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PUREX/UO_3 Facilities Deactivation Lessons Learned History

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January 1995

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PUREX/UO_3 FACILITIES DEACTIVATION LESSONS LEARNED HISTORY

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EXECUTIVE SUMMARY

The Plutonium-Uranium Extraction (PUREX) Facility operated from 1956-1972, from 1983-1988, and briefly during 1989-1990 to produce plutonium for national defense at the Hanford Site in Washington State. The Uranium Trioxide (UO_3) Facility operated at the Hanford Site from 1952-1972, 1984-1988, and briefly in 1993. Both plants were ordered to permanent shutdown by the U.S. Department of Energy (DOE) in December 1992, thus initiating their deactivation phase. Deactivation is that portion of a facility's life cycle that occurs between operations and final decontamination and decommissioning (D&D). This document details the history of events, and the lessons learned, from the time of the PUREX Stabilization Campaign in 1989-1990, through the end of the first full fiscal year (FY) of the deactivation project (September 30, 1994).

During the standby period for these two facilities from 1990-1992, some progress began towards deactivation but many steps could not be taken because mission flexibility needed to be preserved. A notable step at this time was the preparation of an Independent Review Team assessment and report setting a pathway for the eventual deactivation.

Once the deactivation order came, work planning and scheduling began with the goal of reducing the safety risks and costs of the facilities quickly, so that they could be vacated to await future D&D. The value of fully integrated, logic-based, resource-loaded schedules was proven by the PUREX/UO_3 deactivation project, as a model for deactivating facilities across the nation. Schedule and work planning involved all levels of facility personnel.

The pathway to regulatory compliance taken by the PUREX and UO_3 Plants was unique. The basic philosophy was to meet the intent of the regulations while at the same time avoiding costs that did not make sense for facilities that soon would be closing. Through extraordinarily effective teamwork, regulators and Hanford Site officials achieved breakthroughs, such as a two-phased Closure Plan, which can be used to guide other facilities. In terms of safety documentation, the objective was to ensure safety but to avoid unnecessary documentation costs for the project. In the area of worker safety and health, a unique graded approach was developed that is being adopted across the DOE complex.

Many technical challenges existed in deactivating both the PUREX and UO_3 Facilities. Contamination fixation techniques were employed to eliminate the need for equipment removal, recycling and re-use was a guiding principal in disposing of some contaminated solutions, and other solutions were disposed quickly as waste to avoid protracted processing steps and costs. The concept that the entire facility must be deactivated was adopted so that overall costs for operating individual systems would not remain high. Careful characterization and consolidation of substances wherever possible was another key concept that guided technical decisions.

A great deal of innovation was involved in setting end point criteria, an iterative process undertaken jointly with D&D personnel. Stakeholder involvement also was considered crucial, with employees, Site neighbors, Indian nations, and many others considered as stakeholders. The overall *Project Management Plan* for the deactivation was a large and encompassing document that might better have been broken into separate strategic and technical components to make it easier to revise and function as a "living" document.

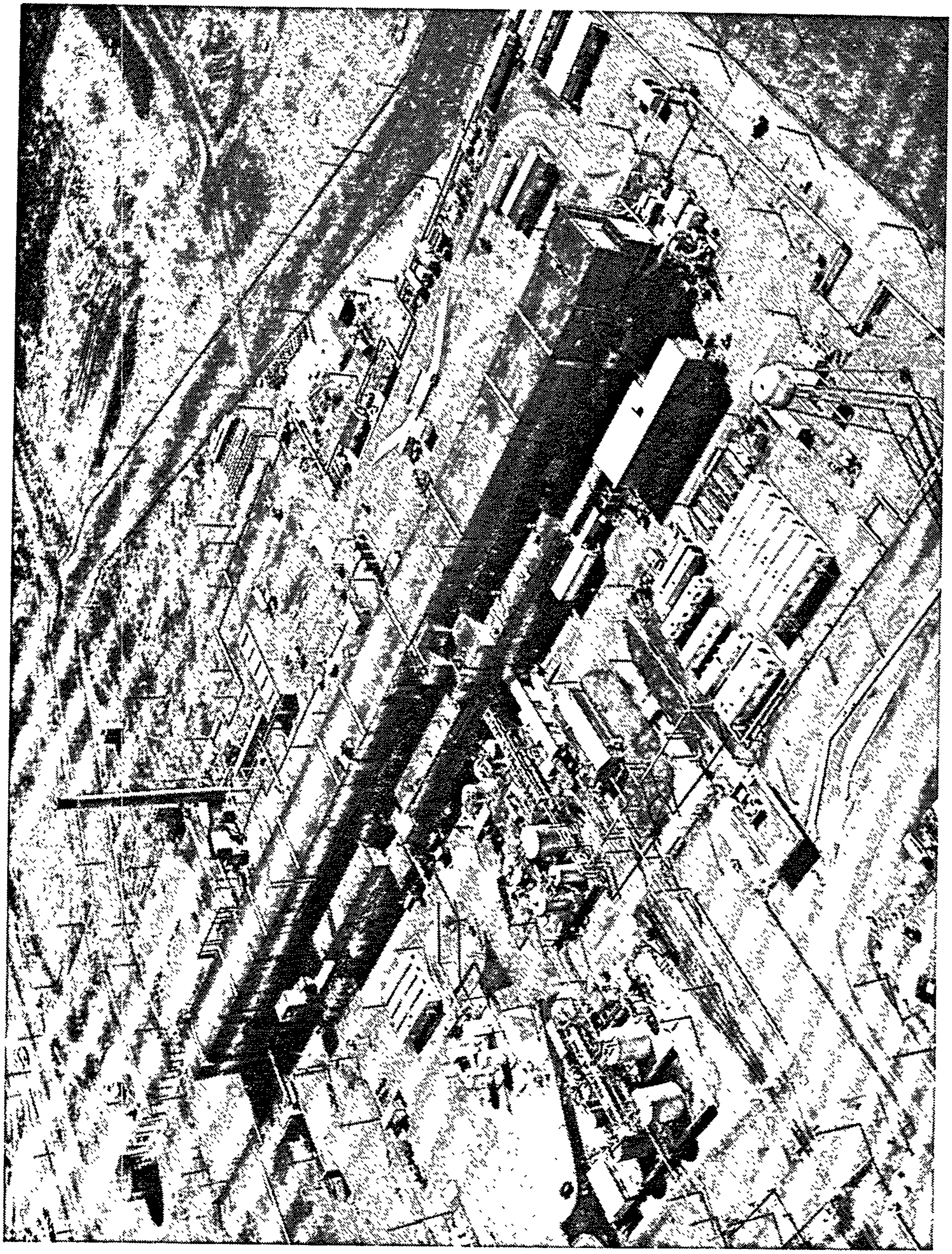

Figure 1. Aerial View of the PUREX Plant in 1990.

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ALARA	as low as reasonably achievable
BNFL	British Nuclear Fuels Limited
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CX	categorical exclusion
D&D	Decontamination and decommissioning
DOE-HQ	U.S. Department of Energy,Headquarters
RL	U.S. Department of Energy,Richland Operations Office
DOH	Washington State Department of Health
EA	Environmental Assessments
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FSAR	Final Safety Analysis Report
HVAC	heating, ventilation and air conditioning
HEAL	Hanford Education Action League
ITE	Independent Technical Experts
NEPA	*National Environmental Policy Act of 1969*
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NPH	normal paraffin hydrocarbon
OSHA	Occupational Safety and Health Administration
OSR	operations safety requirements
P&O	Pipe and operating
PCM	process control manual
PFP	Plutonium Finishing Plant
PHSA	Preliminary Hazards Screening/Assessment
PR	product removal
PUREX	Plutonium-Uranium Extraction
RCRA	*Resource Conservation and Recovery Act of 1976*
S&M	surveillance and maintenance
SRIDs	Standards and Requirements Identification Documents
TAP	toxic air pollutants
TBP	tri-butyl phosphate
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
UNH	uranyl nitrate hexahydrate
UO_3	Uranium Trioxide
USQ	unreviewed safety question
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION AND BACKGROUND

The Plutonium-Uranium Extraction (PUREX) Facility (202-A Building) was constructed by the Atomic Energy Commission [a predecessor agency to the U.S. Department of Energy (DOE)] during 1953-1955, and began full-scale processing of aluminum-clad, irradiated natural uranium (U) fuel elements in January 1956. It operated in support of the national plutonium (Pu) production efforts until September 1972. The dissolver equipment was changed beginning in 1963 to accommodate the processing of larger, zirconium-clad fuel elements with higher U-235 content. Throughout its early operating years, other modifications were made to the PUREX Plant to allow production increases, the separation of neptunium-237 in a separate, continuous stream, the processing of fuel from various special test reactors throughout the nation, and other missions. In November 1983, after undergoing 11 years of upgrades, the PUREX Facility reopened to resume the processing of irradiated fuel elements for defense production. The PUREX Facility closed for a brief period in 1988, to correct a minor violation of safety standards. On December 7, 1988, the plant was shut down for nearly a year when steam pressures fell below those needed to support backup safety equipment.

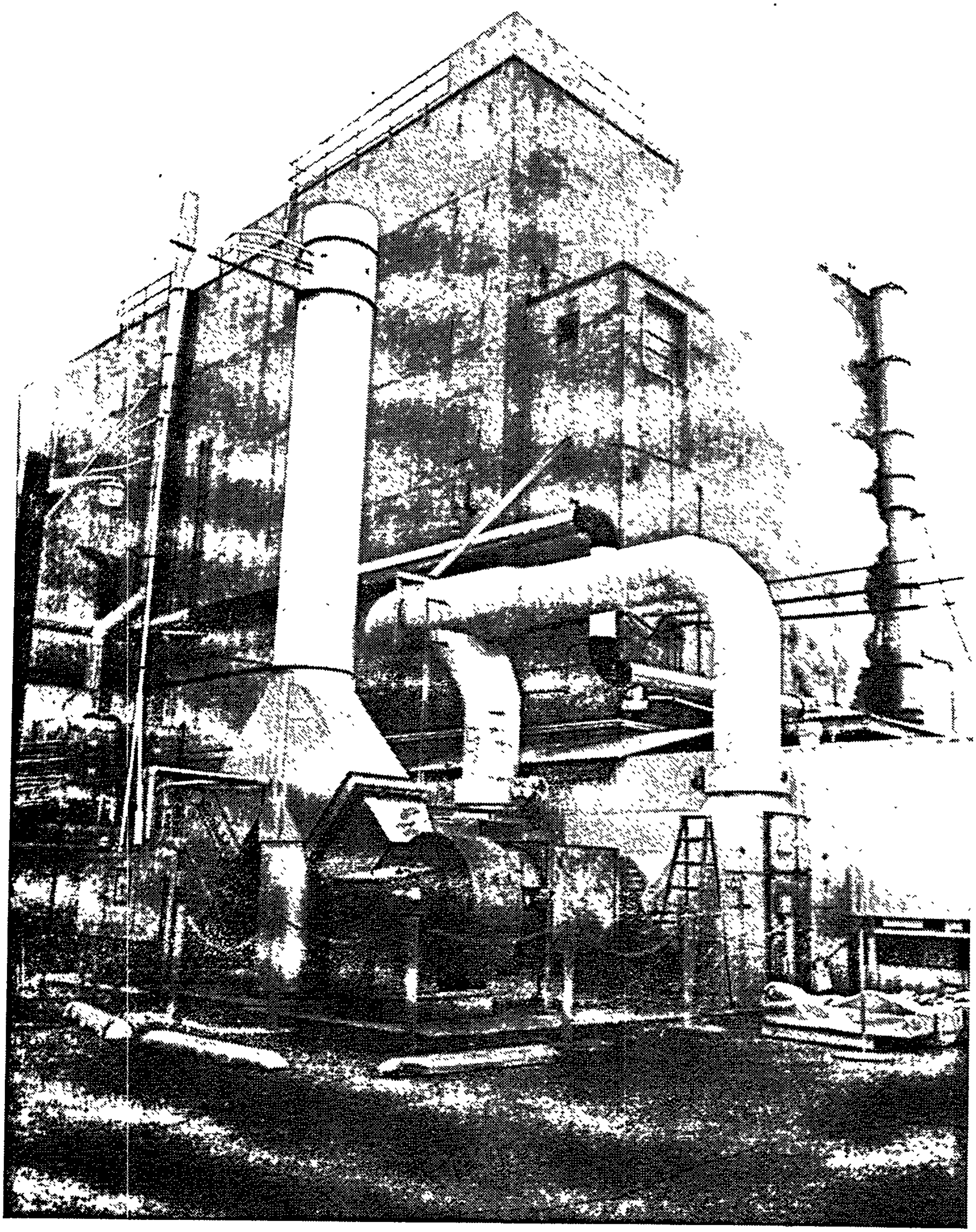
On January 12, 1989, the Natural Resources Defense Council, writing on behalf of two additional interest groups (the Hanford Education Action League [HEAL]) and the Nuclear Safety Campaign), notified the DOE of their intention to sue if PUREX operations were resumed without preparing a supplement to the 1983 Environmental Impact Statement (EIS).[1] Following several equipment repairs and improvements to waste handling systems, the PUREX Facility conducted a "stabilization campaign" to reduce its inventory of special nuclear materials and to place various internal systems into a stable configuration. This activity lasted from November 1989 through March 1990. (see Part III.)

On July 12, 1990, President George Bush approved the Nuclear Weapons Stockpile Memorandum, demonstrating that plutonium recovered in the PUREX Facility was not needed to support nuclear weapons requirements. In effect, this memorandum invalidated the basis for the 1983 PUREX EIS, which had stated that PUREX operations were to be resumed to process plutonium necessary for national defense. In light of these developments, Secretary of Energy James Watkins announced in October 1990 that the PUREX Plant would be placed in standby mode, and that an options study and an EIS would be prepared before restart of the facility. On December 22, 1992, a final shutdown (closure) order was issued by the DOE for the PUREX Plant.[2]

The Uranium Trioxide (UO_3) Facility was created in 1951 via modifications to the World War II, 224-U Facility. It began full-scale operations in February 1952, to convert liquid uranyl nitrate hexahydrate (UNH) to UO_3 powder through a calcination process. During 1954 and 1955, an addition known as the 224-UA Building was constructed to hold six continuous-action calciners and improve powder and waste handling facilities. Together, the 224-U and 224-UA Buildings operated as the UO_3 Plant until the 1972 shutdown of the PUREX Plant. UO_3 operations closely followed the chronology of the PUREX Facility, since PUREX provided the sole feed material for UO_3 operations after 1967.

Calcination activities in the UO_3 Plant resumed in 1984, shortly after the 1983 re-start of the PUREX Plant. Since that time, there have been 17 operating campaigns at the UO_3 Plant, because the small facility could calcine UNH at a much faster rate than the PUREX Facility could produce it while processing zirconium-clad fuel. The final UO_3 Facility closure order from the DOE came in December 1992, in tandem with the PUREX closure order. A last run was carried out at the UO_3 Plant from April through June 1993, to convert 757,080 L (200,000 gal) of remaining UNH to uranium trioxide powder. At the close of this campaign, as in past operations, the nitric acid recovered in the UO_3 calcination process was returned to the PUREX Plant.[3]

Figure 2. White Room Fans and Effluent Stacks Where Exhausts Were Reduced During the Standby Period (Outside View).



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2.0 PUREX STABILIZATION CAMPAIGN

In November 1989, the PUREX Plant began a campaign to process a total of 90.7 metric tons of irradiated uranium material that had been "stranded" in various forms and locations within the plant at the time of the abrupt shut down on December 7, 1988. It was determined that such a stabilization campaign would place the facility in a much safer mode than would leaving the irradiated material in its then-current state. The material processed in the stabilization campaign included 54.7 metric tons of irradiated uranium material already declad and dissolved in tanks D3, D4, D5, E6, and H1, as well as material in the three dissolvers in A-, B-, and C-Cells. It also included 36 metric tons of uranium in solutions containing plutonium needing re-work (i.e., plutonium that did not meet specifications from previous processing).

During the stabilization campaign, several minor equipment failures were experienced, including failure of the steam coil to tank 20 in the 211-A Chemical Tank Farm, and various small power failures. The most serious equipment problem was the failure of the number 1 canyon exhaust fan, which resulted in a loss of over two weeks of solvent extraction time. However, all routine effluent radionuclide and chemical releases from the campaign were within required limits, and the quality of the plutonium product generated was well within specifications. A list of 21 lessons learned recommendations, pertinent to operations and testing of equipment systems within the PUREX Facility, were generated as a result of the stabilization run.[4]

At the end of the stabilization campaign, the PUREX Plant still contained large quantities of radioactive and hazardous materials. Major portions of the inventory included the following:

- Approximately 9 kilograms (kg) of plutonium in oxide form in N-Cell and the Product Removal (PR) room
- Approximately 3.76 kg of plutonium nitrate in recycled uranium nitrate solution in tanks D5 and E6
- Approximately 4,164 L (1,100 gal) of neptunium-bearing solution in tank J2
- Solids on the L-Cell floor containing an estimated 3.90 kg of plutonium
- Sludge on the E-Cell floor including approximately 1.1 to 1.4 m^3 (40 to 48 ft^3) that could contain up to 400 grams of plutonium
- 2.9 tons of aluminum-clad irradiated uranium fuel in the PUREX Slug Storage Basin

- 681,372 to 757,080 L (180,000 to 200,000 gal) of contaminated nitric acid (both recovered from the PUREX process and subsequently from the UO_3 Plant)

- 79,493 L (21,000 gal) organic solvent [tri-butyl phosphate (TBP), 23% in a normal paraffin hydrocarbon (NPH), 77% diluent -- TBP/NPH] in G and R Cells

- Approximately 40 zirconium-clad, irradiated fuel elements on the floor of dissolver Cells A, B, and C

- Silver reactors still containing active ^{129}I in A-, B-, and C- Cells.

Additionally, lead, mercury, and other hazardous substances existed in various parts of the facility, and 907,200 to 1,088,640 kg (1,000 - 1,200 tons) of bulk, fresh chemicals also were present.[5]

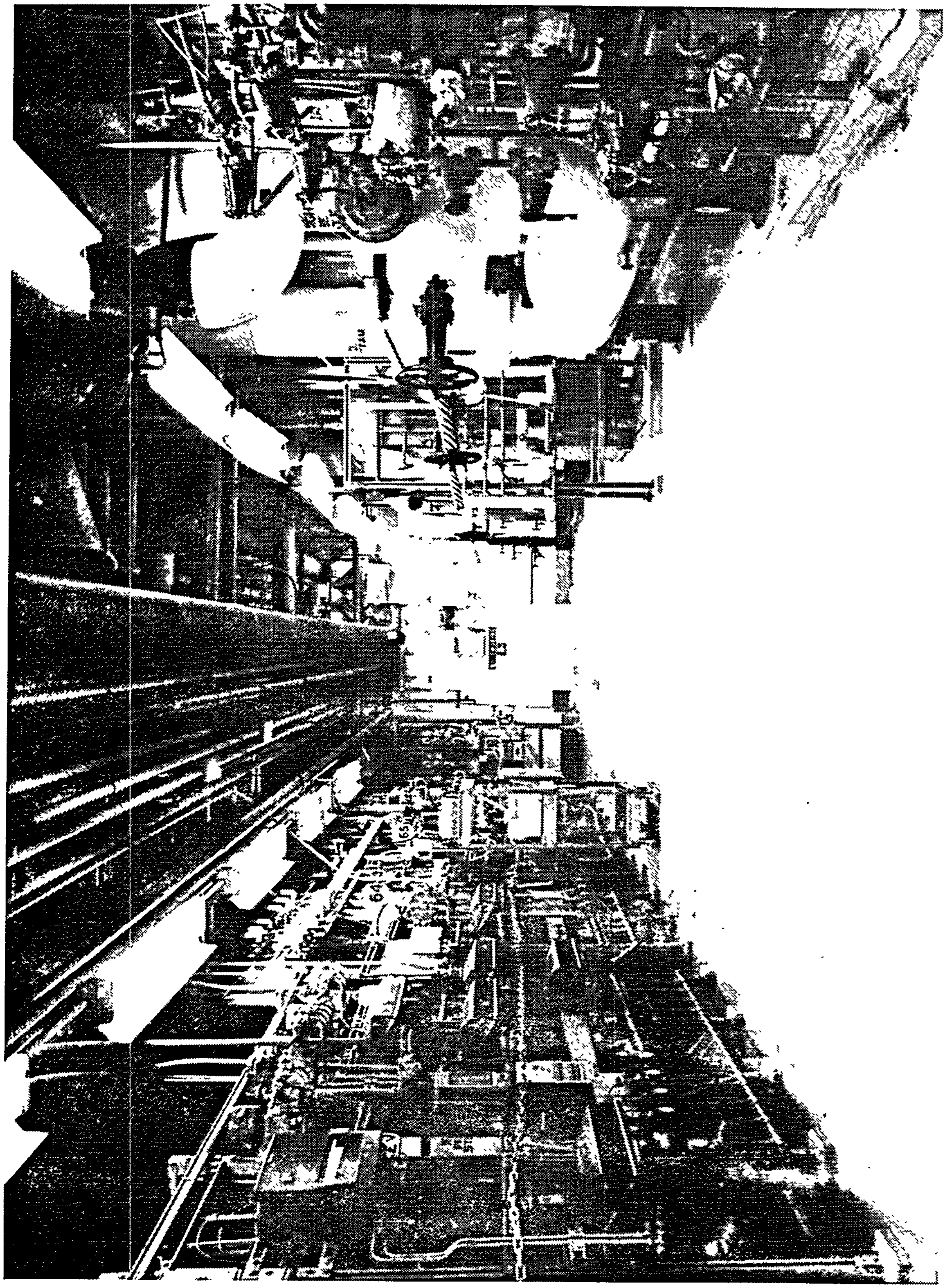

Figure 3. Inside the PUREX Pipe and Operating Gallery During Operations.

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3.0 STANDBY PERIOD

Although the PUREX Plant was not officially ordered to standby status until October 1990, it began transition-to-standby activities as soon as the stabilization campaign was finished in March 1990. Thus, the standby period can be considered as the time period from March 1990 through December 1992.

