Liquid Effluent Retention Facility while awaiting treatment in the 200 Areas Effluent Treatment Facility. Cooling water and nonradioactive steam condensate from the evaporator were discharged to the 200 Areas Treated Effluent Disposal Facility starting in 1997.

2.3.10.2 Liquid Effluent Retention Facility

The Liquid Effluent Retention Facility consists of three Resource Conservation and Recovery Act-compliant surface impoundments for storing and treating process

condensate from the 242-A Evaporator and other aqueous wastes. The facility provides treatment through equalization of the flow and adjustment of pH of the feed to the 200 Areas Effluent Treatment Facility. The maximum capacity of the Liquid Effluent Retention Facility is 92 million L (24.3 million gal). The basins are constructed of two, flexible, high-density, polyethylene membrane liners. A system is provided to detect, collect, and remove leachate from between the primary and secondary liners. Beneath the secondary liner is a soil/bentonite barrier should the primary and secondary liners fail. Each basin has a mechanically tensioned floating membrane cover constructed of very low-density polyethylene to keep out unwanted material and to minimize evaporation of the basin contents. The facility began operation in April 1994. Aqueous waste is currently being received from both Resource Conservation and Recovery Act- and Comprehensive Environmental Response, Compensation, and Liability Act-regulated cleanup activities. Approximately 39 million L (10.3 million gal) of aqueous waste were stored in the basins at the end of 1997.

2.3.10.3 200 Areas Effluent Treatment Facility

The 200 Areas Effluent Treatment Facility is a series of unit operation providing treatment and storage for hazardous and radioactive aqueous waste. The treated effluent is stored in verification tanks, sampled and analyzed, and discharged to the State-Approved Land Disposal Site (north of the 200-West Area). The treatment process constitutes best available technology, and the unit operations include filtration, ultraviolet light/peroxide destruction of organic compounds, reverse osmosis to remove dissolved solids, and ion exchange to remove the last traces of contaminants. Treatment capacity of the facility is 570 L/min (150 gal/min). The facility began operation in December 1995; approximately 59 million L (15.5 million gal) of aqueous waste were treated in 1997.

The treated effluent is sampled to verify that the concentrations of radioactive and hazardous waste constituents have been reduced to regulatory levels; then discharged via a dedicated pipeline to the State-Approved Land Disposal Site. The disposal site is located north of the 200-West Area and consists of an underground drain field. The percolation rates for the field have been established by site testing and evaluation of soil characteristics. Tritium in the liquid effluent cannot be practically removed, and the location of the disposal site maximizes the time for migration to the Columbia River to allow for

radioactive decay. The Final Delisting (40 CFR 261, Appendix IX, Table 2) excludes the treated effluent from the requirements of dangerous waste regulations and the Resource Conservation and Recovery Act; however, certain effluent quality restrictions are imposed. The disposal site is permitted by the Washington State Department of Ecology under WAC 173-216. The permit requires monitoring of the groundwater and the treated effluent to ensure that concentrations for certain constituents are not exceeded.

Secondary waste from treating aqueous waste is concentrated, dried, and packaged in 208-L (55-gal) drums. The 200 Areas Effluent Treatment Facility is a Resource Conservation and Recovery Act-permitted storage and treatment facility. The secondary waste from treating regulated aqueous waste is transferred to the Central Waste Complex for subsequent treatment (if needed to meet land disposal restriction treatment standards) and disposal in mixed waste Trench 218-W-5 in the 200-West Area. The secondary waste from treating Comprehensive Environmental Response, Compensation, and Liability Act-regulated aqueous waste is transferred to the Environmental Restoration Disposal Facility near the 200-West Area for disposal.

2.3.10.4 200 Areas Treated Effluent Disposal Facility

This disposal facility is a collection and disposal system for non-Resource Conservation and Recovery Act-permitted waste streams that have implemented "best available technology/all known and reasonable treatment." Implementation of regulatory "best available technology/all known and reasonable treatment" is the responsibility of the generating facilities. Generating facilities currently include the Plutonium Finishing Plant, 222-S Laboratory, T Plant, B Plant and Waste Encapsulation and Storage Facility, 242-A Evaporator, A Tank Farm, 244-AR Vault, and 242-A-81 Water Services Building.

This facility began operation in April 1995 and has a capacity of 12,900 L/min (3,400 gal/min). Approximately 696 million L (184 million gal) of treated effluent were discharged in 1997. The effluent is discharged to two 2-ha (5-acre) disposal ponds located east of the 200-East Area. The discharge permit requires monitoring of the effluent and the groundwater to ensure that concentrations for certain constituents are not exceeded.

2.3.10.5 300 Area Treated Effluent Disposal Facility

Wastewater from laboratories, research facilities, office buildings, and former fuel fabrication facilities in the 300 Area is treated in the 300 Area Treated Effluent Disposal Facility. The wastewater consists of once-through cooling water, steam condensate, and other liquid wastes generated in noncontact radioactive processes. The laboratory services are particularly critical to Hanford Site cleanup activities, including tank waste remediation efforts.

This facility is designed for continuous receipt of wastewaters, with a storage capacity of up to 5 days at the design flow rate of 1,100 L/min (300 gal/min). The treatment process includes iron coprecipitation to remove heavy metals, resin ion exchange to remove mercury, and ultraviolet light/hydrogen peroxide oxidation to destroy organics and cyanide. Sludge from the iron coprecipitation process is dewatered and used for backfill. The treated liquid effluent is monitored and discharged through an outfall to the Columbia River under a National Pollutant Discharge Elimination System permit. Capability exists to divert the treated effluent to holding tanks before discharge, if needed, until a determination can be made for final disposal based on sampling. This facility began operation in December 1994. In 1997, approximately 331 million L (87 million gal) of wastewater were treated.