Expensive and frequent surveillance and maintenance (S&M) checks of safety and operating systems, mandated in safety documentation and necessary to keep the plant in standby-ready condition, consumed most of the facility's time and budget. During 1990, tank integrity assessments, tank and vessel flushes, tank and other instrument calibrations, various stack filter change-outs, and flushes and drains of headers in the pipe and operating (P&O) gallery were performed. Belt replacement and other repairs were completed on facility exhaust fans. A leak in the 15-cm (6-in.) high pressure steam isolation valve to tank farms was repaired, as was a leak in a 15-cm (6-in.) sanitary water line. The steam condensate system pumps, the main stack monitor building air conditioning motor, and the cooling water alpha monitor detector assembly were replaced. Some other instrument calibrations for non-critical systems and repairs to non-essential equipment were postponed, as facility managers did not know when or if the instruments and equipment would be used. The nitrogen oxide monitors on the main stack and the back-up facility were deactivated, as were exhausters in the P&O gallery. The PUREX Plant was visited by DOE Tiger Teams (internal fact-finding teams) in May and June of 1990.[6]

In early 1991, shortly after the standby order had been issued officially, PUREX personnel began to define both overall and specific goals for the standby condition. General goals were listed to include minimizing utility and surveillance requirements, and curtailing gaseous and liquid effluent releases to levels as low as reasonably achievable (ALARA) (at or below permitted levels) while laying up essential plant systems. Ventilation flows were to be reduced as far as possible to maintain confinement in radiation contamination zones and to maintain health and comfort in occupied areas. Program objectives were listed as maintaining compliance with all applicable regulations and policies, maintaining effluent systems in a safe, minimum flow condition, satisfying *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) milestones, minimizing chemical inventories in the plant, minimizing solid and liquid waste generation, limiting equipment deterioration to the extent that equipment would be available to support subsequent facility activities (either terminal cleanout or the resumption of fuel reprocessing), and executing all activities in a cost-effective manner.[7]

In January 1991, in response to a DOE, Richland Operations Office (RL) request for a Standby Plan that would look ahead 3 to 8 years awaiting final mission clarification, PUREX documented the actions that would be taken and conditions that would be maintained during Standby. Physical actions that had been taken already included (1) flushing the dissolvers and other ammonia-handling vessels; (2) blanking the ammonium fluoride/ammonium nitrate header (from tank 207 in the aqueous make-up area) in the P&O gallery; (3) turning off the dissolver off-gas system; (4) emptying all plant vessels of high-level waste; (5) isolating the transfer routes for organics from tank R7 to K-Cell and from G5 to the solvent extraction vessels; (6) flushing and emptying the sugar make-up tank (TK-204); and (7) emptying the M-Cell plutonium product storage tanks to minimum "heels" (residues). Additionally, the ammonia off-gas exhaust (296-A-24) flow of about 28 m^3 (1,000 ft^3/min) was eliminated.

Actions that would be taken during the indefinite Standby period included keeping the dissolver heels in A-, B-, and C- Cells and the single-pass fuel in the storage pool covered with water, locking out the dissolver off-gas electric and steam heaters, and disconnecting air supplies to air-driven pumps in N-Cell. The plant also pledged not to receive any further irradiated fuel shipments, not to introduce any ammonia-bearing solutions into its systems, to maintain water coverings over the dissolver heels and the single-pass reactor fuel, to continue applicable operational safety requirements surveillances, and to maintain engineering and administrative controls designed to prevent criticalities.[8]

Because the ultimate mission of the PUREX Plant was unknown in 1991, work was selected on a case-by-case basis to ensure future mission flexibility. Much of the day-to-day work of the facility continued to focus on preventive maintenance to electrical and other essential systems, filter changeouts, sampling various effluents and in-plant materials, tank and piping assessments and integrity verifications, transfer and consolidation of various solutions, and necessary repair work. One major repair, sampling, and cleanup effort was necessitated by a flood (because of broken pipes) in the 293-A Building that allowed contaminated water to enter a portion of the ventilation exhaust system downstream of the last filter (291-AE). As in 1990, many optional equipment upgrades and instrument calibrations at PUREX were deferred until the plant's future could be better defined. However, an in-cell closed circuit television system was installed in the west canyon crane and new liquid beta-gamma monitors were installed for the PUREX chemical sewer.

Major cleanout work went forward in 1991 in N-Cell and the PR room. Plutonium oxide powder was removed from N-Cell glove boxes, dissolved in nitric acid, and transferred to tank E6 via storage tank L-11. Later, in March 1992, approximately 8,328 L (2,200 gal) of plutonium nitrate solution were transferred from tank E6 to tank D5 to make room for additional L-11 transfers into tank E6. Other work accomplished in 1991 included terminating the PUREX steam condensate and cooling water heat exchange effluents, reducing the cold side service effluents in the P&O gallery (to minimize corrosion attack during standby), and shutting down the carbon-14/tritium sampler on the main stack.[9]

Additionally, a major activity undertaken at PUREX in 1991 ultimately became the beginning and the initiator of some key deactivation work. In this activity, the sale of bulk fresh chemicals in storage at the plant, PUREX learned one of its first real deactivation lessons. In early 1991, PUREX had an inventory of 1,000 to 1,200 tons of fresh chemicals (about 80% in liquid form and about 20% in the form of dry powders) that had been shipped to the facility in anticipation of use in radiochemical processing. Plant personnel decided to try and remove the chemicals in case the plant did not re-start, and to avoid the safety implications and environmental concerns associated with long-term storage. They evaluated the possibility of disposing of these chemicals as waste, a quick but expensive choice. Because waste generators retain "cradle to grave responsibility" when generating a waste (under 40 CFR 262), there would have been the initial disposal fees (estimated at $300,000 to $400,000) as well as potential later expenses if the land fill that accepted the chemicals ever leaked. Also, the General Services Administration procurement processes followed by the contractor that operated PUREX, Westinghouse Hanford Company (WHC), did not have a ready means to sell the chemicals back to the original vendors.

Therefore, PUREX personnel decided to sell these chemicals as excess on the open market. Bids for purchase were solicited by placing notices for sale in the Commerce Business Daily. Chemical brokers and distributors, local fertilizer companies, and another DOE site purchased or accepted most of the chemicals. Only about 20% of the original market value was received, but all disposal costs (and potential liability costs) were saved by not declaring the chemicals as waste. Under U.S. Department of Transportation regulations (DOT 40 CFR), most of the chemicals had to be re-labeled as hazardous materials, thus imposing some shipping delays. Still, shipments off the Hanford Site took place beginning in May 1992 and continued for about a year. For this work, an individual at PUREX won the WHC Total Quality Achievement Award for individual professionals.[10]

Lesson No. 1. It is better to find an alternate use for a material than to dispose of it as waste, even if the alternate use brings little or no monetary income. A designation as waste subjects a material to long-term regulatory control, and to the costs associated with disposal and regulatory surveillance and paperwork. Also, the creative process of thinking of alternative uses for materials can be expanded, and later was expanded at PUREX, with the idea of sending contaminated nitric acid to British Nuclear Fuels Limited (BNFL) (see Section 7.0).

During 1992, work was again performed at PUREX on a cautious basis, as the mission continued to be uncertain. Cleanout continued at N-Cell, with the calciners in glove boxes N3 and N4 being taken apart to remove loose plutonium oxide powder from crevices in the equipment. This powder then was placed into the muffle furnace in the powder loadout glove box, dried, placed into storage cans, and taken to the 2736-Z vaults at the Hanford Site's Plutonium Finishing Plant (PFP) for safe keeping. Only two cans of oxide product were so generated. Also, about 4,164 L (1,100 gal) of neptunium-bearing solution were removed from tank J2 and disposed to the Hanford Site tank farms as high-level waste. Record sampler equipment was replaced on the main stack, as were two stack sample vacuum pumps. The steam condensate stream overflow line was plugged, thus preventing any discharge to cribs 216-A-30 and 216-A-37-2 and allowing the shutdown of steam condensate stream monitoring instrumentation. An upgrade was performed on the chemical sewer effluent monitoring system, and closed-loop chillers were installed on the main stack vacuum pumps to eliminate single-pass cooling water effluent. The main PUREX sanitary septic tile field failed and was taken out of service, and the sewage flow was successfully re-routed to a second (backup) tile field. One of three cooling water liquid effluent streams was terminated, and major maintenance activities were performed on the PUREX steam system in a 33-day summer outage. The door on burial tunnel No. 2 was repaired after it locked in a partially open position, and the backup foam fire system at the main stack as well as the krypton and iodine monitoring systems were deactivated. Other work included transferring liquids, flushing various tanks, draining of pipes and other lines, assessing tank and vessel integrity, and of course, the required S&M checks.[11]

However, in the early spring of 1992, DOE and PUREX management conceived and embarked on a new, key activity that led directly into deactivation planning. In view of the end of the Cold War, the breakup of the former Soviet Union into 15 independent republics, the re-unification of East Germany and West Germany, and other obvious trends that lowered even further the national need for additional special nuclear materials, it seemed prudent to start planning an overall strategy to close down the PUREX and UO_3 Plants in an orderly, comprehensive manner. If these steps were not taken, it was feared, crucial, experienced staff people would be lost and facility conditions might degrade. At that time, there was no officially defined, intermediate position between standby/shutdown and decontamination and decommissioning (D&D) for nuclear facilities, except for a commercial power reactor condition termed "SAFSTOR" by the Nuclear Regulatory Commission. When PUREX managers examined the SAFSTOR requirements, they realized that few of them applied to the PUREX and UO_3 Facilities. A whole new concept in planning and establishing requirements was needed.

DOE headquarters, RL, and PUREX management decided that, because the entire concept of a "transition" or "deactivation" phase in facility life-cycle was new, independent, third-party experts should be brought in to evaluate the planning process itself. If PUREX/UO_3 planning could be formulated into a system, then the knowledge gained could serve as a model for other aging, terminated facilities across the DOE complex. An Independent Technical Review Team (known as the Red Team because it was to serve as a red flag or bold indicator of a new pathway) was chartered by the DOE EM-60 organization on May 19, 1992. This team itself was overseen by a Technical Oversight Board of senior-level individuals with extensive experience in industry and the nuclear world. The mission of the Red Team was defined to "perform a review of the planning, technical basis, and issues related to the transition of the PUREX Plant status from standby to safe deactivation, with minimum surveillance." Additionally, the Red Team would "provide recommendations, methods, activities, criteria and potential changes to requirements that would be applicable at PUREX and other Department of Energy Facilities while personnel familiar with the plant operation are still available." The technical bases, regulatory requirements, safety documentation strategy, management, documentation, and planning activities pursued at PUREX all were to be evaluated.

An initial deactivation planning document drafted by PUREX personnel first was reviewed by Red Team personnel, and plant visits took place in July and August. In October 1992, the Red Team Report was issued. It concluded that the PUREX Plant had no technical barriers to a timely transition to safe deactivation, defined as a "D&D ready state" that could be maintained "for a decade or more." It found that institutional management and regulatory barriers existed but that these factors could be surmounted by "a change in methods of doing business." Treating the deactivation as a project, rather than as another form of ongoing activity, could save one-third the time, one-seventh the personnel effort, and one-sixth the integrated cost of a "more conventional approach." Achieving the goal of a "low mortgage end-state," the report summarized, would take close and active cooperation among many organizations, including DOE at all levels, Washington State and other regulators, the DOE's operating contractor, and numerous stakeholders.[12]

In terms of specific recommendations, the Red Team report offered seven crucial end point criteria in order of importance:

- Eliminate or stabilize environmental and safety risks
- Leave in place equipment, systems, and materials for which an end state is not yet defined
- Complete activities dependent on facility-specific process, operating and facilities engineering expertise
- Complete activities dependent on existing, functional facility-specific equipment which will be inoperable following a decade deactivation period
- Configure the facility for and limit access to a quarterly assessment entry,
- Establish and archive records and drawings
- Leave the facility in an orderly condition.[13]

The report proposed that all of the regulatory and planning documents except for any required Environmental Assessments (EAs) be combined into one Transition Project Management Plan , and that "overly conservative, zero-risk interpretations should be avoided...Not all regulations and orders apply to the transition to deactivation, and not all activities are regulated." In terms of work planning, the report stated that "project tasks should be managed by work packages using a graded [commercial] approach to simplify the packages." Additionally, the report observed, "planning is an inherent transition delay. To offset this the project management team...must immediately define activities that can proceed in parallel with deactivation transition planning." Integrated, resource-loaded schedules with logic ties and a highlighted critical path were identified as the most sensible way to map, direct, and track the project.

The question of safety documentation was addressed clearly by the Red Team: "Preparation of a new SAR [Safety Analysis Report] for transitioning PUREX is not considered necessary...Use of the existing PUREX SAR, with appropriate supplements, is an effective method to define and manage the safety envelope during transition to safe deactivation." The report also recommended close coordination between the management teams of PUREX, RL, and DOE, Headquarters (DOE-HQ) (the "troika" approach) to ensure the timely success of the project. It further made a simple and direct attempt to address each major technical, physical challenge in the PUREX/UO_3 deactivation with a brief statement of the scope of work to be accomplished. Such work included draining and flushing tanks and vessels, fixing surface contamination, mothballing certain equipment, disposing of fuel elements and contaminated solvents, burying solid wastes, and many similar tasks.[14]

Lesson No. 2. The early involvement of an independent technical review team to review a major deactivation operation and make overview recommendations provides healthy and useful input. It allows the operation to be viewed by those with experience in the commercial world, and by those not directly tied to, nor constrained by, the day-to-day concerns of facility operations and management. It also provides a challenge to the facility staff to think of the deactivation project in different terms. In terms of broad concepts, the value of independent oversight is immeasurable.

Lesson No. 3. The advice of an independent review term in attempting to scope and define specific work tasks and pathways within a large deactivation project is less helpful than the broad overview perspective brought by such a team. As it turned out, Washington State regulators, regional trustees and stakeholders, and the constraints imposed by the needs and requirements of other divisions on the Hanford Site actually shaped the PUREX deactivation project along the way.

Lesson No. 4. Creativity and forethought, such as was displayed in the PUREX sale of excess bulk chemicals, can be employed even in Standby periods, to the benefit of a facility. Even during periods when clear direction is lacking and when mission flexibility needs to be preserved, some steps can be taken to deactivate portions of a large facility on a temporary basis and bring down costs. Those who know the plant most intimately are best equipped to brainstorm the specific ways to implement cost-saving steps.

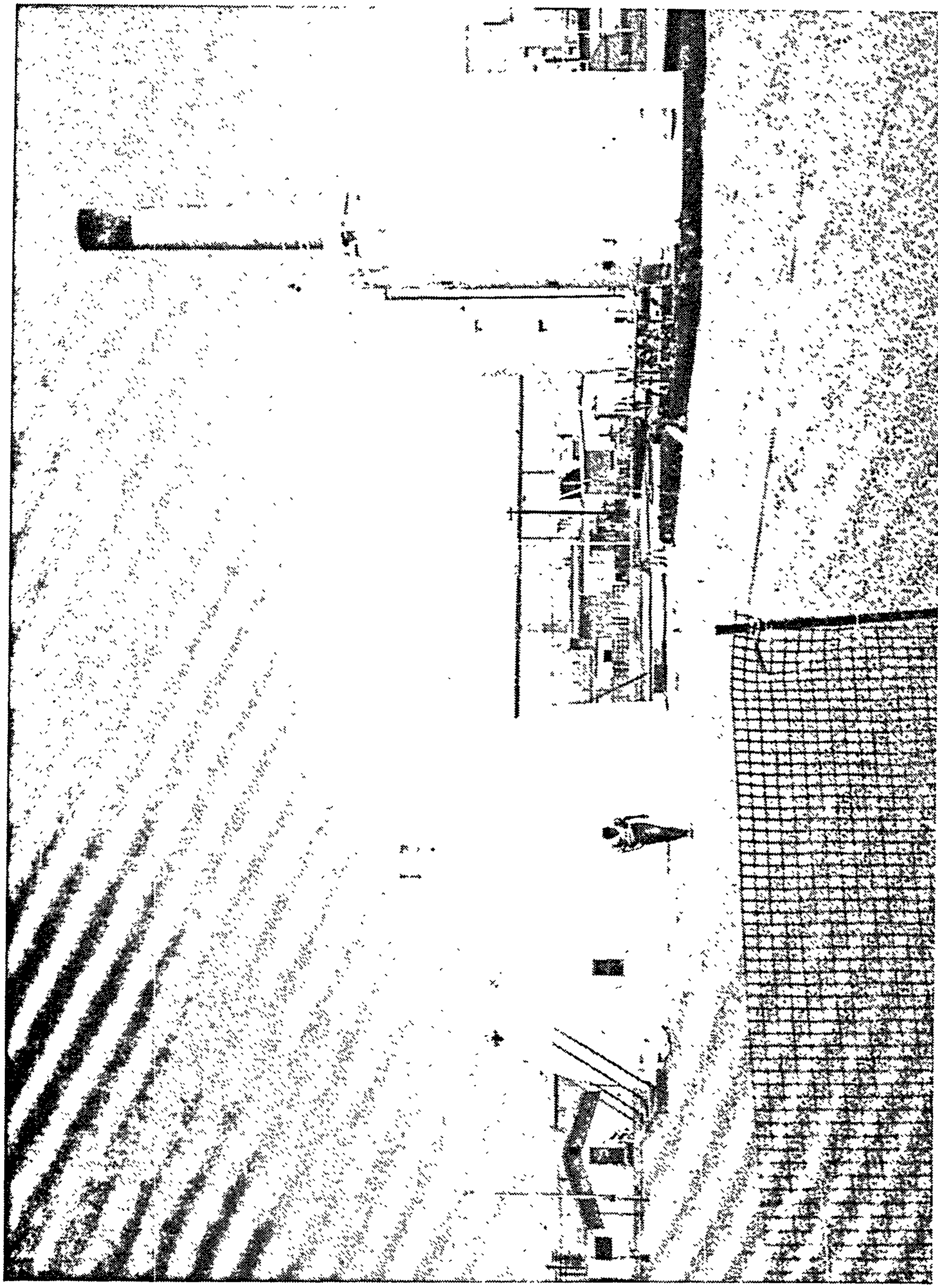

Figure 4. PUREX Tanks Transferred to 200-W Groundwater Treatability Project, as Part of the Policy to Relocate and Re-use Equipment.

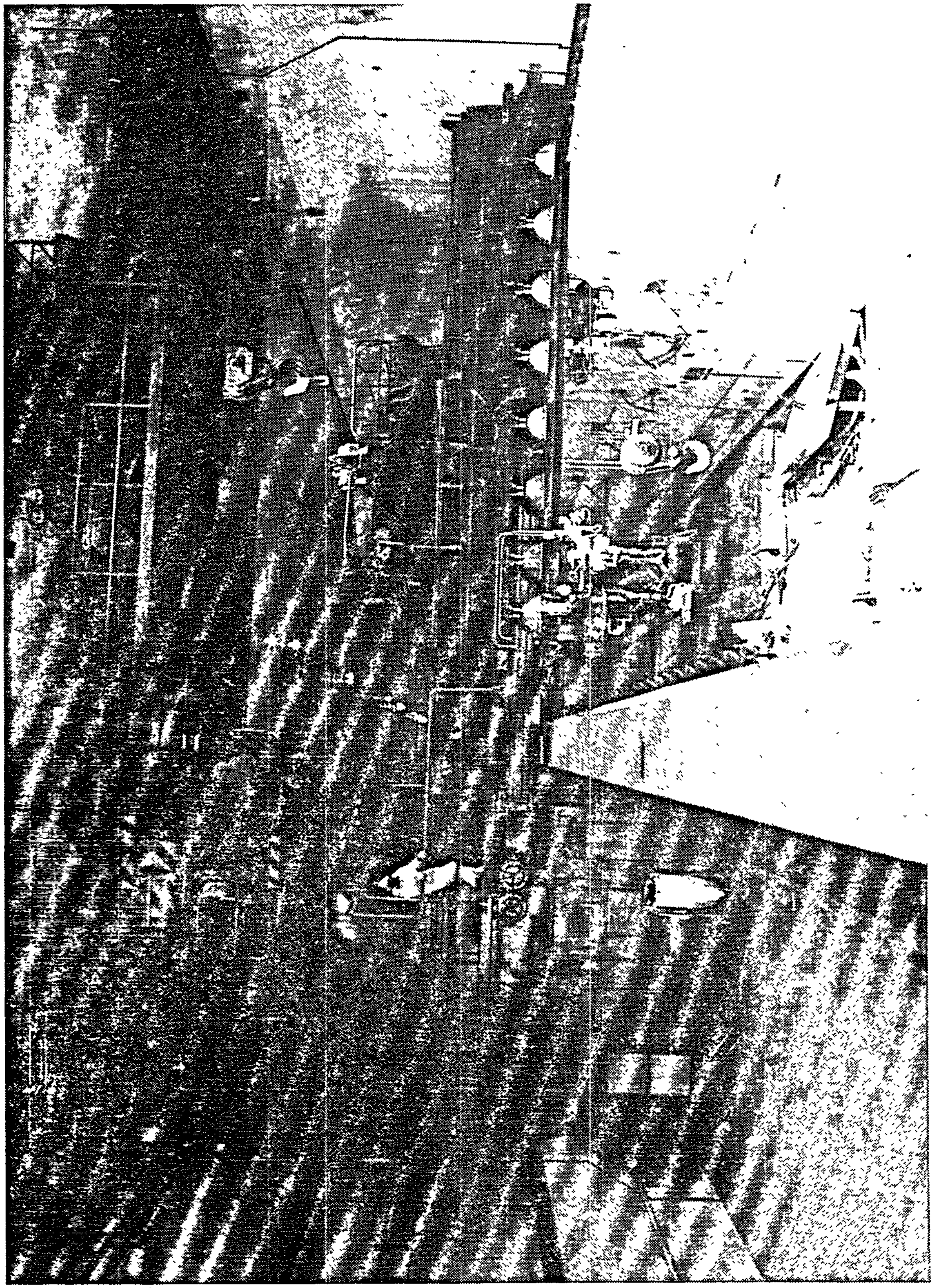

Figure 5. Inside the PUREX Canyon (Long View).

4.0 DEACTIVATION ENGINEERING AND WORK PLANNING

As soon as the PUREX shutdown order was received in December 1992, facility managers began detailed planning for the actual physical steps that would be needed to bring the huge facility to a safe, low-cost, low-maintenance status. After receiving a generic set of D&D acceptance criteria in March 1993, PUREX personnel held a large workshop to discuss and define the major technical tasks. They divided the technical work into 20 major tasks:

- Chemical disposition
- Single-pass reactor fuel disposition
- Slug storage basin deactivation
- N-Reactor fuel disposition
- Zirconium heel stabilization
- Uranium/plutonium solution disposition (D5/E6)
- Canyon flushing
- In-plant waste concentration
- Contaminated solvent disposal (organic - TBP/NPH)
- Contaminated nitric acid disposition [692,728 L (183,000 gal)]
- PR room cleanout
- N-Cell cleanout
- Q-Cell cleanout
- Sample gallery deactivation
- Laboratory deactivation
- P&O gallery and white room deactivation
- Utilities and service systems (water, steam, electrical, and fire suppression)

- Support and ancillary systems deactivation (293-A, 203-A, 211-A, 206-A, 205-A, 212-A, 294-A) and other ancillary buildings

- Heating, ventilation, and air conditioning (HVAC) consolidation

- UO_3 Plant deactivation

Some technical tasks and sub-tasks were reorganized many times, but by July 1993, the above list was finalized and has held through the end of the first official year of the PUREX/UO_3 deactivation project (FY 1994).[15]

Once the major technical tasks were defined, a lead engineer and a support engineering team were assigned to each one. However, because of limited engineering resources, the same lead engineer often supervised multiple major tasks. For two months beginning in August 1993, nearly continual meetings were held in the PUREX "war room" among personnel from the engineering, operations, maintenance, and program and project control organizations. The logic and sequence of each main task needed to be defined first, along with the resources to continue routine and required S&M checks. In the summer of 1993, schedulers from the PUREX project control organization began producing draft schedules primarily based on the input and decisions of the meetings held in the war room. See Section 4.0 for more detailed information on scheduling. On September 30, 1993, the draft schedules showed that the project could be completed in five years. Because of more detailed planning, this set of schedules extended beyond the three years first estimated by the Independent Technical Review team. In the autumn of 1993, the initial project baseline was set, and budget figures were calculated based on the draft schedules. These figures showed that the PUREX funding levels, which showed only 25 percent of total spending on deactivation tasks in the first year of the project (FY 1994), would switch gradually to reflect greater and greater spending on such tasks over the life of the project.[16]

At the same time, DOE-HQ and Independent Technical Experts (ITEs) assigned to aid the PUREX deactivation project questioned the work planning at its most basic level. ITEs were a follow-on to the Independent Technical Review Team chartered by EM-60 to continue to provide an external perspective to the deactivation. They pointed out that without pre-determined end point criteria, the deactivation project truly lacked a compass. How could planners decide whether or not a particular job was necessary and valid if they had not defined the desired or required end products of all of the jobs? How could specific meaning be added to vague end point terms such as "safe," "D&D-ready," and "clean." These comments led to a PUREX management decision to hold an End Point Criteria Value Engineering Study in February 1994.[17]

The End Point Criteria Value Engineering Study was held jointly with representatives of the contractor D&D organization, RL EM-40 and EM-60, ITEs, and multiple components of the PUREX/UO_3 organization. The purpose of the study was to define D&D acceptance criteria for this particular project in a cooperative manner. The study emphasized the fact that maximum safety improvements must be extracted from every deactivation dollar spent.