2.3.10.6 340 Waste Handling Facility

This facility provides receipt, storage, and loadout capability for low-level mixed liquid waste generated during laboratory operations in the 300 Area. The waste is accumulated and stored in two 57,000-L (15,000-gal) tanks located in a covered, below-grade vault in the 340 Building. Six additional 30,000-L (8,000-gal) tanks in the adjacent 340-A Building provide backup storage capability. The accumulated waste is pumped into railcars and transported to the 204-AR Unloading Facility in the 200-East Area for neutralization and transfer to double-shell tanks for storage. The 340 Waste Handling Facility does not have a Resource Conservation and Recovery Act permit for storage; therefore, wastes cannot be stored for more than 90 days.

The facility will cease receiving waste in September 1998 when the new waste handling facility, with storage and truck loadout capability, is provided in the 325 Building. The 340 facility will then be cleaned out, decontaminated, and decommissioned.

2.3.10.7 Phase II Liquid Effluent Streams

DOE committed to implement “best available technology/ all known and reasonable treatment” for nine wastewater streams and to permit the streams under WAC 173-216 by October 1997. This activity was required by the Washington State Department of Ecology Consent Order #DE 91NM-177 and Tri-Party Agreement Milestone M-17-00B and included the elimination, minimization, or treatment of effluents being discharged to the 216-B-3 Expansion Ponds in the 200-East Area.

Project W-252 (Phase II Effluent Treatment and Disposal) was completed in 1997 and connected the following streams to the 200 Areas Treated Effluent Disposal Facility: 242-A Evaporator cooling water, 242-A Evaporator steam condensate, 284-E Power Plant wastewater (including 282-E and 283-E), and B Plant/Waste Encapsulation Storage Facility cooling water. Another stream, the A Tank Farm cooling water, was connected to the 200 Areas Treated Effluent Disposal Facility as part of Project W-030. State waste discharge permit #ST-4502 was revised so that additional streams may be disposed of to the 200 Areas Treated Effluent Disposal Facility.

2.3.10.8 Miscellaneous Streams

Miscellaneous streams are lower priority wastewater streams that discharge to the soil column throughout the Hanford Site and are subject to requirements in Washington State Department of Ecology Consent Order #DE 91NM-177. The *Plan and Schedule for Disposition and Regulatory Compliance for Miscellaneous Streams* (DOE/RL-93-94, Rev. 1) was approved by the Washington State Department of Ecology in February 1995. That plan and schedule ensure that miscellaneous streams will be in compliance with the applicable state regulations (e.g., WAC 173-216 and 173-218). The commitments established in the plan and schedule include annually updating the miscellaneous streams inventory (through 1998), registering injection wells, submitting categorical permit applications, and implementing best management practices.

The inventory includes more than 640 miscellaneous streams. Not included in the inventory are streams that already have discharge permits in place, streams for which permit applications have been submitted, or streams that are covered under a National Pollutant Discharge Elimination System permit. All injection wells were registered

under WAC 173-218 in August 1995, including injection wells that were previously registered. This ensured that the registrations were current, complete, and in the same format.

Use of categorical permits provides a vehicle to easily permit miscellaneous streams with similar characteristics. Categorical permit applications have been submitted or permits have been issued for the following:

- hydrotesting, maintenance, and construction discharges; permit #ST-4508 was issued in May 1997
- cooling water discharges and uncontaminated steam condensate; permit #ST-4509 was issued in May 1998
- stormwater discharges; permit application to be submitted in 1998.

Another categorical permit was planned for vehicle washing, coal ramp washdowns, and safety shower discharges. These streams have either been eliminated or were included in another existing permit. A best management practices report (DOE/RL-96-40) was submitted to the Washington State Department of Ecology in August 1997, identifying preferred options and an implementation plan to remediate those streams that have a potential to affect the groundwater.

2.3.11 Revegetation and Mitigation Planning

DOE Richland Operations Office and the environmental restoration contractor work cooperatively with the Natural Resource Trustees on the mitigation action plans for the various remedial action projects. The plans describe the planning and implementation of appropriate mitigation measures for areas disturbed during remediation. Mitigation measures include avoidance, minimization, rectification, or compensation of impacted resources. Revegetation/mitigation plans will include the use of native plant species (seeds and shrubs) as appropriate to restore the areas disturbed by remediation activities.

The *Hanford Site Biological Resources Management Plan* (DOE/RL-96-32) was developed to provide DOE and its contractors with a consistent approach to protect biological resources and monitor, assess, and mitigate impacts to them from site development and environmental cleanup and restoration activities. This comprehensive

plan provides a framework to enable Hanford Site resource professionals to effectively fulfill their responsibilities and address tribal, resource agency, and other stakeholder concerns about the site's biological resources. The policies and guidelines described in the plan were developed based on legal requirements and policy initiatives that direct an ecosystem management approach toward resources management.

The *Hanford Site Biological Resources Mitigation Strategy Plan* (DOE/RL-96-88) contains strategy that is part of the broader biological resource policy contained in the biological resources management plan (DOE/RL-96-32).

The strategy is designed to aid DOE in balancing its primary missions of waste cleanup, technology development, and economic diversification with its stewardship responsibilities for the biological resources it administers. This biological resources mitigation strategy will help ensure consistent and effective implementation of mitigation recommendations and requirements, ensure mitigation measures for biological resources meet the responsibilities of DOE under the law, enable Hanford Site development and cleanup projects to anticipate and plan for mitigation needs via early identification of mitigation requirements, and provide guidance to site personnel in implementing mitigation in a cost-effective and timely manner.