However, the key conclusion of the study was the recognition that, with a long lag time between deactivation and eventual D&D, planners of the deactivation project could not know nor anticipate the methods, needs, and capabilities of future D&D endeavors. In other words, factors ranging from technology to public desires could change the character of 21st century D&D efforts into forms not even imaginable by today's planners. Therefore, the study concentrated on developing a methodology for making deactivation decisions, rather than on defining specific technical end states. The process itself was the product. Its highest value was that it could be applied in a flexible fashion to resolve the concerns raised (above) by the ITEs as well as other concerns and issues that might develop along the way.

Lesson No. 5. The end point criteria process developed by the Value Engineering Study should have been in place before the draft PUREX schedules were developed. Such an approach could have set end point criteria to better guide decisions in terms of which specific tasks would and would not be scheduled.

A matrix-based approach to establishing deactivation end points became the product of the study. A two-dimensional matrix was devised to be applied across systems and spaces in the PUREX and UO_3 Facilities. At the top of each page of the matrix, one structure or space (or a collection of similar structures and spaces) within the plants was identified. On one axis of the matrix were listed the top six goals to be considered in deciding which deactivation tasks to complete. These six goals were: protect the deactivation and eventual D&D workers, protect the public and the environment, prepare the facilities to need only quarterly S&M checks, comply with applicable regulations, consider D&D needs insofar as is possible in a general sense, and keep commitments made to stakeholders.

On the other axis, issues and hazards associated with each structure or space were listed. Examples of such issues and hazards included the presence of fixed radioactive contamination, non-fixed radioactive contamination, mixed waste, low-level waste or transuranic waste, transuranic mixed-waste, non-regulated waste, hazardous material, fissile materials, industrial Occupational Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Administration hazards, residual liquids, dose rates in the area, whether or not the areas or structures in question were posted as radiation and/or asbestos zones, structural integrity and equipment status, the presence of confined spaces, exterior penetrations that could allow animal or weather access, fire hazards, active utilities, and spare parts. Then, working across the matrix, each condition or hazard within the plants could be addressed in light of which actions could/should be taken to mitigate the hazard. The study report stated that the matrices identified in terms of concept and initial design during the Value Engineering Study needed to be refined and extended to more sophisticated levels. These next steps were taken when the UO_3 Plant end point criteria were developed (see Section 9.0).[18]

Lesson No. 6. Because many years often pass, or can be expected to pass, between deactivation and ultimate D&D of major DOE facilities, the exact needs, methods, and end states of D&D in the 21st century cannot be anticipated. Therefore, a functional matrix-based approach to deciding which deactivation tasks add value to a project is better than establishing vague end point criteria. Such an approach must have joint participation and concurrence between the EM-60 and EM-40 organizations.

Once the End Point Criteria Value Engineering Study was completed, PUREX personnel again convened in the war room of the plant to re-examine each planned deactivation action. Schedules were re-worked in light of some new decisions. Next, the PUREX engineering organization began examining the existing work plans and procedures for the facility and writing new ones where needed for deactivation actions. Where possible, existing work plans were used as a cost-savings measure. Additionally, revisions began on the PUREX/UO_3 Deactivation Project Management Plan. The engineering organization also began to design new equipment that would be needed for certain specific tasks. Among this new equipment were fuel grabbers, lifting yokes, canister cover installers, and other devices needed to retrieve irradiated fuel still remaining in the PUREX Plant.[19]

Even as deactivation work planning consumed much of the time and attention of PUREX personnel throughout 1993 and 1994, and as required S&M checks expended much of the remaining resources of the plant, some actual deactivation tasks moved ahead. Meeting together, engineers, supervisors, and nuclear process operators defined several deactivation tasks that they agreed would have to be done under virtually every planning scenario and they also tried to combine deactivation work that could be done in conjunction with S&M checks. Much of the work they agreed on was done under "best management practices," before specific end point criteria plans were finalized. As early as the late winter of 1993, the deactivation of certain control room instruments began. The instruments deactivated first were those that all personnel agreed would never be used again such as the instruments controlling dissolver operations. The consolidation of heels, recycle materials, and normal tank flush material from both PUREX and the UO_3 Plant also went forward, as did the cleanout of glove boxes in N-Cell, repairs to the main west crane (which was needed for both long-term S&M and for deactivation support), further cleanouts of the 211-A fresh chemical make-up area, dissolver passivation, and the removal of failed jumpers and other equipment from the canyon deck.[20]

Throughout 1994, PUREX engineers, supervisors, and other work planners continued to provide input to develop the work plans for deactivation, and several specific deactivation work plans began to be issued. Much physical evaluation work was needed including equipment and instrument inspections. For example, machinery that had sat virtually idle since the 1989 to 90 stabilization run needed repairs and upgrades in some cases. Instruments that had long been idle, but that would be needed in deactivation work, had to be re-calibrated. Again, because it was still early in the deactivation project, planners tried to make decisions that would result in work output that could serve both routine S&M needs and deactivation needs. The cleanout of N-Cell continued, sample gallery deactivation went forward (with the deactivation of 19 out of 77 samplers), as did the processing of plutonium-bearing waste solutions in tanks D5/E6 and the first seven (out of 49 planned) batch transfers of this material to the Hanford Site's tank farms, various flushings and consolidations, and instrument and equipment calibration and repairs. Dissolver passivation was completed, and all the organic material (TBP/NPH) was removed from the canyon and consolidated in tank 40 outside the main PUREX building. Approximately 13,935 m^2 (150,000 ft^2) of radiation zone space [out of about 46,450 m^2 (500,000 ft^2)] were cleaned and released from zone status. Also, a special entry into L-Cell to achieve initial characterization that would help define deactivation tasks was completed in the summer. However, some work was delayed by a 54-day steam outage caused by a breakdown in the aging 200 East Area generating plant.[21]

Lesson No. 7. The time that elapsed during the PUREX Plant's Standby period actually created additional work for the deactivation project because some instruments and equipment had deteriorated during that period. To prepare for the deactivation, significant work needed to be done to re-calibrate and upgrade instruments and machinery. As much fore-warning as possible should be given to facilities as a shutdown status approaches. Such warning would allow the facility engineers and work planners to begin the preparations for deactivation work in a timely and efficient manner.

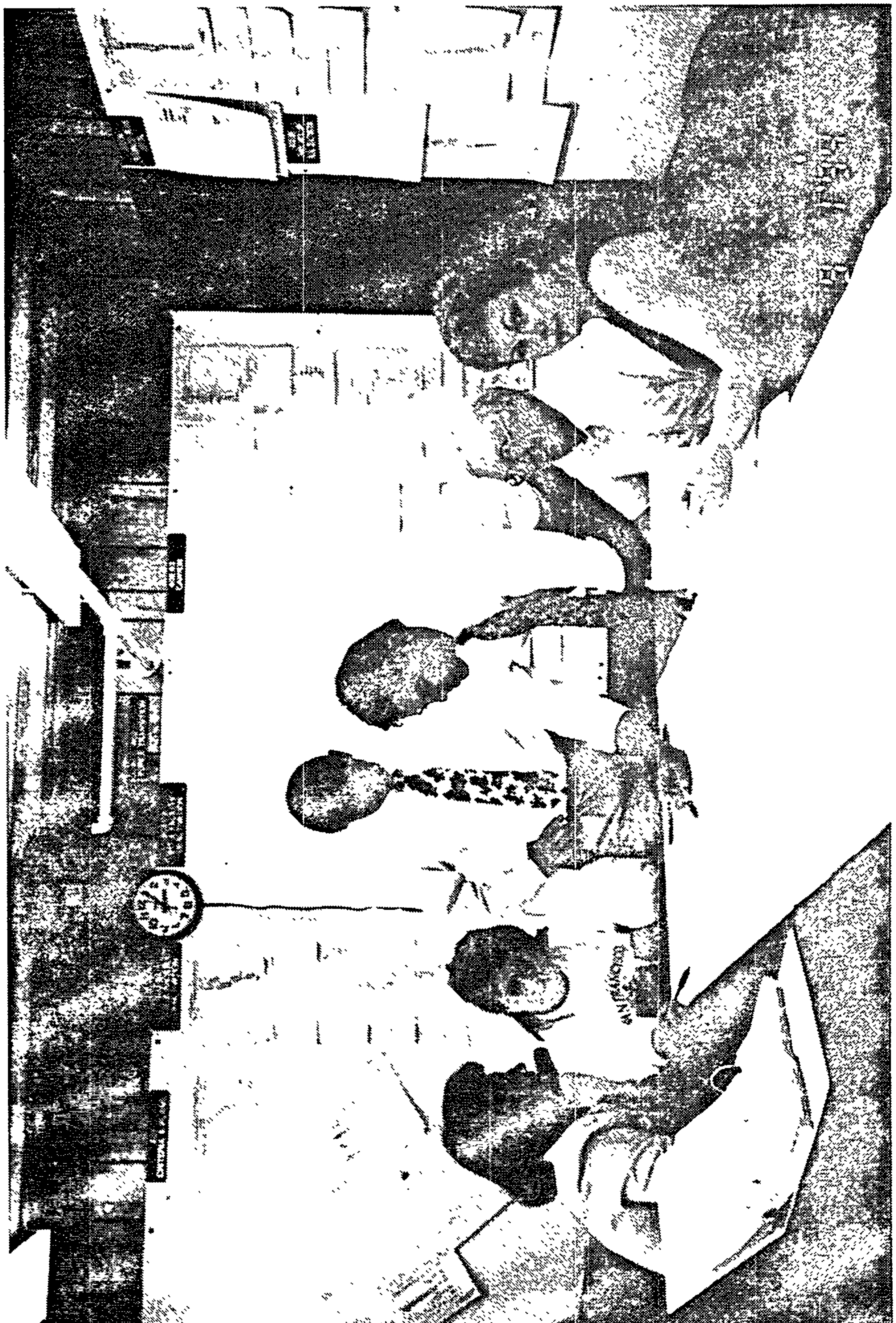

Figure 6. Scheduling Crew in PUREX War Room (Summer 1994).

5.0 SCHEDULING PROCESS AND PRODUCT

In early 1993, DOE made it clear to the PUREX management that the project schedules should be a key component of the planning. The benefits of logical, integrated schedules, it was thought, would more than surpass the costs and effort of producing them. By integrating tasks in a logical sequence, timed and resource-loaded to accurate completion dates, the huge deactivation project could proceed without repetitious effort, time lags or gaps, and thus save money. The first questions to be addressed in schedule planning concerned which organization would do the scheduling and which software would be used. The idea of bringing in a subcontractor to perform the scheduling work was considered. However, the PUREX Project Control organization wanted very much to "own" this work, yet they had never before coordinated a project of this complexity and magnitude. The decision was made that the dedication and commitment of the in-house PUREX Project Control organization to the old facility would outweigh the experience value that might have been possessed by other organizations. Further training, it was believed, could bring the technical skills of the PUREX group to the necessary level.

It was decided to use the "Quik-Net"[1] software scheduling program, primarily because Quik-Net equipment (software and compatible computers) already was in use at PUREX and many schedulers and engineers who would have input into the schedules were familiar with it. It was thought that several scheduling programs would or could function to establish the PUREX/UO_3 schedules, but that the procurement, training, and start-up times would impose unacceptable delays to the project. In view of the tremendous volume and complexity of the schedules that the PUREX/UO_3 deactivation would require to coordinate over 2,000 separate work tasks, the Quik-Net vendors conducted two types of special, project-specific training. They spent 90 days in full-time residence at the Hanford Site, working with the expanding PUREX Project Control scheduling staff. They also believed that the key to producing good schedules was to upgrade the level of understanding of scheduling needs among all of the personnel who would provide input to the schedules. To implement this belief, the Quik-Net vendors conducted two-day training sessions for the non-schedulers associated with the deactivation project.[22]

In early 1993, PUREX Project Control issued a call letter to all plant personnel responsible for Standby schedules. It was asked that open items on the old schedules be evaluated as to whether or not they were necessary to the deactivation project. Unnecessary items were removed via a formal schedule change request, and useful items were retained but sometimes re-named or re-grouped with other activities. At the same time, the Quik-Net vendors were asked to conduct a schedule review to identify crucial concepts that would allow the most useful deactivation schedules to be created. The primary recommendations from this review included the need to develop a high-level ("master") project framework and planning process;

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[1] "Quik-Net" is a trademark product of Project Software and Development Inc., of Cambridge, Massachusetts.

strengthen the resource management process; build flexibility for changes into the scheduling process; monitor progress in specific, identifiable ways; and transfer real leadership authority for schedules to the PUREX Project Control organization.[23]

Scheduling for the PUREX/UO_3 deactivation tasks began in the spring of 1993 with four main project areas (known as Level I Schedules) identified: criteria and plans, facility deactivation, UO_3 transition, and project management. A lead manager was assigned to each Level I area and asked to gather a team of engineers to name the Level II tasks within each area. This process resulted in the identification of two major tasks with criteria and plans, 15 activities within facility deactivation, eight activities within UO_3 transition, and six activities within project management. Each Level II activity then was assigned a champion, who in turn assembled a larger team composed of engineers, craft supervisors, and nuclear process operators. It was at that time that the marathon meetings in the PUREX war room began (see Section 4.0). The specific tasks necessary to accomplish each Level II task were written on small pieces of paper and discussed in detail by the persons who actually would write the work plan and perform the work. Then the specific tasks were rearranged in various sequences along the walls until consensus was achieved on the best pathway to accomplish each task. Thus, Level III, IV, and V schedules were drafted. However, the same level of scheduling effort was not applied to the ongoing S&M tasks that still consumed much of the overall PUREX/UO_3 budget.

For the deactivation tasks, the next scheduling step was to identify the proper sequence in which various activities should be conducted. PUREX personnel soon learned that in defining the sequencing step they encountered the real differences between facility operations work and project work. In routine operations, many jobs occur simultaneously, so work groups don't have to coordinate very closely with one another. Also, operations personnel generally work in just one area or task. However, in a project environment, work must be performed in a logical sequence or else the performance of one task will result in idle delays in another task. Additionally, work already performed in one task may have to be re-done, if, for example, the work on another task re-contaminates or re-activates an area already cleaned or closed in the first task. Also, in a project environment, personnel will shift among various jobs so their time needs to be carefully and logically allocated.

Once the "logic ties" were identified, "critical path" jobs (high-priority jobs with long duration or first need in the project) were highlighted. Then all of the jobs were "resource-loaded." Again, engineers and the people actually responsible for performing the tasks met to decide how many person-hours or days were necessary to accomplish each task. For some tasks that depended on specialized, aged equipment (such as the PUREX cranes), a 40 percent contingency factor was added to the time allotments to allow for outages and equipment breakdowns. At this point, the PUREX Project Control schedulers placed all of the crucial information developed in the war room into their programs and produced draft schedules to be examined for overlaps, duplication, and other flaws. At the same time, the engineers responsible for each Level II task wrote a work breakdown structure dictionary that named and described each task, along with a listing of the sub-tasks necessary to accomplish it and any unknown factors that could affect the task. By the end of FY 1993, a set of 108

Level V schedules, fully integrated and resource-loaded, were issued as the baseline schedule of the PUREX/UO_3 deactivation project. The magnitude of this undertaking taxed the Quik-Net program to the point that a different software known as PX[2] was chosen for the schedule revisions needed in 1994.[24]

During FY 1994, the 1993 baseline schedules were revised in response to various technical and work changes imposed by regulatory requirements, stakeholder input, new information received from preliminary characterizations of plant areas, steam outages, and other equipment and system breakdowns, cost estimates, and many other factors. Throughout the year, the PUREX war room often was filled with discussions of how best to accomplish specific tasks in light of new developments. Two major innovative ideas in disposition options for the plutonium/uranium solution and for the contaminated nitric acid remaining in the plant resulted in a schedule compression of ten months (see Section 8.0). In combination with the reduced S&M costs associated with them, these new approaches saved $36.9 million for the overall deactivation project. At the end of FY 1994, the PUREX/UO_3 deactivation project still was guided by 108 Level V schedules, albeit revised from the 108 schedules of FY 1993.[25]

Lesson No. 8. The practice of generating fully developed, integrated, resource-loaded schedules, while it is time-consuming in itself, saves money for a large project in the long run. The costs and efforts of producing the schedules are vastly surpassed by the cost savings that result from avoiding the work delays and duplication that would occur without such schedules.

Lesson No. 9. Organizations internal to old facilities and DOE sites often have strong emotional ties and commitments to these facilities. They are willing to learn new skills to stay with the facilities throughout deactivation. This loyalty produces a strong work ethic and is valuable to the project. Keeping the operating employees with the deactivation project also provides these employees with enhanced skills that can provide them with better career opportunities after the deactivating facility closes.

Lesson No. 10. Personnel who are intimately familiar with large and complex, aging DOE facilities need to be involved in every step of the planning for the deactivation of these plants. This knowledge base is invaluable in producing realistic schedules for performing deactivation work. To make the process work, everyone who is involved in planning deactivation work should receive training from or with the scheduling organization so that they can understand exactly what information the schedulers need. Such training allows all participants to "speak the same language" to produce accurate schedules.

[2] PX is a trademark product of Project Software and Development Inc., of Cambridge, Massachusetts.

Lesson No. 11. Because S&M tasks consume much of a facility's budget during the early years of a deactivation project, detailed scheduling attention should be given to these tasks as well as to deactivation tasks.

Lesson No. 12. Everyone involved in planning and scheduling deactivation work needs to understand that this work must be approached with a different mind set than that which functions for operations work. Changing the perspective from that of operations to that of a project is crucial to the success of deactivation endeavors.

Lesson No. 13. Schedules in large and complex deactivation projects need to have the capacity to easily incorporate change. They need to be "living" schedules because no person or collection of persons, however knowledgeable, can anticipate all of the various changes that will occur over the life of the project.

Lesson No. 14. The software package chosen for a large deactivation project should be evaluated carefully before it is adopted. The sheer size and complexity of integrated, resource-loaded schedules that guide thousands of tasks demands software of huge capacity and flexibility. In retrospect, a different software might have better served the needs of the PUREX project.

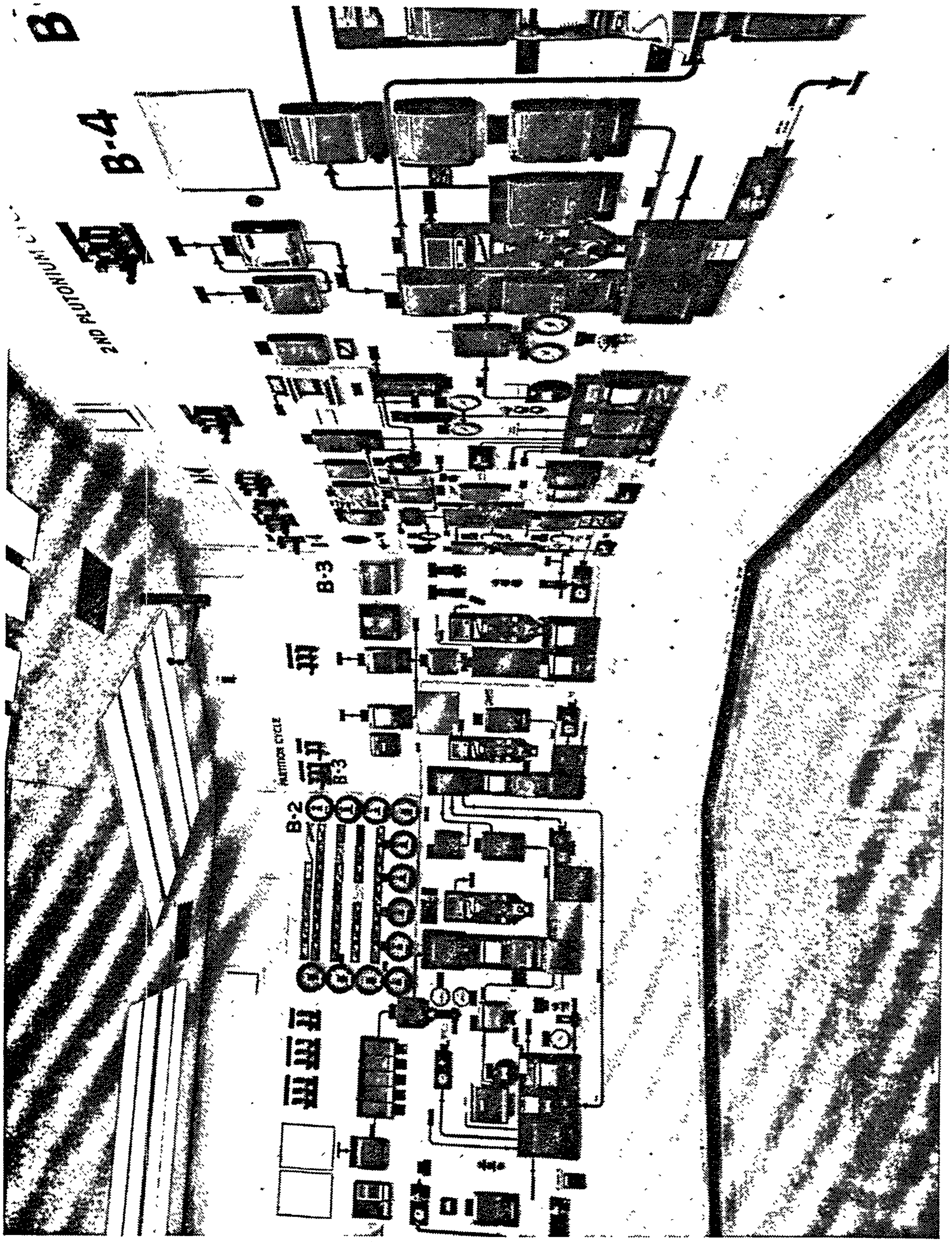

Figure 7. PUREX Control Room Showing Deactivated Instruments (1993).

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6.0 REGULATORY ISSUES

As soon as the PUREX/UO_3 shutdown order came in December 1992, the status of certain materials within the plants changed. As WHC pointed out in January 1993, during the facility operations period "materials containing special nuclear materials...[were] classified...as feed material to an on-going production process. Therefore, the materials were not considered subject to regulation as a dangerous waste, as defined by Washington Administrative Code (WAC) 173-303. Since these materials are now intended for discard, the in-process materials are solid wastes, and to the extent that nonradioactive components exhibit dangerous waste characteristics, those nonradioactive components are dangerous wastes....The units these materials are stored in are not covered in the PUREX interim status Part A Permit Application." In light of this new situation, RL requested an early meeting to review the PUREX situation with the Washington State Department of Ecology (Ecology), the state agency that administered the *Resource Conservation and Recovery Act of 1976* (RCRA) as well as its own dangerous waste statutes.[26]

The RCRA issues centered around the fact that only eight vessels out of over 300 within the PUREX Plant were identified as treatment, storage, and/or disposal units in the Part A Permit Application for the plant at the time the shutdown order was issued. However, many more vessels contained in-process materials that could be re-classified as solid waste regulated under RCRA as a result of this order. Under WAC, an automatic 90-day "clock" (a temporary waste storage period under RCRA) began to tick for the PUREX Facility. At the end of that time period, all vessels and tanks that were determined to hold hazardous wastes, and all solid wastes existing in the plant outside of vessels, would need to be permitted in a Part A Permit Application. However, WHC and RL noted and invoked an interpretation written into the Federal Register by the U.S. Environmental Protection Agency (EPA), a co-regulator of the Hanford Site along with Ecology. This interpretation stated that process materials were excluded from being designated as waste for the first 90 days after facility operations ceased. Therefore, the PUREX Plant's 90-day clock under RCRA actually did not begin ticking until an initial 90 days had passed. PUREX had 180 days to develop a regulatory plan for the process materials and other solid materials.

Beginning in March 1993, WHC and RL met with Ecology and EPA, and solicited their help in effecting a proper shutdown of the PUREX and UO_3 Facilities. Waste minimization, cost-control, and compliance all were important goals. The contractor and federal management agency informed the regulators of the situation existing with the soon-to-be unpermitted tanks in the PUREX Plant, and asked for time and help in charting a pathway through such a new, large, and complex regulatory situation.

Because the PUREX Facility had received its shutdown order without prior warning, it had not been able to anticipate the disposition of its hazardous materials nor to prepare permitting documentation. In April 1993, a week-long workshop was held with RL, DOE-HQ, WHC, and Ecology to strategize and discuss the PUREX regulatory dilemmas imposed by the shutdown order. A day-long workshop also was held with PUREX work planners and engineers and WHC regulatory support personnel to help each group understand what types of information and help each would need from the other to resolve the complex PUREX regulatory situation. In July 1993, regular monthly video conferences to discuss these issues were initiated among RL, WHC, Ecology, EPA, and the Washington State Department of Health (DOH). In the summer of 1994, a series of unprecedented, face-to-face meetings were held at PUREX between WHC, DOE, and regulators. The cumulative outcome of all of these meetings was to build trust and ownership and to obtain the assent of all of the parties to work together to find solutions, rather than to impose penalties or engage in other confrontational actions. Among the specific outcomes was the development of a Data Quality Objectives document that set forth the requirements for flushing process vessels.[27]

In the meantime, a list of all the in-process chemicals remaining in the PUREX Plant was compiled, along with a tabulation of all of the process vessels and tanks within the facility. For each vessel and tank, the location and capacity were identified, along with the part of the process in which they had been used, the current status and contents, the flush methodology, the sampling requirements, and when (if) they had been emptied. In early 1994, WHC and RL adopted the position that all but 41 of the PUREX vessels could be dispositioned without a permit application under RCRA. The materials in these tanks could be consolidated, sent or sold for re-use elsewhere, or flushed through underground piping to the Hanford Site's tank farms. Because eight of these vessels already were included in the existing permit application, DOE stated its intention to include the additional 33 tanks in a revision of the RCRA Dangerous Waste Part A Permit Application. The agency also agreed to add a box, containing solid radioactive and mixed-waste concrete debris and stored in the canyon, to this revised permit application. The status of contaminated equipment in the canyon was as yet unresolved.[28]

In January 1994, the Tri-Party Agreement was modified so as "to include the stabilization of facilities and 'transition' activities (those activities between the shutdown decision and the start of formal decontamination and decommissioning." Specifically, the amended agreement stated that negotiations for definite milestones for the PUREX and UO_3 Facilities stabilization and transition must be concluded by December 1994. Therefore, in 1994 many of the key issues still pending under RCRA and under other laws and regulations affecting PUREX and UO_3 were swept into Tri-Party Agreement milestone negotiations.[29]

A specific variance was requested by DOE for the organic (TBP/NPH) solution and vessels at PUREX, asserting that this substance did not constitute a waste as defined by RCRA. As of the end of FY 1994, no response had been received from regulators. Likewise, DOE contended that the contaminated nitric acid at PUREX was not a waste, because an alternate process use had been found for the material in England. Another issue concerned listed wastes in the PUREX Plant. In past practice, the PUREX laboratory had removed small liquid samples from the process and conducted solvent extraction operations on the samples for analytical purposes. Then, it had placed the leftover materials back into the process solutions. Solvents from the products that had been removed technically constituted listed wastes. However, DOE proposed to Ecology in 1994 that "de minimus additions of PUREX laboratory solvents to the PUREX process do not necessarily make the PUREX system a hazardous waste management system." As of September 30, 1994, negotiations between the DOE and Ecology about the hazardous materials in the PUREX Plant were ongoing as a part of the Tri-Party Agreement.[30]

Among the key issues still under negotiation at the end of FY 1994 (September 30, 1994) was that of whether a RCRA Part B Permit Application or a facility Closure Plan would constitute the final documentation for the hazardous and dangerous components of the PUREX Plant. While WHC and RL initially proposed that the regulators accept "equivalent documentation" that would need to be prepared in any case under DOE Orders (such as a deactivation Project Management Plan, a D&D Plan, and other documents), Ecology and EPA seemed to prefer a Closure Plan. Such a Closure Plan would describe how each dangerous waste management unit at the PUREX Facility would be remediated and closed. As of September 1994, negotiations were focusing on the submittal of a Closure Plan. However, because of the expected long lag time between deactivation and final D&D, a two-part Closure Plan was being negotiated. Such a plan would set a new precedent at the Hanford Site. In it, the initial submittal would document the deactivation actions and status at the time of facility turnover to EM-40. A later submittal would revise the Closure Plan once final land use decisions for the 200 Areas as a whole, and specific D&D decisions about PUREX, had been made.

Other issues under discussion in Tri-Party Agreement negotiations at the end of FY 1994 concerned end point criteria for the PUREX/UO_3 deactivation project and the final surveillance and maintenance plan for the facilities. At issue was whether or not all of the Tri-Party Agreement signatories would become involved in approving such criteria and plans. Specific technical activities such as the transition of the 211-A area, the sample gallery, the U-Cell fractionator, and when to designate equipment as dangerous waste also were under consideration for inclusion in the Tri-Party Agreement, as was the final disposition (under a Part B Permit Application or a Closure Plan) of the PUREX waste storage tunnels.[31]

In the area of air permitting for the PUREX/UO_3 deactivation project, the approval of DOH, Ecology, and EPA was needed to conduct deactivation activities. DOH had the authority to regulate radioactive air emissions, while Ecology had the responsibility to regulate non-radioactive air emissions (nitrogen oxides - nitrogen oxide and toxic air pollutants). EPA had the authority to regulate both radioactive and nitrogen oxide emissions, but not toxic air pollutants. WHC and RL believed that deactivation activities would generate emissions at a much lower level than emissions during years of past normal operations, as represented by the last two full years of normal PUREX and UO_3 operations. WHC and RL proposed to demonstrate the lower emissions to the regulators with clear figures, in hopes that full new permit applications would not be necessary. Such a strategy would save time and money. Several "emissions comparison documents" were submitted to the state regulators in early 1994, and accepted by them later in the spring and summer. However, a new permit application for radioactive air emission generated by deactivation activities was required by EPA.

In the case of nitrogen oxide emissions, Ecology did not approve of the levels of nitrogen oxide that were to be generated by an initial PUREX proposal to conduct sugar de-nitration (destruction) of approximately 692,728 L (183,000 gal) of contaminated nitric acid. However, the issue was dropped when PUREX technical personnel developed an alternative strategy for dispositioning this nitric acid (see Section 8.0). Another PUREX initiative in 1994 challenged the classification of all of the facility's eleven exhaust stacks. From discussions with regulators and technical evaluations, all but two of the stacks were re-classified as "minor" under National Emissions Standards for Hazardous Air Pollutants (NESHAPS) (40 CFR 61) regulations, thus reducing the frequency of required monitoring and saving costs.[32]

Jointly, WHC and RL worked to achieve compliance with the requirements of the *National Environmental Policy Act of 1969* (NEPA) in as cost-effective and efficient manner as possible. A creative solution was needed that encompassed both compliance and time- and cost-saving measures. The PUREX and UO_3 Facilities had an existing EIS for operations, and the management realized that the preparation of a new EIS for deactivation could be a lengthy activity and consume a sizeable share of the project's budget.[33]

Together with WHC regulatory support personnel, PUREX management proposed the formation of a NEPA screening panel that would compare each deactivation activity with activities already documented and analyzed in the existing EIS for plant operations. The screening was performed in the autumn of 1993 by a panel composed of personnel from PUREX, WHC regulatory support, and RL. The panel initially indicated that all proposed deactivation activities save two could be performed under existing Hanford Site-wide categorical exclusions (CXs), a simple form of NEPA documentation, or under three, separate new CXs that would need to be written for the deactivation. It was believed at the time that the three new CXs would be needed to document consolidation of the PUREX HVAC, contaminated nitric acid offsite, and shipment of the PUREX TBP as a waste to an offsite incinerator.

The NEPA screening panel also initially indicated that, in addition to the three new CXs, the PUREX deactivation project would need to prepare EAs, a medium level of documentation, for two activities: Phase III cleanout of the N-Cell and shipment of irradiated fuel to wet storage in the Hanford Site's K-Basins. It was further determined in a separate review that none of the actions planned in the PUREX/UO_3 deactivation were invasive or intrusive enough to activate the need to prepare facility documentation under the *National Historic Preservation Act of 1966*.[34]

As events developed in 1994, some changes took place in the initial NEPA strategy. PUREX management changed its plans with regard to N-Cell deactivation, making the cleanout less extensive (see Section 8.0). With this decision, the screening panel determined that an EA would not be required. In September 1994, DOE-HQ decided that a CX for shipping the contaminated nitric acid offsite was insufficient, and provided direction to prepare an EA for this action. This decision involved both environmental and non-proliferation concerns (see Section 8.0).[35]

Compliance with clean water regulations in the PUREX deactivation project was not difficult or complicated because no discharges to the Columbia River would occur. Discharges to groundwater beneath the Hanford Site already had been addressed in previous Tri-Party Agreement negotiations. In accordance with Tri-Party Agreement milestone M-17-00, 19 major untreated Site discharges to the ground would cease by June 1995, and 14 other major untreated discharges would cease by October 1997. Accordingly, the PUREX Facility had plans in place to connect its post-1995 discharges to the 200 Area Treated Effluent Disposal Facility.[36]

The regulatory compliance situation for the UO_3 Plant deactivation was considerably simpler than that for the huge PUREX Facility. No RCRA permits were required at the UO_3 Plant, because no wastes were treated or stored there for over 90 days. The facility did have some less-than-90-day-storage pads, but RCRA permits are not needed for such satellite accumulation areas. It was determined by WHC regulatory support, with the concurrence of RL, that all NEPA documentation requirements for the UO_3 deactivation already were fulfilled under existing Hanford Site-wide CXs. Contaminated discharges to the ground and groundwater were eliminated in decontamination actions taken as part of the UO_3 deactivation (see Section 9.0).[37]

Lesson No. 15. Every effort should be made for facilities to coordinate their status and potential regulatory situations to DOE-HQ on a constant basis, to avoid sudden or unexpected shutdown orders. Better planning and communications between the DOE and its contractors should be instituted in the future, so that facility preparations for the consolidation and disposition of hazardous materials can begin prior to the arrival of formal closure orders. The PUREX Facility was in possession of a number of substances for which there were no RCRA permits after the operational/standby status of the facility changed. Likewise, NEPA documentation might/could have been prepared as part of the deactivation decision, and in support of that decision.

Lesson No. 16. It is essential to involve and inform regulators early in any regulatory process or negotiation. A cooperative spirit is established by such actions, and joint efforts then can be directed at solutions rather than into confrontational or penalty-based actions. The regulatory dilemmas inherent in the PUREX deactivation project were unique and first-of-a-kind. Early and open communication with regulators was crucial to finding acceptable solutions to these dilemmas.

Lesson No. 17. Regulatory issues and needs must be communicated by contractor and DOE experts to all of the managers, engineers, and work planners at a facility. Just as understanding the methods and needs of the scheduling professionals by the plant operating personnel contributed to better schedules, likewise understanding of regulatory requirements by facility operators will (and did at PUREX) help ensure that regulatory mistakes and violations are avoided.

Lesson No. 18. For facilities in states that have negotiated special agreements with state and federal regulators (such as the Hanford Site's Tri-Party Agreement), such agreements can serve to break regulatory impasses that might be encountered under RCRA and other statutes. Because the Hanford Site Tri-Party Agreement has legal precedence over some other environmental laws, it can be a useful tool in negotiating creative solutions in response to unique needs. One example of such a prototypical solution might be a two-phase Closure Plan for PUREX.

Lesson No. 19. Emissions Comparison Documents are a useful tool in saving the costs and time that would be necessary to prepare full new permit applications for deactivation actions. The unique and successful use of such documents at the PUREX and UO_3 Plants should be extended to other facilities undergoing deactivation.

Lesson No. 20. The NEPA screening approach taken in the PUREX and UO_3 Facility deactivations is an extremely helpful and precedent-setting activity. Because an operational EIS existed, it was possible to comply with NEPA requirements without preparing a new EIS for deactivation. This action saved enormous amounts of time and money, and in particular should be highlighted and used at other facilities that are undergoing deactivation and that possess existing EIS documentation.

Figure 8. Plugging a Sump Drain to Prevent Spills to the 211-A Chemical Sewer (September 1993).

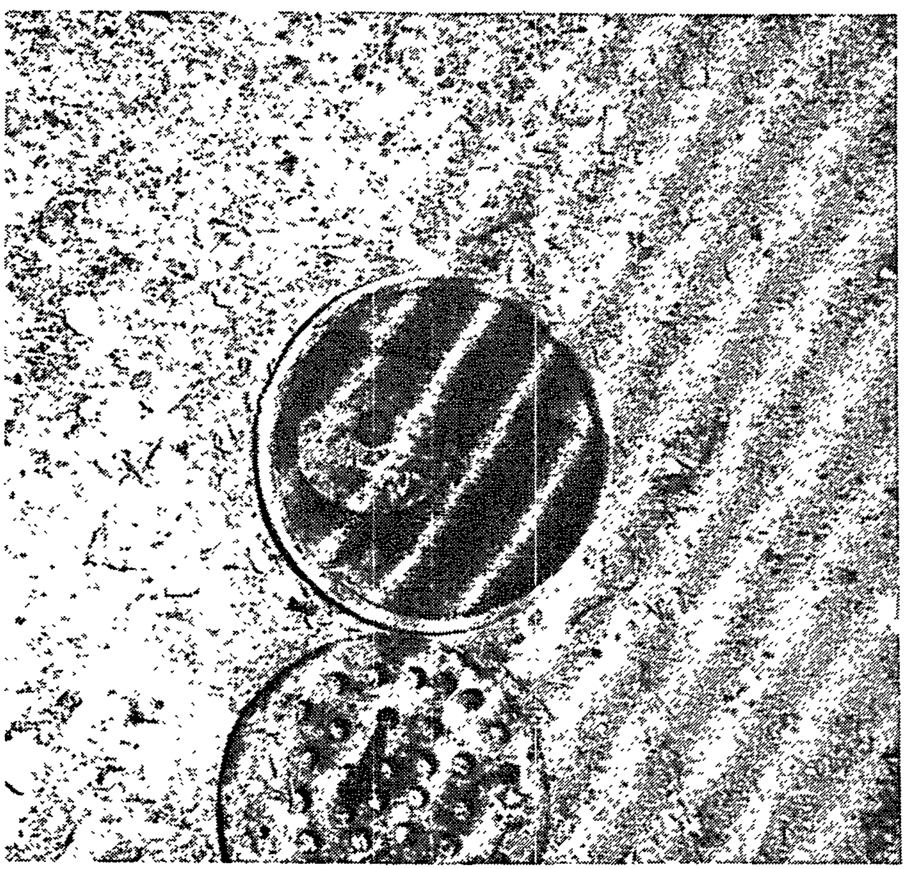
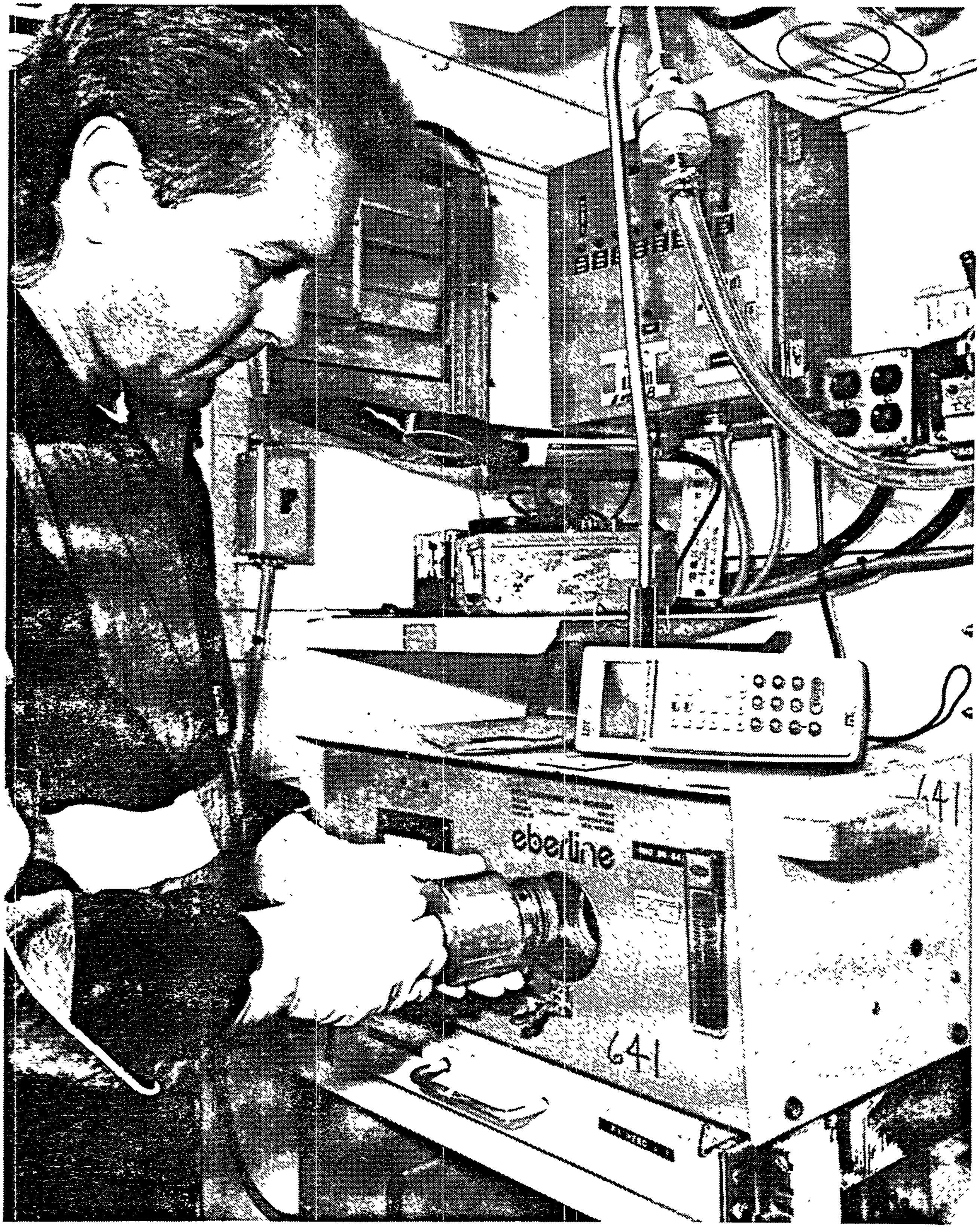


Figure 9. Washington State Department of Health Installing Sample Filter Online for 291-A-1 Main Stack for Independent Monitoring Purposes (September 1993).

Figure 10. Stack Monitoring Photograph, Showing an Individual Taking Readings (1994).



7.0 SAFETY DOCUMENTATION STRATEGY

When the shutdown order came for the PUREX and UO_3 Facilities in December 1992, each facility had an existing Final Safety Analysis Report (FSAR). The PUREX Plant's operations safety requirements (OSR), the safety boundaries, safety conditions, and other control features, were contained in Chapter 11 of the facility FSAR. PUREX also possessed a long list of pre-existing hazards control documents and criticality prevention specifications, along with a process control manual (PCM), with Addendum, that mandated which routine S&M checks were required at the facility. During the Standby period, a revised version of the PUREX FSAR had been written, along with an operating specifications document, to cover expected activities that had not been documented and analyzed from a safety perspective during operations. However, this revision had not yet been approved by DOE-HQ. A separate document, known as the "Split Report," also was created at PUREX as the result of a screening process in which each OSR was examined for its applicability to the operating mode and/or standby conditions. The Split Report represented an effort to reduce the number of OSRs, but still maintain an adequate safety boundary for ongoing actions. This report examined each OSR's applicability to installed instrumentation, to key process variables, and to any structure, system or component that functioned to actuate or to mitigate accidents or transients. All OSRs that were found to be applicable to any of the above cases, were retained as being applicable during Standby.[38]

The analysis contained in the Split Report, as well as other safety analyses carried out by PUREX personnel, defined ten limiting conditions of operation that would apply to limit the PUREX Plant's operations during Standby. As long as the activities described in the ten limiting conditions of operation were prohibited, the plant could safely carry out certain standby activities not fully anticipated or described within existing safety documentation. These ten conditions were as follows: fuel receipt and handling were prohibited, the dissolver off-gas system would be deactivated, charging operations were prohibited, the ammonium fluoride/ammonium nitrate line to the dissolvers would be isolated to prevent accidental additions, the organic streams from G- and R- Cells to the solvent extraction vessels would be isolated, the pumps and agitators servicing the TK-G5 and TK-R7 would be deactivated and the coil inlets isolated, the sugar header would be isolated to prevent the addition of sugar to any canyon vessel (to prevent sugar de-nitration activities), and the inlets to canyon tank coils that discharged to the cooling water low-level effluent stream and the chemical sewer low-level effluent stream would be isolated. Additionally, a preliminary hazards analysis for Standby was performed at PUREX, and Standby operating specifications were approved for issue.[39] It was at this point that the final closure order was issued in December 1992.

In early 1993, a series of small workshops was held with personnel from WHC, RL and a consulting firm with expertise in safety. The purpose of these workshops was to discuss how to address safety concerns about deactivation activities, while remaining true to the Independent Technical Review Team's 1992 advice not to write an entirely new FSAR for deactivation. At a larger workshops that also included stakeholders and regulators in April and June 1993, an idea known as the "crosswalk" was presented and amplified by PUREX personnel. The crosswalk concept consisted of a series of comparison activities (somewhat similar to the NEPA screening concept - see Section 6.0). All of the activities expected during the PUREX deactivation project would be compared with existing safety documentation, and also screened using guidance and forms in DOE Order 5480.23. The existing PUREX safety documents to be used would be the last approved revision of the FSAR (Rev. 5), the PCM Addendum 1 (latest revision), the Split Report, and another applicability document created during the Standby period. Additionally, the existing unreviewed safety question (USQ) process contained in DOE Order 5480.21 would be used to prepare a screening form and examine each deactivation task. Tasks identified as non-USQ (those falling within existing safety envelopes) would be closed. A Safety Evaluation would be prepared for every task falling outside of previously analyzed safety criteria.[40]

In the crosswalk strategy, any deactivation actions that were not covered in existing documentation would be addressed by revising the PCM to add "mode applicability statements," compiling an interim safety basis document for shutdown activities, and writing a preliminary hazards classification document for deactivation. However, DOE-HQ expressed strong concerns that, in the crosswalk strategy as defined, worker safety and health issues were not receiving attention equal to that under OSHA standards. It was suggested that PUREX conduct a scoping review of WHC occupational safety and health manuals, evaluate the applicability of existing manuals and safety and health programs to the PUREX/UO_3 deactivation project, develop and modify existing programs as necessary to cover all deactivation tasks, and then implement these programs during all phases of the deactivation.[41]

Throughout the remainder of 1993 and into early 1994, discussions went forward between PUREX and DOE personnel regarding various proposals for developing adequate safety documentation for the huge deactivation project without writing an entirely new FSAR. Several site visits were made by DOE-HQ personnel, to gain a better understanding of actual field activities. In January 1994, PUREX issued a technical information document that allowed some early deactivation actions to go forward. In March, RL issued a letter authorizing deactivation activities to go forward at PUREX using the safety analyses and requirements in the following documentation: the existing version of Chapter 11 of the FSAR; all of the associated and existing safety bases documentation; the non-radiological risk acceptance guidelines contained in the (revised) WHC *Safety Analysis Manual*; and the (revised) PUREX/UO_3 Plant Administration Manual (for the identification and resolution of unreviewed safety questions). Because this letter did not include the operations-based PCM, it paved the way for the elimination of that document.[42] Both DOE and the contractor realized that Standards and Requirements Identification Documents (SRIDS) also would have to be tied in (or that a path to waive the SRIDS would have to be defined with DOE concurrence). An upgraded worker safety and health program plan also would need to be developed.

Additionally, as a "best management practice" in early 1994, PUREX decided to create a Health and Safety Plan even though one was not required in the *Code of Federal Regulations* because PUREX was not defined as an uncontrolled hazardous waste site. To begin, PUREX commissioned a subcontractor to write a Hazards Baseline Document for the facility. A hazards training class also was developed for deactivation workers. These activities were supported by the development of a unique Preliminary Hazards Screening/Assessment (PHSA) form/process. The process used a two-part screening form to evaluate the relative hazards for each task and to determine the appropriate level of analysis to assess the task. The matrix-based form was based partially on a checklist found in a 1992 Hazards Evaluation Procedures study of the American Institute of Chemical Engineers. The PHSA form was initiated to (1) increase attention to worker safety issues during the PUREX deactivation project; (2) to serve as a graded formal approach to determine activities with potential to impact the safety authorization basis and to analyze them; (3) to involve the workers in the worker safety development and evaluation processes; (4) to serve as a means to communicate potential hazards to deactivation workers; and (5) to integrate SRIDS into the work authorization process in a graded manner. The form was to be used to screen each Work Plan for all levels of potential safety issues as it was written.[43]

The safety requirements and analyses written into the PUREX deactivation PHSA process were more strict than those in general use at DOE non-reactor facilities. This conservative approach was endorsed by DOE-HQ, "in view of the absence of approved...DOE guidelines over the credible spectrum of potential accidents." The PUREX PHSA form analyzed each job on the basis of five initial criteria: its complexity and size, the type of process (physical, electronic, mechanical, computer, biological or human), the type of operation (fixed facility, transportation, permanent, temporary, continuous, semi-batch or batch), the nature of the hazard (toxicity, reactivity, flammability, radioactivity, explosivity, criticality, or other), and the event or scenario of concern (loss of function event, single failure, multiple failure, procedure, process upset, software, hardware, human, or simple loss of containment). It then probed the perceived risks and experiences of workers who would be involved with the job. Finally, it asked a series of questions about the nature of job, the physical hazards, what could go wrong, how much damage would be done in worst-case scenarios, and whether or not further analysis should be done.[44]

Under the PUREX PHSA process, a team of experienced safety analysts and the preparer of each work plan participated in each job screening. If a job was deemed to be so simple that it did not require any formal analysis (Case III), then it could be performed under existing WHC procedures. If a job was judged to be of medium complexity, with more than minimal accident potential (Case II), then a Job Safety Analysis was performed by a team to identify hazards and the controls necessary to prevent or mitigate those hazards. If a job was deemed so hazardous as to require a formal analysis (Case I), then a team would perform a Hazards and Operability analysis or other more detailed analysis techniques, recommend and incorporate job controls into the work plan, and conduct a USQ determination. Additional actions taken included the modification of PUREX procedures in regard to USQs, to strengthen the PHSA form for use with existing safety documentation. PUREX also issued a revised version of its deactivation operating specifications, thus replacing the PCM Addendum 1.[45]

At the close of FY 1994, the PUREX safety documentation strategy, a creative blending of existing safety documentation with new consideration of deactivation tasks, had achieved DOE-HQ concurrence. Especially in the areas of worker safety, health, and participation, recent arenas of increased concern by DOE, the PUREX Health and Safety Plan's graded approach was so successful that its designer was asked to help develop a new EM/EH handbook for the safety documentation and integration of all DOE facilities.[46]

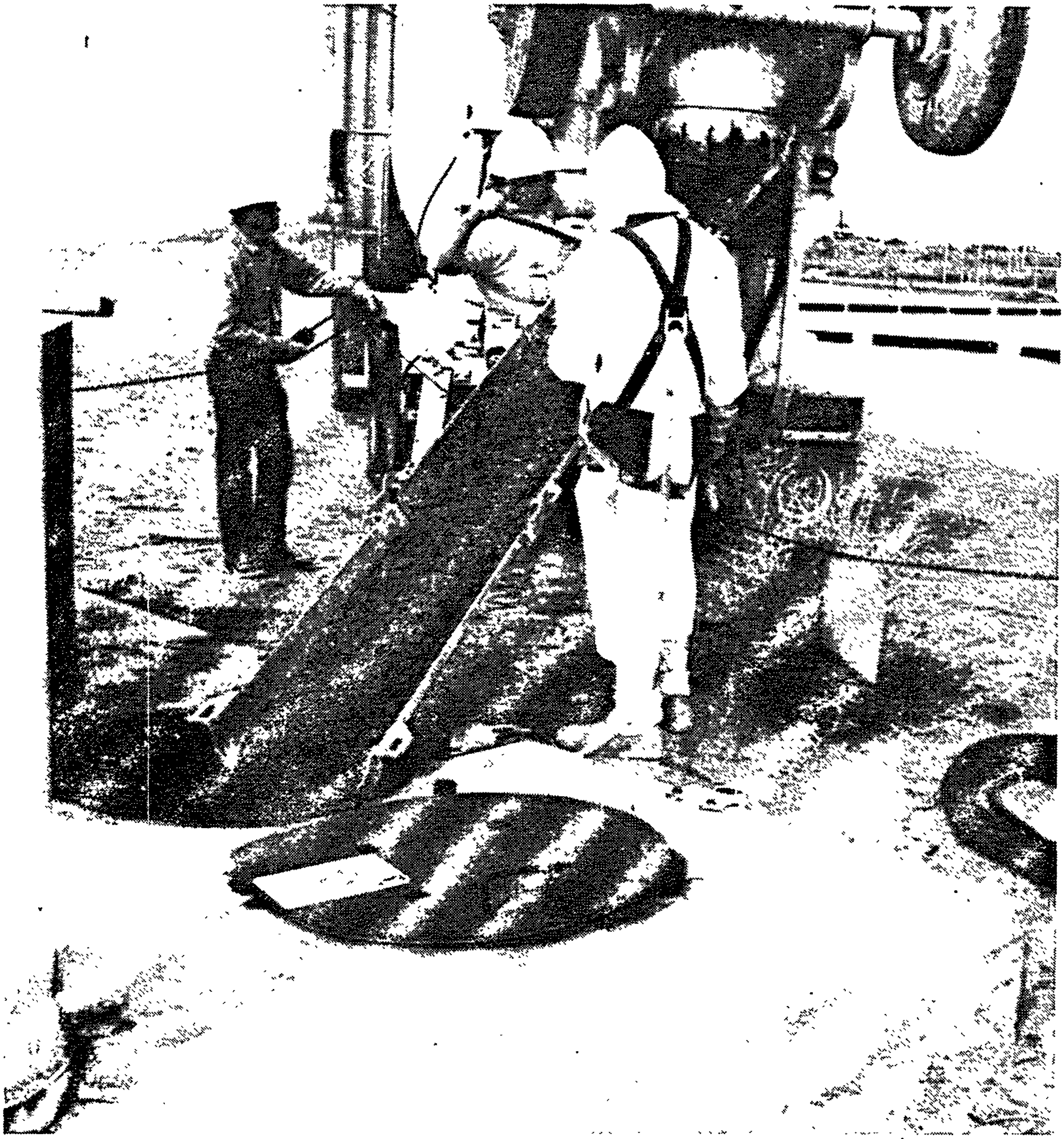
Lesson No. 21. Existing safety documentation from facility operational periods should and can be used in creative and careful ways as the basis for deactivation project safety documentation. Revisions, comparisons, "crosswalks," and other types of screening procedures can be used to evaluate which deactivation actions may be covered in existing documentation, and which actions need supplementary coverage. However, such comparison efforts, performed by those who know the facility well, are more cost-effective and time-efficient than the preparation of all new safety documentation for facility shutdowns.

Lesson No. 22. Workshops and other joint working efforts that bring together the principals interested in safety documentation, DOE, the operating contractor, and ITEs and other consultants, are important early in a deactivation project for brainstorming and establishing the major cornerstones of consensus about the safety documentation.

Lesson No. 23. Worker health and safety, always a DOE and contractor concern, has been elevated in recent years to even more important status. Often, worker safety and health aspects of older facility safety documentation will prove to be the area wherein such documentation falls short of modern standards. It is extremely important that worker safety and health considerations, comparable to or exceeding the levels demanded by OSHA, be incorporated into newer revisions or supplements of safety documentation.

Lesson No. 24. Worker involvement and a graded approach to the levels of safety analysis required for various deactivation tasks are keys to making the safety analysis process useful, efficient, and satisfactory to all concerned. The graded approach is cost effective in that it does not demand a high level of analysis for simple jobs already covered in established procedures. Worker involvement is also cost-effective in that it provides a higher level of assurance that workers are participating willingly and without hesitation in the jobs that are required for facility deactivation.

Figure 11. Blanking of Steam Condensate Lines. Worker is Wearing a Safety Harness to Prevent a Fall Into the Hole.



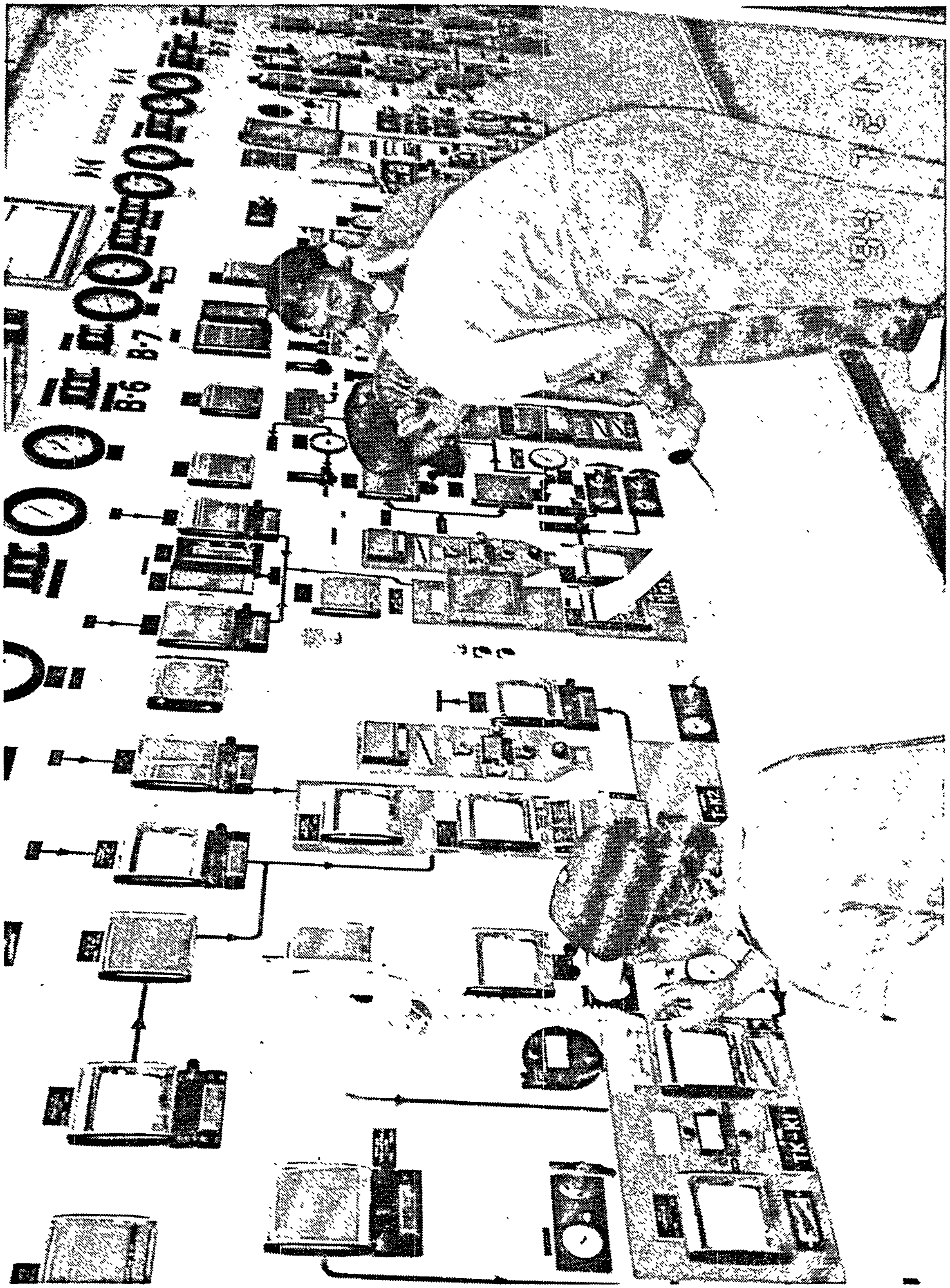


Figure 12. K-Cell Flushing (1994).

8.0 TECHNICAL ISSUES

Not every technical activity in the PUREX deactivation project is described herein. Only the major technical activities believed to yield lessons of larger or precedent-setting importance have been included. Technical activities not discussed encompass instrument deactivation, fire protection system deactivation, liquid effluents system deactivation, utilities deactivation, HVAC consolidation, surveillance and monitoring planning, P&O gallery and white room deactivation, in-plant waste concentration (E-F11), dissolver heels stabilization, canyon and vessel flushing, and 211-A stabilization. Discussion of these issues can be found in the *PUREX/UO_3 Deactivation Project Management Plan.*[47] The following technical activities are discussed because they have followed unique pathways.

8.1 N-CELL, PR ROOM, Q-CELL, AND SAMPLE GALLERY DEACTIVATION

N-Cell processing equipment was added to the PUREX Plant in 1978, to provide the capability to convert plutonium nitrate solution (the original PUREX product) to plutonium oxide powder. Although oxide conversion traditionally had been done at the PFP, it was believed that it would be safer to transport plutonium from PUREX (in the Hanford Site's 200 East Area) to the plutonium storage vaults (in the 200 West Area, PFP Complex) in oxide form. The cell contains six full-size glove boxes [typically 3.7 m (12 ft) tall and 2.7 to 4 m (9 to 13 ft) long], two extra-large glove boxes built together as a free-standing unit [7.6 m (25 ft) tall and 11 m (36 ft) long], as well as four small glove boxes for powder loadout, canning, bagging, and maintenance. Each of the extra-large glove boxes contains a calciner, a first stage titanium calciner and a second stage stainless- steel calciner that operated in series. During operations, the second stage calciner discharged plutonium oxide powder into a vibrating screen assembly known as a scalper. Additionally, the powder loadout glove box contains a small muffle furnace.[48]

Once the decision was made to close the PUREX Facility in 1992, it became important to remove as much plutonium and plutonium-contaminated equipment as possible from N-Cell. A boundary estimate of the plutonium inventory conducted in 1993 found between 900 and 13,000 grams of plutonium in the cell, with the best estimate found to be about 3,000 grams. Such amounts helped to place the PUREX Plant into a "high-hazard classification" (as defined in the preliminary hazards analysis). Reducing this amount was necessary to attain many other deactivation goals: to shut off the criticality alarm in N-Cell, to lower the probability of a contamination spread after the building ventilation was reduced (in later deactivation steps), and to keep the radiation exposure to workers ALARA. It was known that the experienced crew of PUREX nuclear operators available to the deactivation project could perform N-Cell cleanout more efficiently than could future D&D workers who would not be familiar with the plant, and that the decay of ^{241}Pu to ^{241}Am in the intervening years actually would increase future radiation exposures.[49]

Although an early draft plan called for the removal of the twelve N-Cell glove boxes, PUREX personnel decided by mid-1993 that such equipment removal could not be justified as part of deactivation work. Also, an EA would likely have been needed for such activity. The cost of the work itself, as well as the costs of preparing the EA, led to the decision to stabilize the glove boxes in place. The revised planning for N-Cell cleanout included three phases. Phase I, begun in the Spring of 1993, consists of removing small equipment from the glove boxes. "Small" was defined as anything that could fit through a bagout port, including tubing, valves, pumps, and other items. Additionally, new gloves had to be installed on many glove ports that had been sealed temporarily during Standby, and the cell's Segmented Gamma Scanning Assay System had to be refurbished. The Segmented Gamma Scanning Assay System monitoring instrumentation assayed the material being removed from the glove boxes to document the amount of plutonium being placed in each transuranic waste drum. Phase II of N-Cell deactivation will consist of cutting up and removing large equipment (such as the calciners) from the glove boxes. Phase III will include wipe-down and spraying of the interior of the glove boxes with an acrylic latex contamination fixant. Next, metallic "pie pans" will be placed over the glove ports, then the glove ports will be wrapped with a polyolefin "shrink-wrap" material and finally that material will be heated to activate a tar-like adhesive contained within it. Additionally, miscellaneous storage cabinets will be removed from the N-Cell loadout room. Lastly, the entire ventilation system that serves N-Cell, Q-Cell, and the PR room will be consolidated, many of the filters will be removed, and the glove boxes vented to the canyon.[50]

The PR room at the PUREX Plant was used during operations to sample plutonium nitrate solution from the process and then transfer it either to M-Cell storage tanks for processing in N-Cell or into product cans for shipment to the PFP. The PR room also functioned to receive rework solution from N-Cell and L-Cell for transfer back into the PUREX process. Major upgrades in 1981 included the replacement of glove box panels with noncombustible materials, redesign of the L9 agitator shaft seal, and other improvements. The PR room contains four glove boxes, which in turn hold receiver tanks, vacuum jets and condensers, a scale hoist, liquid seal pot, piping, pumps, valves, and other hardware. During the Standby period, PR room tanks and glove boxes were flushed with nitric acid to reduce the plutonium inventory. The flush solution was stored in tank E6, and the nitric acid transfer lines to the PR room were blanked in the P&O gallery.[51]

The deactivation plan for the PR room basically follows the same sequence as that for N-Cell, and will take place as soon as the N-Cell deactivation is complete (planned for 1996). Residual solution heels will be removed from the PR room tanks, small and then larger equipment will be removed from the glove boxes, and then the glove box interiors will be wiped and sprayed with fixant. Lastly, glove box exterior penetrations and ports will be sealed, miscellaneous equipment used during the deactivation work will be removed, the ventilation system will be consolidated, and the glove box ventilation will be re-routed.[52]

Q-Cell in the PUREX Plant was used from 1958 through 1972 to perform the final steps in purification of ^{237}Np from the process stream. Neptunium was separated and concentrated in the J-Cell package, then transferred to Q-Cell for concentration and purification, and finally loaded into bottles as neptunium nitrate for shipment to other facilities. After the decision was made in the early 1980s not to re-start Q-Cell, the transfer line from the J-Cell package was blanked, the vessels and glove boxes were flushed, and the steam and water headers to Q-Cell were disconnected during the Standby period. The most significant pieces of equipment remaining in Q-Cell include the concentrator, an ion-exchange column, feed tanks, and a sump tank located inside a hot cell, and valves, pumps and other small equipment pieces located inside the maintenance glove box.[53]

Again, the deactivation plan for Q-Cell follows the pattern for N-Cell and the PR room. Residual solution heels in Q-Cell tanks will be sampled and, if found to contain hazardous waste, will be removed. Glove box equipment may be removed, the interiors of the glove boxes wiped and sprayed or painted with contamination fixant, and the outer penetrations and ports sealed. Ventilation ducts will be blanked, filters removed, and the glove box ventilation re-routed.[54]

The Sample Gallery in the PUREX Plant is a long corridor that runs parallel to the main canyon on the second floor of the 202-A (PUREX) Building. During operations, it functioned to provide access to the canyon tanks for sampling purposes. Three types of sample stations were built, with varying amounts of shielding to accommodate sample solutions containing different levels of radioactivity. Air jets were used to circulate solutions from process vessels, through sample cups enclosed in housings in sample stations, and then back to the point of removal from the process. Other miscellaneous activities and equipment that were housed in the Sample Gallery included a manipulator maintenance shop, a low-level waste compactor, cold chemical make-up tanks for N-Cell, two neutralization systems, and a shielded pipe chase containing chemical headers. Sampler hoods were exhausted through two stacks (296-A-6 on the east end and 296-A-7 on the west end) via a sampler exhaust duct that runs the length of the Sample Gallery. Recurring leaks of contaminated condensate over the years indicate a buildup of radioactivity in the hoods and duct.[55]

Deactivation plans for the Sample Gallery call for removing debris from samplers and then sealing the sampler hoods, valve pits, and duct. Silicon rubber sealants will be used on the cracks around the hood doors, and larger openings will be covered with rigid plastic sheets. Polyurethane foam sealants will be used to fill the exhaust duct, and seal the dampers, valve pit cover blocks, and valve extension handles. One deactivation alternative considered for the Sample Gallery was the removal of equipment and portions of the duct, but these activities would have increased costs, worker exposures, and would have generated additional mixed waste. The alternative of fixing and sealing the contamination in place was chosen because it allowed safe abandonment in place of equipment and duct work.[56]

Lesson No. 25. New techniques in contamination fixation and sealing can be used to reduce the possibility of contamination migration so that full removal and burial of contaminated equipment and duct work is not necessary during deactivation. Use of these innovative and cost-effective methods reduces the worker exposure that might be encountered in full equipment and duct removal, safeguards the environment from contamination migration, and retains flexibility for any and all future D&D decisions.

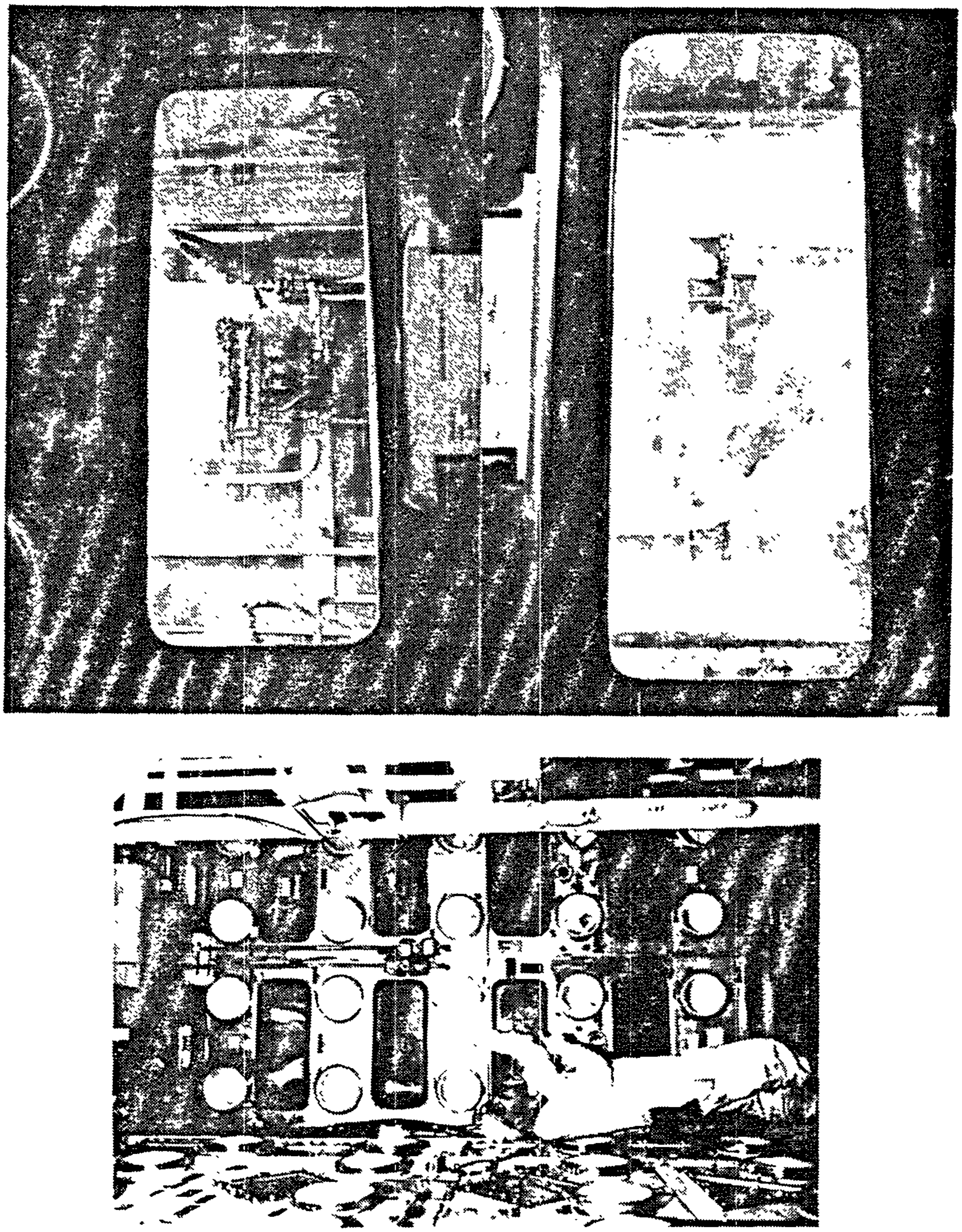


Figure 13. Views of N-Cell, Showing Glove Boxes and Small Equipment to be Removed.

Figure 14. Sample Gallery During Operations With Operator Taking a Sample.

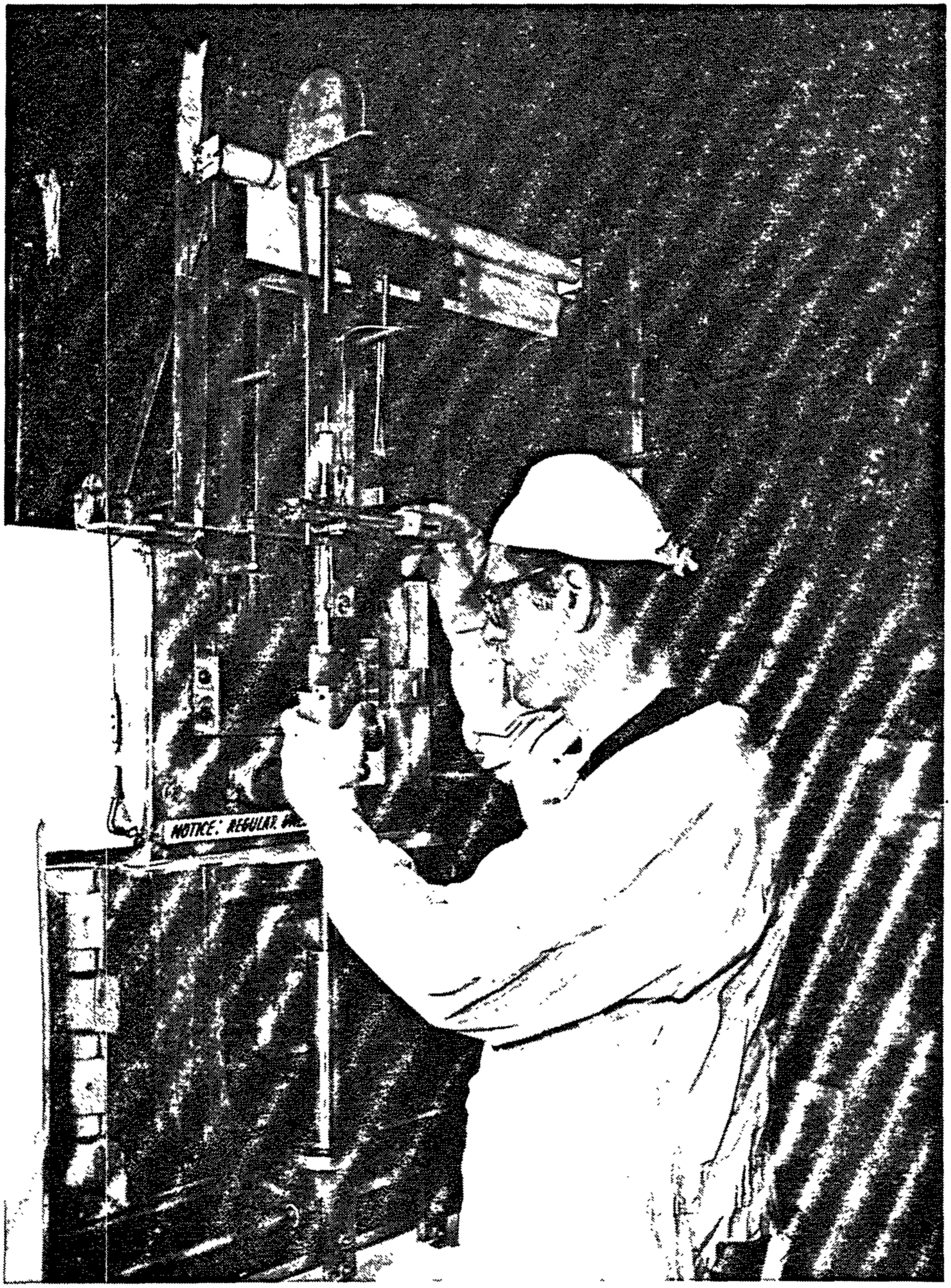


Figure 15. Q-Cell Samplers Being Sealed Shut With Silicon Rubber and Tape During Deactivation Project.

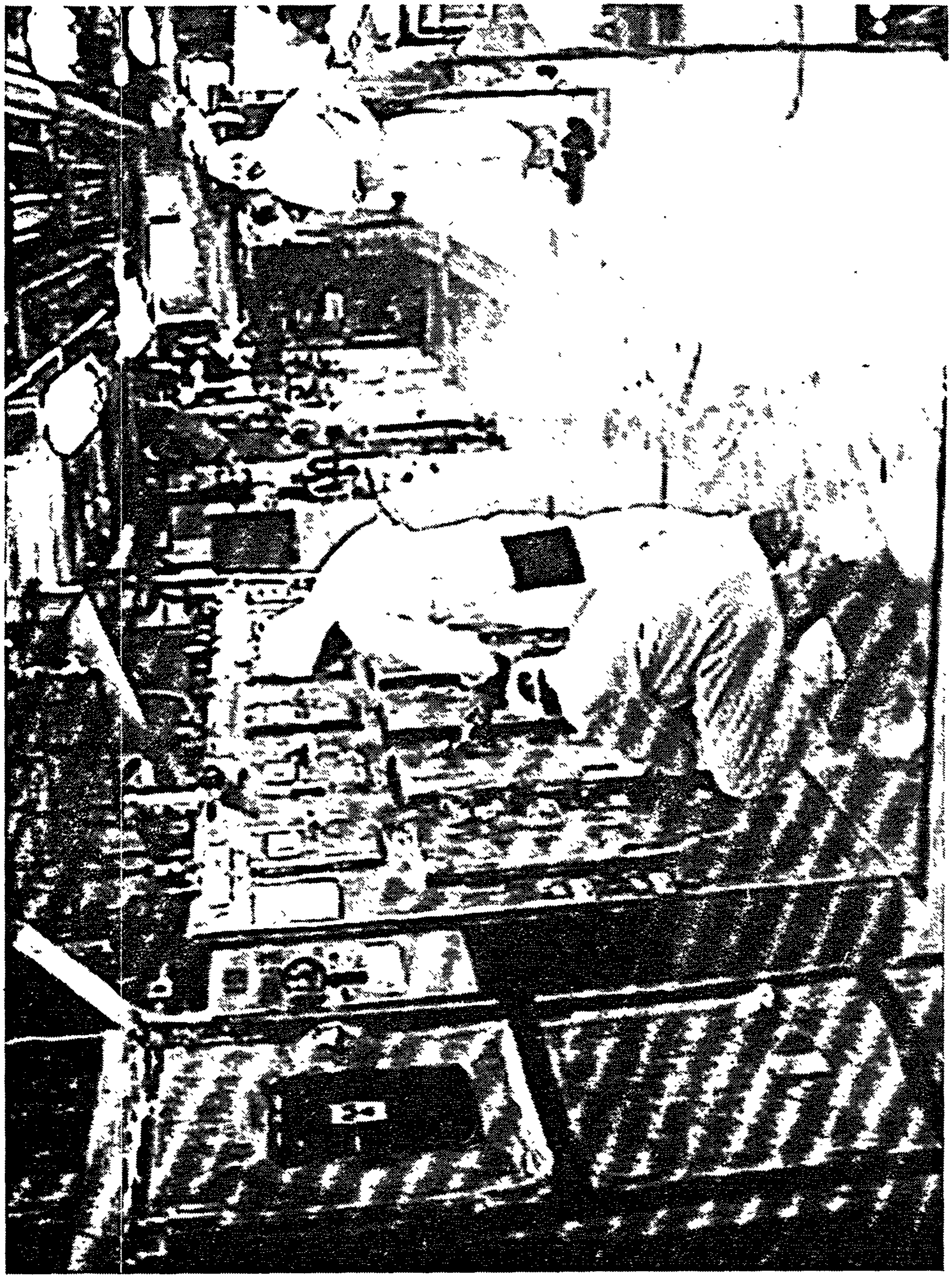


Figure 16. Another View of Q-Cell Samplers Being Sealed Shut.

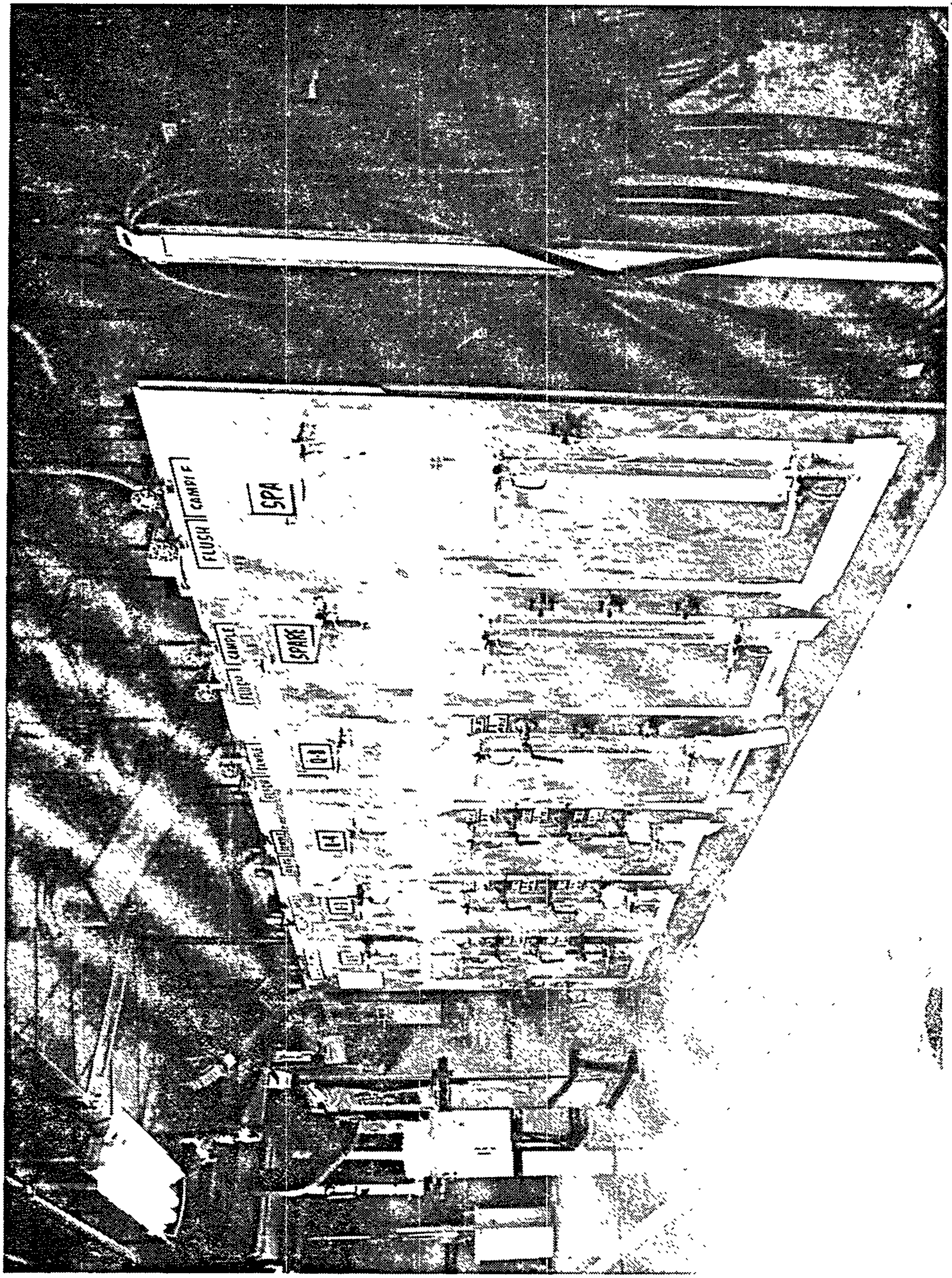


Figure 17. Sealed Q-Cell Samplers Shown Finished (1994).

8.2 METAL SOLUTION DISPOSITION (D5/E6)

Because the PUREX Facility was in "Standby pending restart" until late 1992, approximately 8,101 L (2,140 gal) of recycled product UNH solution were routed into tank E6. This substance was needed to meet criticality specifications for receipt of plutonium-bearing solutions generated during stabilization and cleanout activities conducted at the plant. During 1990 to 1993, the plutonium oxide powder from N-Cell was dissolved in nitric acid and transferred as plutonium nitrate solution into head-end tank E6 (via temporary storage tank L-11). Tank E6 also received plutonium-bearing solutions generated from the flushing of solvent extraction vessels during Standby. In March 1992, about 8,328 L (2,200 gal) of the solution blend in tank E6, containing an estimated 3,760 grams of plutonium, was transferred into tank D5 to make room in tank E6 for additional transfers from tank L-11. By early 1994, the solutions in both tanks E6 and D5 contained approximately 9 kg of plutonium and 5 metric tons of uranium.[57]

With the December 1992 shutdown order, the PUREX Plant was prohibited from any processing activities. Furthermore, solvent extraction vessels already had been partially flushed of residual actinides, canyon process streams had been partially isolated from input and output streams, aqueous make-up tanks were flushed, drained,and disconnected, and many instruments and procedures associated with canyon activities had been deactivated or allowed to lapse. In many cases, operator training to support in-canyon activities associated with the plutonium/uranium solutions had expired. Therefore, a crucial question became that of how best to dispose of the plutonium/uranium solution material in tanks D5 and E6. Several options were considered, including multi-batch separation of the uranium and plutonium, using various partitioning flowsheets and mechanisms. However, the integrity of several PUREX tanks and vessels would have to be verified if these options were adopted, N-Cell would have to be kept operational for conversion of the recovered plutonium portion to plutonium oxide, and some of the required activities were outside the bounds of the existing PUREX FSAR.[58]

Another disposal option involved co-precipitation of the solids from the supernate portion of the solutions. The liquid portions [about 26,498 L (7,000 gal)] would be transferred to the Hanford Site's tank farms, and the solids would be added with absorbent material (vermiculite) into 208-L (55-gal) drums for storage as transuranic waste. It was estimated that 150 to 300 such drums would be generated. For a time in 1993, the co-precipitation option was preferred. However, further analysis showed that for this option, risk levels were in the "medium" range in the areas of worker and environmental protection, regulatory concerns with the vessels needed for the co-precipitation operation, waste minimization, and life-cycle cost. Also, this option presented serious implementation time and schedule impacts, because new equipment would need to be designed, procured, built, installed, tested, and reviewed. In late 1993, another option, that of direct transfers of the neutralized D5/E6 materials to the Hanford Site's tank farms, was selected. It was determined that this material could be diluted with flush solutions that resulted from other canyon deactivation activities and that had been concentrated in the PUREX F-11 concentrator, thus avoiding any criticality difficulties within the waste tanks. Finally, a change in the Hanford Site's tank farms acceptance criteria made feasible the new approach. Approximately 50 batch transfers, totalling 757,080 L (200,000 gal), would be needed. This option was found to involve "low" risks in many of the same areas where the co-precipitation option had involved "medium" risks. An added main benefit of this decision concerned the overall cost reduction associated with early completion of the PUREX deactivation project.[59]

Lesson No. 26. Any unnecessary manipulations, separations, conversions, or handling of plutonium and uranium-bearing solutions should be avoided. The age of the process vessels (at least in the PUREX Plant, and also at many DOE facilities) activates the need for renewed regulatory involvement if any further or different uses are made of this equipment. Also, worker and environmental risk increases every time additional processes are performed on plutonium and uranium materials.

Lesson No. 27. The cost savings associated with timely deactivation of large facilities such as the PUREX Plant are so overwhelming and important that optional activities that involve keeping plant systems active must be declined. The PUREX Facility is so complex and its internal systems so intertwined that the need to perform any activities associated with plutonium/uranium solutions meant that nearly all of the plant's systems would have to remain active. The overall deactivation project itself thus would have been slowed, and the imperative need and desire of the DOE to proceed with deactivation would not have been realized.

8.3 SINGLE-PASS REACTOR FUEL AND N-REACTOR FUEL DISPOSITION

At the time of the PUREX shutdown order, the plant still contained 2.9 metric tons of aluminum-clad, single-pass reactor fuel stored underwater in the facility slug storage basin. This fuel had been in storage in the basin since 1972, and consisted of 779 pieces packaged into four baskets. The PUREX dissolver cells also contained approximately 40 N-Reactor fuel elements (0.5 metric tons total), that had been inadvertently dropped on the floor during charging operations 12 or more years ago. Remote inspections of the fuel and samples of the water from the storage basin showed that the single-pass reactor fuel was somewhat corroded, and that there was significant deterioration in the N-Reactor fuel.

Several alternatives existed for the disposition of the fuel. One option, that of leaving the fuel inside the PUREX canyon, had to be ruled out immediately as the D&D organization absolutely would not accept the building for turnover if it contained spent fuel. Another option that was prohibited specifically by the DOE shutdown order was that of processing the fuel through PUREX. Likewise, the alternative of transferring the PUREX spent fuel to an offsite storage facility was deemed to be nearly impossible because of stakeholder and regulatory concerns about the shipment of unprocessed nuclear fuel. One potentially viable option was to transfer the single-pass fuel to other storage facilities on the Hanford Site. However, of the available facilities, the Fuels and Materials Examination Facility and the Washington Public Power Supply System reactor would have needed extensive, expensive, and time-consuming modifications. The only other available facility was the T-Plant pool cell, and T-Plant officials were trying to rid themselves of their spent fuel inventory to reduce the hazard classification of that structure. Another possible choice was to install a fuel conversion process in the PUREX Plant and convert the fuel to an acceptable dry storage mode. However, selecting, permitting, and installing a stabilization process would have taken several years. By 1993, the preferred option for WHC and DOE officials was to transfer the PUREX spent fuel to wet storage in the K-Basins of the Hanford Site. These basins already stored 2,200 metric tons of other spent nuclear fuel, and were funded on a path forward to stabilizing and moving this fuel to a new storage facility to be built and permitted onsite.[60]

Lesson No. 28. Alternatives for the disposition of spent fuel are severely limited by considerations of the time and money it takes to satisfy regulatory requirements, safety considerations, and stakeholder concerns. Additionally, the requirements to permit the movement of even small amounts of spent fuel away from the DOE site of origin are very significant and perhaps not even achievable in today's climate. Therefore, spent fuel remaining at the end of processing activities should be dealt with onsite, and should be grouped with other existing spent fuel if it exists.

8.4 NITRIC ACID DISPOSITION

Once the PUREX/UO_3 Facilities received their final closure orders and the UO_3 stabilization run (see Section 8.0) had taken place, the plants were left with approximately 681,372 to 757,080 L (180,000 to 200,000 gal) of slightly contaminated (low specific activity) nitric acid. The original plan in 1993 was to dispose of this material via sugar denitration in the PUREX Plant. Sugar denitration had been a standard practice at the facility since 1963, but it produced a strong nitrogen oxide off-gas that would have posed a significant regulatory hurdle. Additionally, the amounts present at PUREX would have taken over one year to process, thereby prolonging the overall deactivation project. In early FY 1994, an alternate disposition plan was developed to sell the nitric acid as a process chemical to a fuel re-processing facility owned by BNFL at Sellafield, England.[61]

Because it was known that the transfer of a process chemical to a foreign reprocessing facility would involve non-proliferation concerns, DOE stipulated that the UO_3 product that would be generated by BNFL would not be placed on the commercial uranium market. The next concern then became the safe transportation of the material, and the development of adequate NEPA documentation (with attendant public involvement) to ensure such safety. A Memorandum of Understanding was drawn between WHC and DOE, and a transportation plan was developed to ensure the implementation of all required safety procedures. In the summer of 1994, an export license for the shipment was sought by the DOE from the Nuclear Regulatory Commission, and a final contract was under negotiation between BNFL and the DOE. In August however, strong concerns involving the non-proliferation issue and the costs and procedures of the transfer were expressed by the environmental group

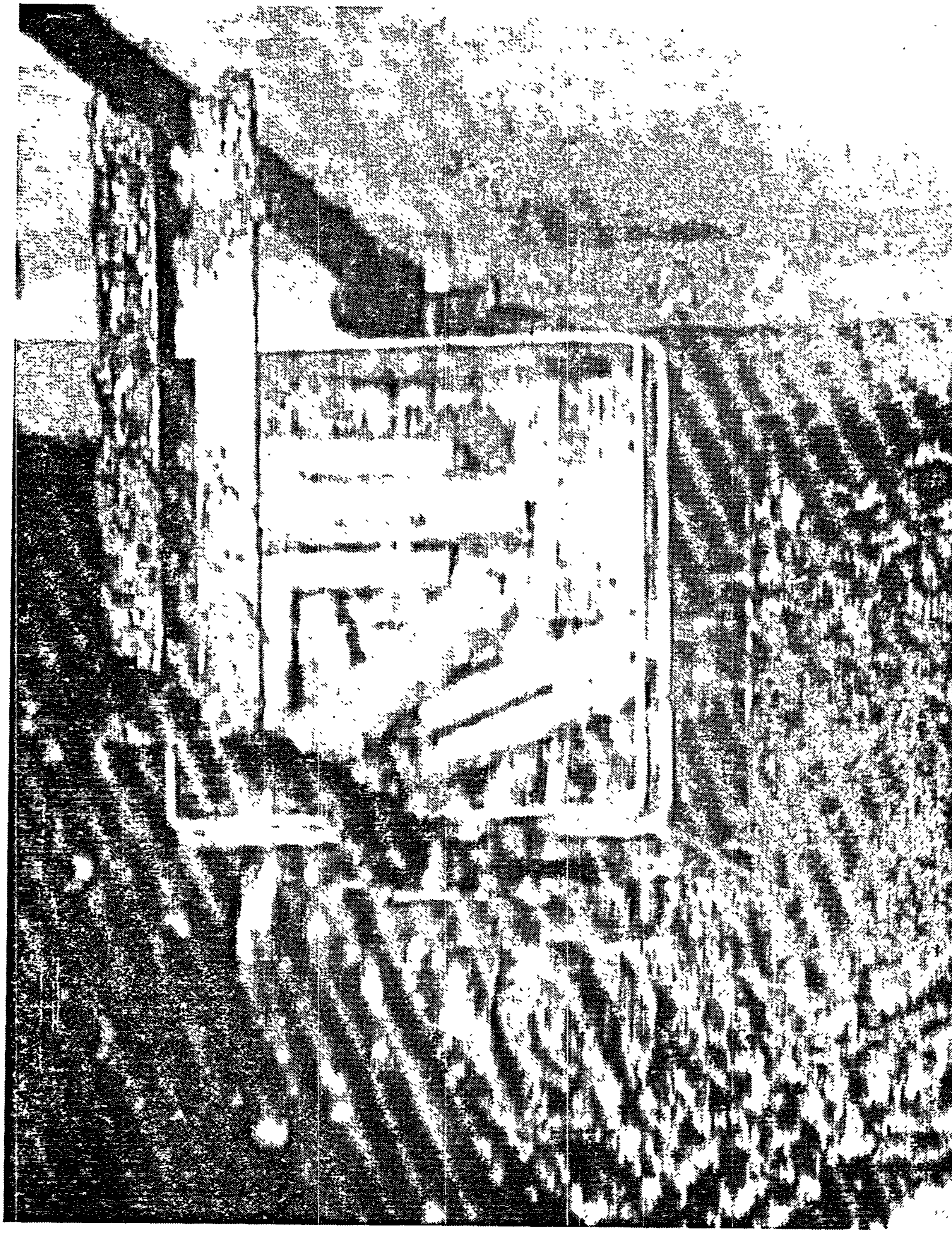


Figure 18. Single-Pass Reactor Fuel Shown in a Basket in the PUREX Plant.

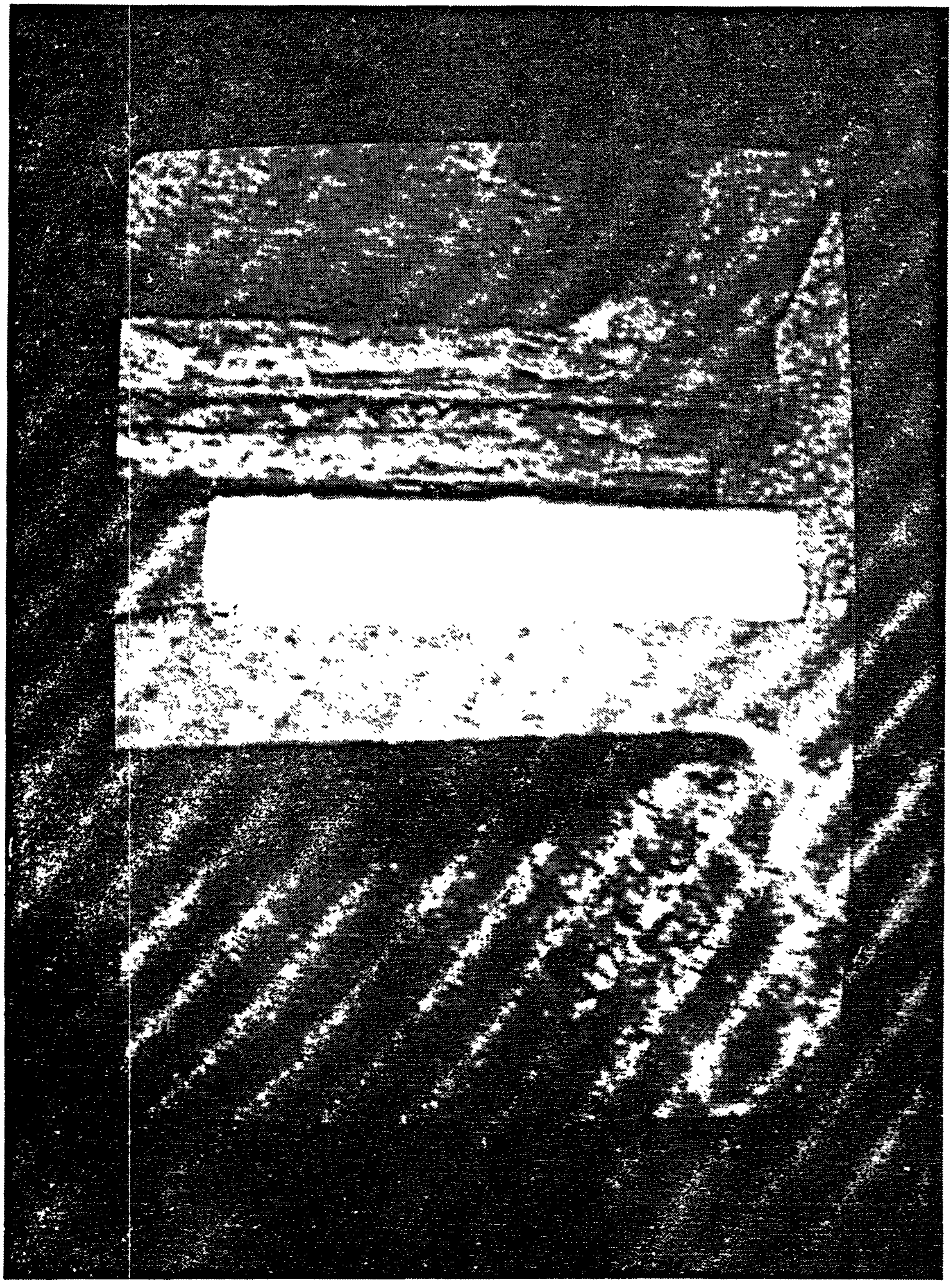


Figure 19. N Reactor Fuel Shown on a Dissolver Cell Floor in the PUREX Plant.

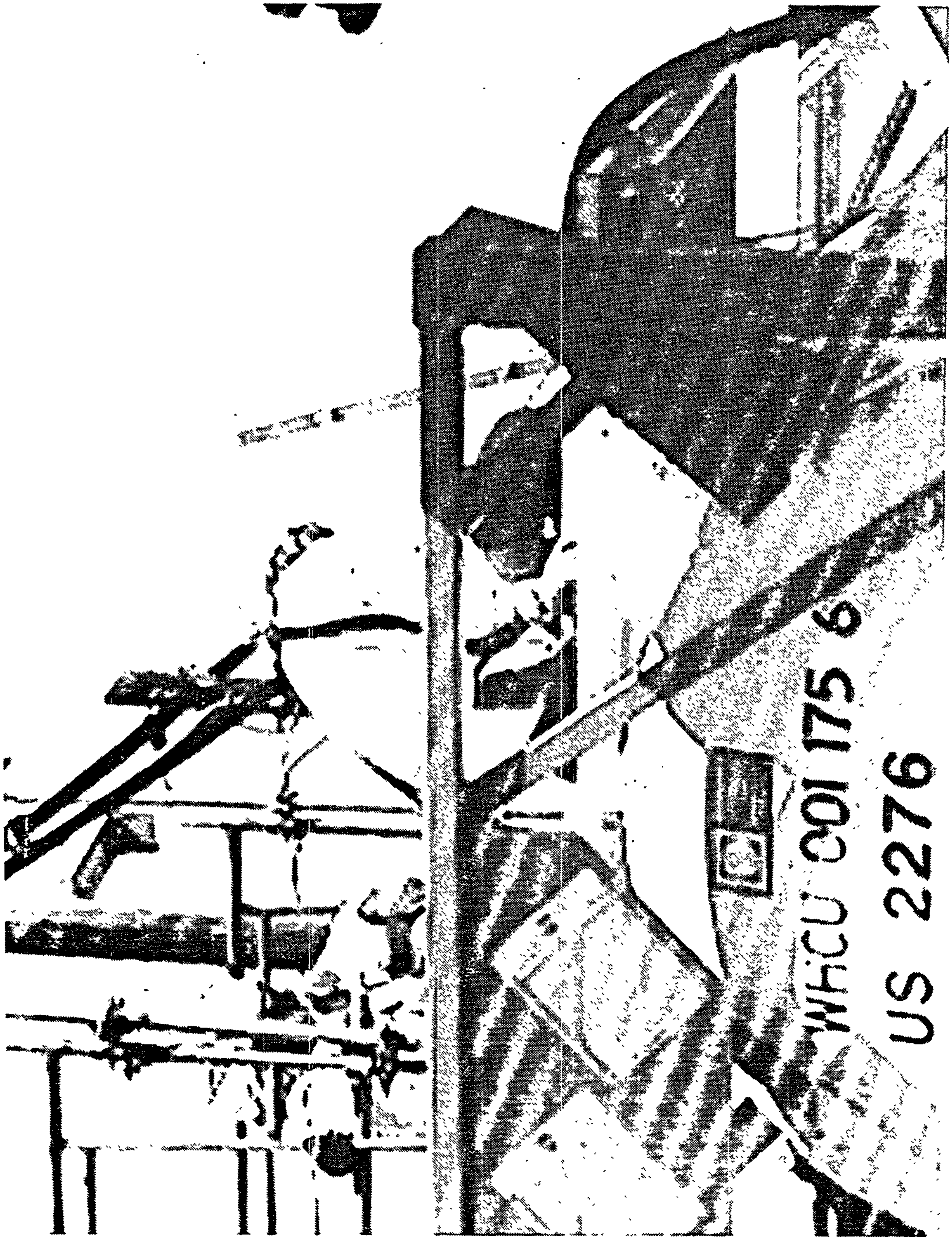


Figure 20. Dry Run Preparations for Nitric Acid Transfer (1994).

Greenpeace and by some members of the DOE-HQ staff. In September, Secretary of Energy Hazel O'Leary authorized the shipment to proceed pending the preparation of an EA (with attendant public involvement), the receipt of an export license, and the approval of a transportation plan. At nearly the same time, concurrence was achieved with Washington State regulators that the nitric acid was not a waste, as it would be used as a beneficial process chemical and would not be abandoned or stored. The export license was granted in November, and as of the end of FY 1994 the EA was in preparation.[62]

Lesson No. 29. It is better to find an alternate use for a slightly contaminated process chemical, with an interested buyer or consumer, than to have the material declared as a waste. The same lesson was learned, and for the same reasons, in connection with uncontaminated fresh chemicals that were sold from the PUREX Plant during the Standby period (see Lesson No. 1).

8.5 ORGANIC DISPOSITION

When the shutdown order came for the PUREX Plant, the facility was left with approximately 79,493 L (21,000 gal) of slightly contaminated organic solvent, a mixture of tri-butyl phosphate (TBP) and normal parafin hydrocarbon (NPH). It was located in tanks G5 and R7 within the PUREX canyon, but was moved outside the plant into tank 40 in 1993, to allow the deactivation of certain in-plant fire system components. Among several potential disposal methods, two were identified as the most viable from the perspectives of safety, waste minimization, and environmental hazard control. Thermal destruction in a licensed commercial incinerator was one preferred option, but this choice would have cost approximately $1.5 million due to the scarcity of incinerators able to accommodate mixed wastes. The alternative pursued most avidly by WHC and RL was to transfer the solvent to the New Waste Calcining Facility at the Idaho National Engineering Laboratory for use as a fuel. Discussions to effect this transfer were initiated in the Spring of 1993 among all of the interested parties: RL, DOE/ID, WHC, Westinghouse Idaho Nuclear Company, Inc., and state officials and regulators of both Washington and Idaho. The material was to be shipped as a hazardous waste. Approvals were obtained from nearly all parties, and a shipping date was set in September 1993. However, Idaho state officials, having taken strong positions in the recent past against the receiving nuclear waste from other states and having had to compromise and accept unwanted spent nuclear fuel from decommissioned naval vessels earlier in 1993, decided that they could not accept the PUREX solvent as a waste.[63]

A series of negotiations followed in 1994, wherein DOE officials attempted to demonstrate that the PUREX organic solvent was not a waste because of its intended beneficial use as a product in the New Waste Calcining Facility. Furthermore, the 1993 CX prepared on the shipment of the solvent had identified it as a Low Specific Activity material, one of the least restrictive transport categories. However, as of the end of FY 1994, Ecology had not responded to a RL request to declare the solvent simply a hazardous material. Such a designation might have made it easier for Idaho officials to accept, but might also have set a precedent that Ecology did not wish to set. The matter is yet unresolved.[64]

Lesson No. 30. There are some obstacles to movement of nuclear process materials, and to other types of deactivation alternatives, that cannot be controlled nor overcome by plant and DOE personnel. The historical/political climate with regard to nuclear materials is such that even the most preferred alternatives (from the technical perspective) sometimes cannot be implemented.

8.6 LABORATORY DEACTIVATION

The PUREX laboratory was/is an integral part of the facility in that it was constructed to be completely contained within the facility. At the time of PUREX construction, this connection was seen as an advantage because it offered radiological protection superior to those involved in transferring sample solutions outside the plant. However, such a connection appeared in a different light when it came time for the PUREX Plant to shut down. For a time in 1993, consideration was given to keeping the PUREX laboratory open to perform waste characterization and other work valuable to the Hanford Site. However, even though laboratory shortages were a subject of concern to the DOE, the continuing function of the PUREX laboratory after plant deactivation could not be justified. Whole new support systems (i.e., electrical, water, HVAC, etc.) would have to be constructed, or else overall plant utilities would have to be maintained. The overall goal of driving S&M costs to the absolute minimum also could not be reached. Therefore, the decision was made to close the PUREX laboratory toward the end of the deactivation project after maintaining it to sample canyon flush materials and other substances generated by the project itself.[65]

The actual steps in the deactivation of the PUREX analytical laboratory will follow closely the pattern established in the cleanout of N-Cell, the PR room, Q-Cell, and the Sample Gallery. Small equipment within glove boxes and open-faced hoods will be removed, but the structures themselves will remain. Contamination fixants will be sprayed and painted inside and around the glove boxes and hoods. Then the exhaust plenum at the rear of each hood, the exhaust lateral between hoods and the overhead exhaust header, and the exhaust lateral itself will be filled with polyurethane foam to prevent contamination migration. The vacuum header lateral lines will be injected with epoxy resin, utilities will be disconnected, piping and drains will be blanked, and filters will be removed. Sink drains will be filled with grout.[66]

Lesson No. 31. The lessons learned in the deactivation of the PUREX analytical laboratory closely follow those learned in connection with N-Cell, the PR room, Q-Cell, and the Sample Gallery. Individual systems within large facilities cannot be kept open without the undue expense of maintaining at least portions of larger systems. There is an optimum time to deactivate a support facility and to move the needed services to other facilities. Also, modern contamination fixant techniques allow glove boxes and other large equipment pieces to be left inside facilities, while still controlling contamination migration.

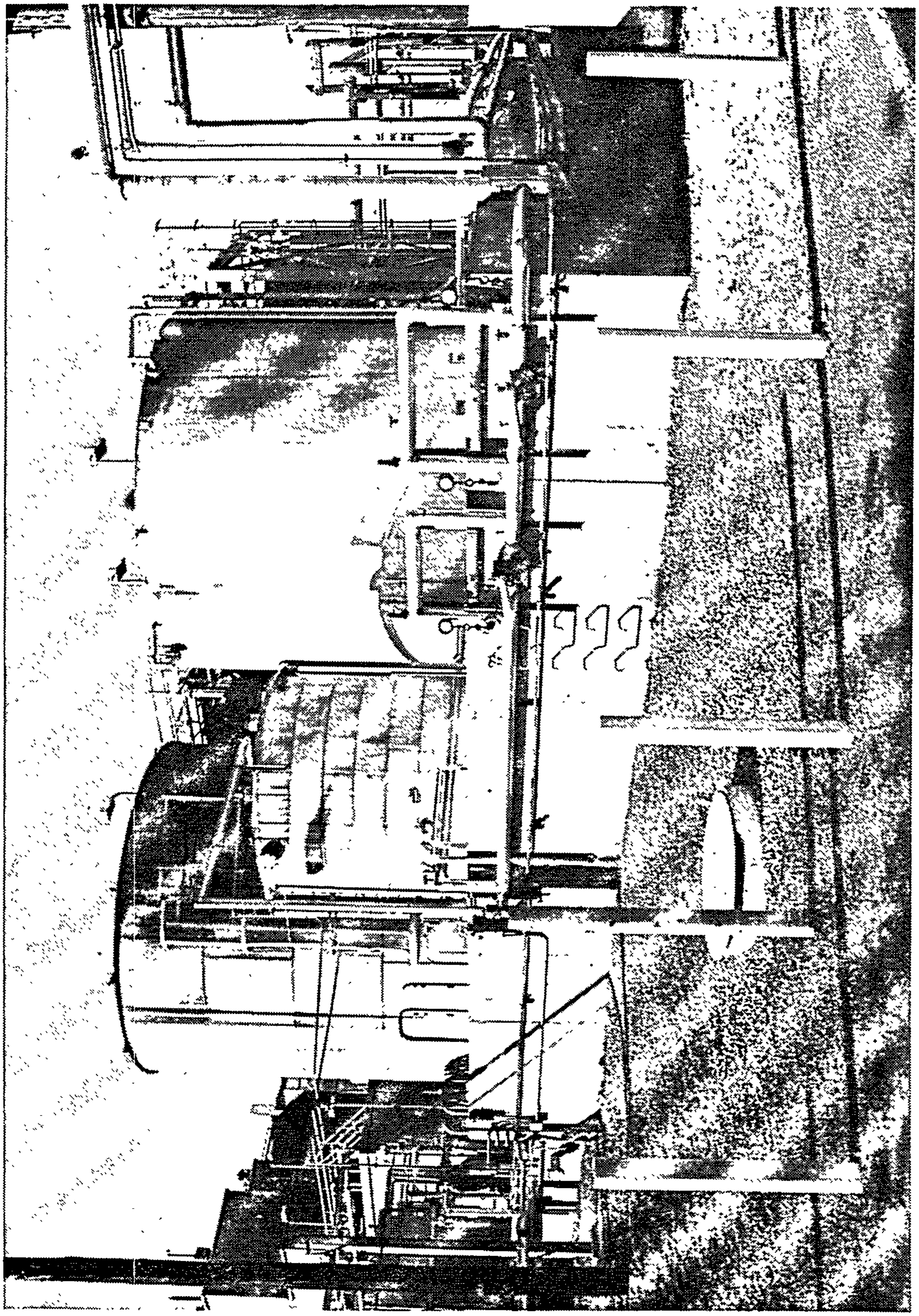


Figure 21. Tank 40 Outside the PUREX Plant Where Organic Solvent (TBP/NPH) is Stored.

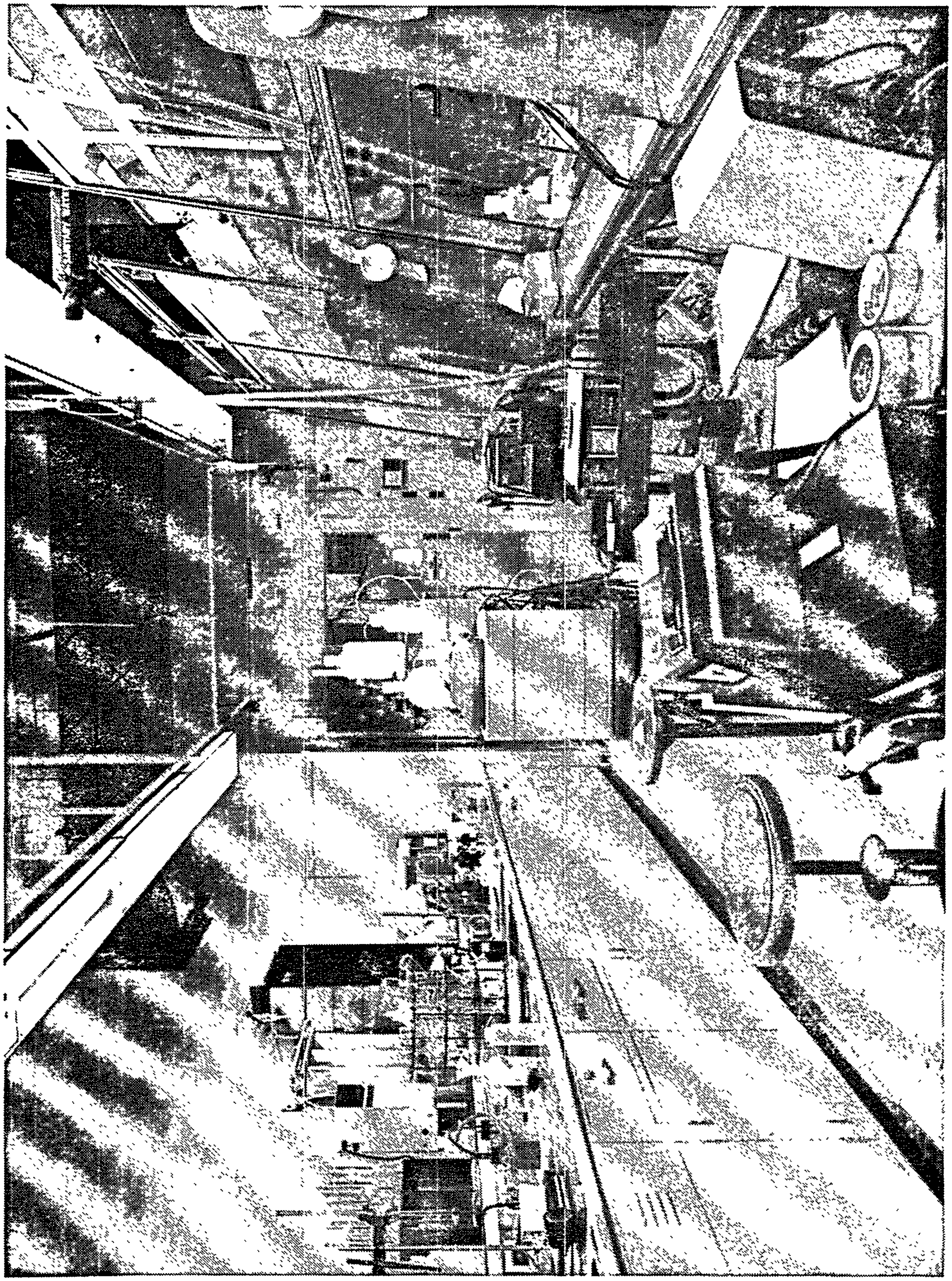


Figure 22. PUREX Analytical Laboratory (1983).

8.7 L-CELL CLEANOUT

L-Cell at the PUREX Facility housed the third (final) plutonium concentration step. As such, it became highly contaminated over the years. During the standby and early deactivation periods, remote television cameras operated by the PUREX crane detected solids and sludge material on the floor of L-Cell. Learning about the nature, extent,and source of this contaminated material was essential to characterization efforts. In the spring of 1994, a team of PUREX personnel comprised of health physics technicians, engineers, managers, safety experts, and nuclear process operators began meeting to plan a human entry into L-Cell to obtain better characterization information. They carefully mapped a route through the cell that would be followed by the entering personnel who would take video footage and obtain floor residue samples. Then they made the crucial decision that, to best follow the ALARA radiation exposure guidelines, the entry would be made by just one person. Next, "dry run" dress and undress procedures, as well as a practice route through an uncontaminated area, were rehearsed. When the L-Cell entry was made on May 4, 1994, it went smoothly and two hours of valuable video footage, as well as many important samples, were obtained. Two solid matrix accumulations were found under tanks L2 and L8, and overall cell floor estimate of between 3,718 to 6,168 grams of plutonium was determined.[67]

Lesson No. 32. Careful planning, involving many knowledgeable plant people, as well as practice dry runs, are key elements in achieving smooth, efficient, and low exposure results when work is required in high radiation areas.

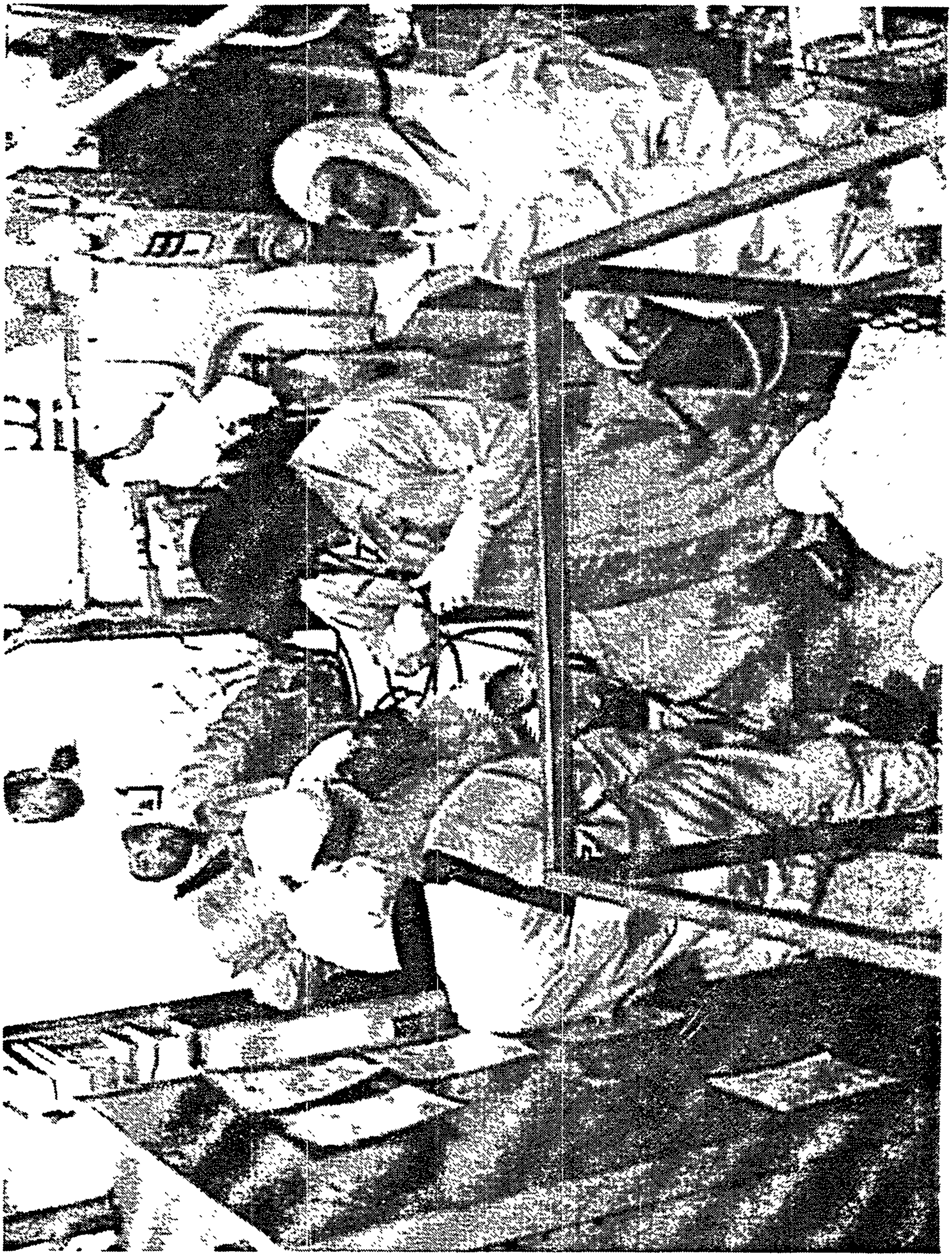


Figure 23. Workers Dressing for L-Cell Characterization Entry (May 1994).

9.0 UO_3 DEACTIVATION

During the months April to June 1993, a stabilization run was conducted at the UO_3 Plant to convert 757,080 L (200,000 gal) of UNH liquid to UO_3 powder. At the same time, deactivation planning was underway. The initial deactivation plan, completed in July 1993, enunciated the following objectives for the UO_3 project: reduce the level of support needed to maintain and monitor the plant in a safe shutdown condition, define and meet D&D acceptance criteria, terminate effluents, shut off electrical power at the main transformer, remove PCB-contaminated transformer oil, connect to a new power source, disconnect steam and water lines outside the building, and shut down all active ventilation so that only quarterly entries were needed for periodic maintenance.[68]

The initial deactivation plan proposed a three-phase project. Phase I was to include the removal of residual process materials, the cleanout, flushing, and deactivation of most process instrumentation and equipment (including the calciners themselves), the stabilization and pump out of plant liquid systems, the isolation of unnecessary steam and water lines, and the removal of most spare parts, furniture, tools, and other equipment and supplies. Phase II was to include the decontamination and/or covering of outside surface contamination areas so that storm water processing no longer would be needed. This work would eliminate the ongoing generation of liquid effluents that might need treatment and would obviate the need for most S&M checks at the facility. Then, the remaining equipment that processed storm water was to be deactivated. Phase III was to encompass "all remaining activities that must be completed before the facility is turned over to the Surplus Facilities Program." The work of Phase III was to encompass the deactivation and isolation of all remaining utilities, deactivation of the HVAC and fire protection systems, sealing building penetrations, dealing with a problematic roof, stabilizing the 211-U chemical storage tanks associated with the UO_3 Plant, cleanout of the 272-U Shop Building, shipping of stored UO_3 powder to the Oak Ridge Site, and removing any last flammable or hazardous materials and miscellaneous items.[69]

As the UO_3 deactivation project went forward, however, opportunities for consolidation of work were seen so that some work was performed in a sequence other than those originally planned. Also, Phases II and III of the deactivation project were combined. Shortly after the stabilization run was completed, four tons of depleted UO_3 powder stored in drums were shipped to the Oak Ridge Site. At the same time, transfers of recovered nitric acid to PUREX began. In total, approximately 378,540 L (100,000 gal) of this substance were sent to PUREX in 33 tank truck shipments. While these transfers were taking place, UO_3 Plant liquid systems were being flushed. The goal was to flush until the pH of the flush solution measured greater than three. The plant liquid systems included the UNH receiving and concentration systems (tanks C-1, X-1, X-2, X-30, concentrators ED-2, ED-6, and ED-7, along with all associated pumps and piping), the nitric acid and wet scrubber system (TA-3 acid tower, tank C-6 acid cooler, storage tanks C-3 and C-4, the wet scrubbers, and all associated pumps and piping), and miscellaneous tanks and equipment (tanks X-38, X-19, X-20, and associated pumps and piping, the plant's two UNH trucks, and three nitric acid tank cars). The tanks of the 211-U chemical storage tanks that were associated with the UO_3 Plant also were flushed and stabilized.

As soon as the flushings were complete, about 37,854 L (10,000 gal) of flush solutions measuring more than one molar nitric acid were shipped to PUREX, along with small amounts of UNH concentrated from tank flushes. The UNH tank truck heels then were removed at PUREX, but the nitric acid tank car heels were not sent to PUREX for removal until late 1994. Further steps taken in Phase I of the UO_3 Plant cleanout included removing the tops of the calciners and vacuuming out the UO_3 powder. Powder also was removed from the powder handling system and bag filters, the U-2 exhaust system was disconnected, and the UO_3 Facility instruments were deactivated. Phase I of the deactivation project was completed in early March 1994, two weeks ahead of the RL milestone date of March 16.[70]

One of the most crucial projects within Phase II of the UO_3 Plant deactivation was to discontinue discharges of low-level contaminated effluents to the 216-U-17 crib and the 216-U-14 ditch. Almost all such effluents resulted from the run-off of storm water over contaminated roofs, piping, and other outdoor surfaces at the facility. In the system that had been used since the mid-1980s, such storm water was collected in sumps and tank enclosures at the back of the 224-U Building (sumps 203-U and 203-UX), and in sumps located in a concrete pad between the 224-U, 224-UA, and 272-U Buildings. The sumps drained to a collection tank (C-7) and then were sent to tank C-2 for concentration. Condensate from the off-gases was collected and stored in tank X-37 until ready for disposal. The tank C-2 condensate was neutralized with potassium hydroxide and a small amount of phosphoric acid (for pH stabilization) in tank C-5, and then sent to the 216-U-17 crib. Additionally, some storm water drained to the 207-U basins from the caustic truck pad at the UO_3 Plant, and from the 211-U recovered (contaminated) nitric acid loading spot. From the 207-U basins, this material was sent to the 216-U-14 ditch for ground percolation.

When the UO_3 deactivation project began, UO_3 Plant work planners did not know whether they would place protective coverings over the contaminated outdoor surfaces, re-roof the facility, or decontaminate the surfaces. To evaluate the decontamination option, they had to negotiate acceptable levels of contamination reduction with the Hanford Site's regulators. A new approach was devised in meetings among the contractor and DOE representative, and regulatory agencies. It was agreed that if outside surfaces could be decontaminated such that not more than 5 to 50 grams of uranium per year would enter the 207-U basins via runoff from the UO_3 Plant, then re-roofing and protective outside coverings would not be needed. The 207-U basins had been lined with high-density polyethylene in December 1992 and could be used to evaporate relatively clean run-off. Verification would be assured by independent DOH sampling of ambient air at a location 100 yards from these basins. To implement the agreement, decontamination was undertaken at UO_3 with water, scrub brushes, and a mobile pressure sprayer attached to a HEPA filter. No chemical decontaminating agents were used.

Then, the sump collection system at the facility was diverted to the 207-U basins (not tanks C-7, C-2 and C-5), and the lines between the 207-U basins and the 216-U-14 ditch were blanked. The tie-ins were completed on September 22, 1994, thus surpassing a RL milestone.[71]

Further work done in the UO_3 Plant deactivation project by the end of FY 1994 included asbestos stabilization in rooms housing old calciner pots and the old powder handling tower, cleanout of both the "hot" (radioactive) and cold portions of the 272-U Shop, application of a new roof coating to the 272-U shop and the 224-U Facility, disconnection of remaining utilities and power sources to the UO_3 Plant buildings, and installation of an independent power source for the new surveillance lights for 224-UA. This latter step was taken due to the poor condition of the existing wiring and lights. A great deal of time also was spent removing small objects, furniture, contaminated tools, and other miscellaneous materials from the facility, and documenting the plant's legacy equipment for turnover to the D&D program.[72]

In defining its end point criteria, the UO_3 Plant took a series of precedent-setting steps that extended the concepts initially defined in the PUREX Deactivation End Point Value Engineering Study of February 1994 (see Section 4.0). The seven key, generic objectives for facility deactivation projects remained the same. However, seven logic-based guiding principles were defined for the UO_3 deactivation. First, every end point decision should be driven by, and clearly linked to, major program objectives and goals (those defined by PUREX in the Value Engineering Study). Second, the end point condition of the deactivated facility should employ "defense-in-depth" as a fundamental safety approach. As applied at UO_3, there would be three layers of protection: elimination of hazards, effective facility containment, and facility monitoring and control. Third, end point decisions should be linked integrally to decisions and constraints on resources and methods. In other words, cost effectiveness was important. Fourth, successful end point development would require ownership ("buy-in") by all affected organizations. Fifth, clear, measurable completion criteria would need to be established for work teams in the field. Sixth, because ultimate D&D methods, time frames, and end states could not be known, end point decisions should not be driven by D&D presumptions.[3] Lastly, end point development should be an iterative process. While end points should be established early, they should retain some flexibility because they might have to be revised during the deactivation process.[73]

In the UO_3 Plant End Point Criteria document, the primary deactivation tasks were defined as follows: eliminate or reduce hazards (chemical and physical), deal with radiation fields (eliminate, shield or isolate), reduce contamination and prevent its spread, remove waste, isolate and contain residual, potentially hazardous materials or conditions, provide the capability to monitor and control the facility, refurbish or install any facility modifications necessary to support future work (S&M or D&D), and document and label legacy equipment

[3] Note: End point criteria are those that apply to the finish points of a deactivation process. End state criteria are those that apply to the finish points of a D&D process.

and systems. An internal classification system for spaces and systems within the facility then was applied. There were six cases or criteria, three concerning spaces and three concerning systems. Case 1 was internal spaces for which routine access was expected during the S&M period (post-deactivation, but pre-D&D), Case 2 was internal spaces for which routine access was not expected, Case 3 was external spaces, including building envelopes, Case 4 was systems and/or equipment that had to be kept operational (such as surveillance lights), Case 5 was systems and/or equipment that was to be mothballed for possible future use by D&D, and Case 6 was systems and/or equipment that was to be abandoned in place. Every place, system, and piece of equipment in the facility was to be assigned to one of these cases.[74]

The UO_3 deactivation project objectives, fundamental tasks, and the six cases then were integrated in the first prototypical example of the extended end point matrix. Three levels of evaluation were performed. Level I activities were those that applied to all the facility. Level II activities were those that applied to just one of the six cases (but to all spaces, systems or equipment within that case), and Level III activities were those that applied to just one object in the plant. A matrix then was created for each level. End points were determined for each level, based on what specific tasks would be necessary to achieve deactivation objectives. Each task was evaluated as it related to each objective, and was placed into one of four general categories. Tasks placed into Category One were those that, due to the objective(s) they supported, needed to be given primary consideration or rank in setting the end points. Tasks in Category Two were those that, due to the objective(s) they supported, could be given secondary consideration. In other words, they were important but would not be the controlling factors in setting end points. Tasks in Category Three were those applicable to particular regulations, requirements, or stakeholder commitments. Tasks in Category Four were those not applicable to the direct support of any end point objective. Every activity that could/might be done in deactivation then was scored in at least one matrix (and sometimes in a matrix for each level), graded, and negotiated among representatives of EM-60 and EM-40. Finally, in this manner, agreement was reached as to which activities would be performed in the UO_3 Plant deactivation. Each matrix and its agreed result then was complied into the UO_3 End Point Criteria Tracking Document, a signature book that actually recorded completion of each of 1,740 end points (signature by EM-60 contractor personnel) and verification (signature by EM-40 contractor personnel).[75]

Lesson No. 33. While an early deactivation plan provides a good starting point for activities, facility managers and work planners should watch for opportunities to combine or accelerate tasks throughout the project. New and creative resolutions, resulting in cost and time savings, can present themselves as the facility representatives meet with regulators, crafts people, and others who may have input.

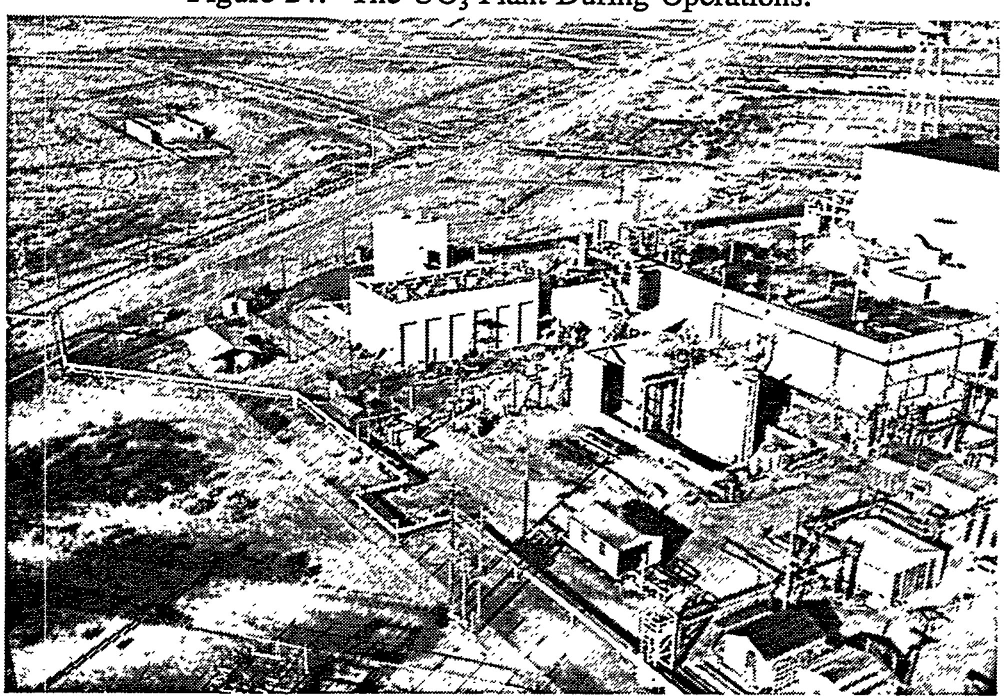
Lesson No. 34. At UO_3, the final flushes of the process vessels were included as part of the activities of the stabilization run. Because these flushes were considered part of operations, no RCRA permits were needed for the flush material and the RCRA "90-day clock" for the UO_3 Facility did not start ticking until the final flushes were completed. By that time, almost all hazardous materials that might have been considered wastes under a different timing structure had been removed from the plant. Other facilities should consider writing vessel and equipment flushes and other ancillary activities into their stabilization run plans.

Lesson No. 35. The disposition of small equipment, tools, furniture, and other miscellaneous supplies and items might be viewed as a private business opportunity as facilities deactivate across the DOE complex. The amount of time spent on such disposition was disproportionately large, in the view of facility management, and these activities had to compete with other deactivation tasks to capture the time of facility personnel. If such activities were privatized, more productive uses might be found for some of the equipment and waste burials might be minimized.

Lesson No. 36. The sophisticated and interwoven objectives, fundamental tasks, levels, cases, and matrixes developed in the UO_3 Deactivation End Point Criteria document should be a model for the entire DOE complex and beyond. This methodology, while it looks initially complicated, saves time and money in the long run because it forces all parties to take a justifiable, accountable look at **why** each task is done. Each task must have value to pass this test and to be approved and executed. This approach, in the words of one UO_3 official, "takes a D&D wish list and forces it into reality." Another advantage of this new methodology is its inherent ability to build consensus between deactivation and D&D programs, and to avoid costly disagreements at the time of facility turnover and beyond.

Lesson No. 37. End point criteria should be developed at the start of a deactivation project so that they can be available as tools to prioritize the work throughout the project.

Figure 24. The UO_3 Plant During Operations.



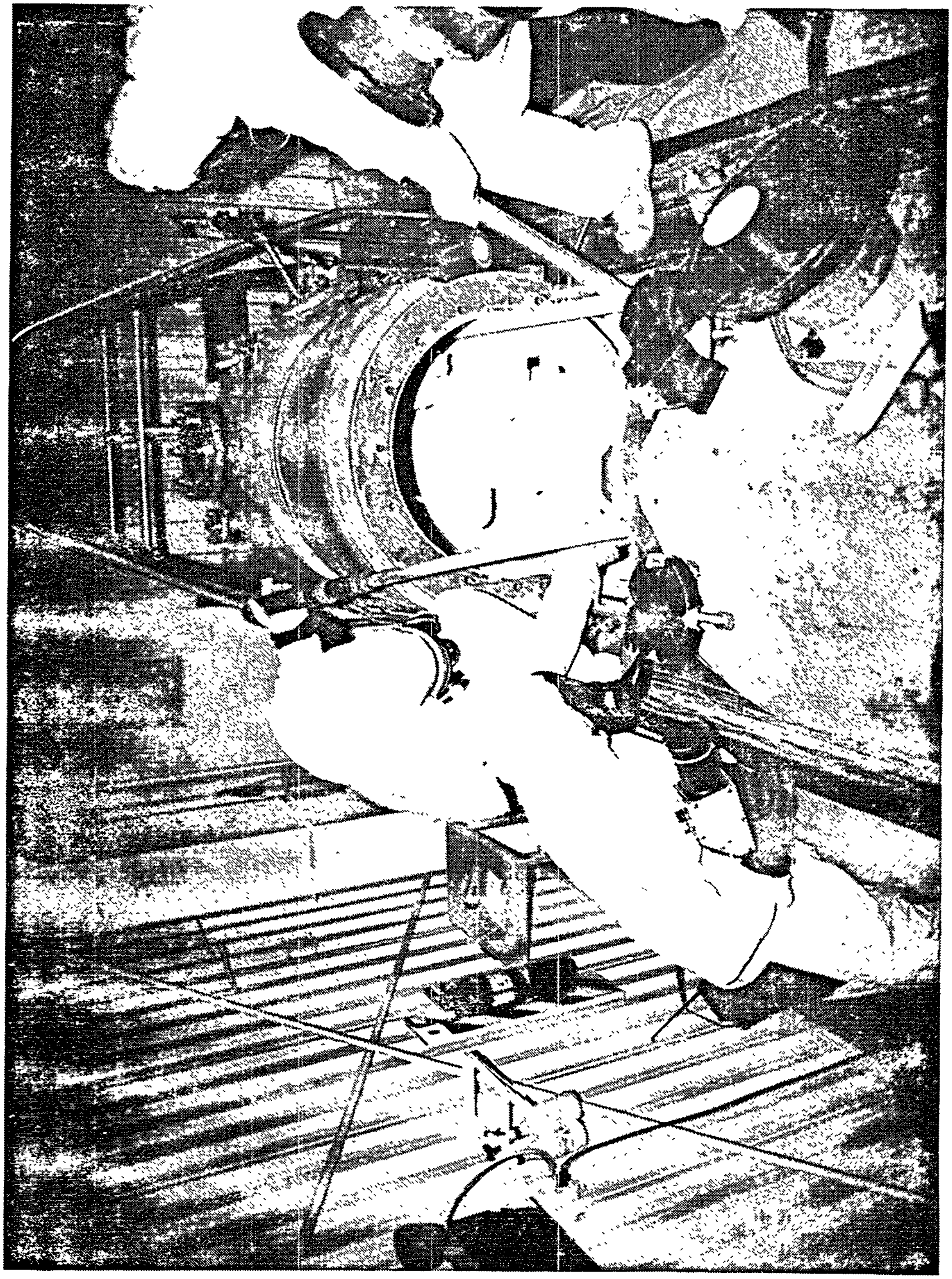


Figure 25. Workers Vacuuming UO_3 Powder from Open Calciner.

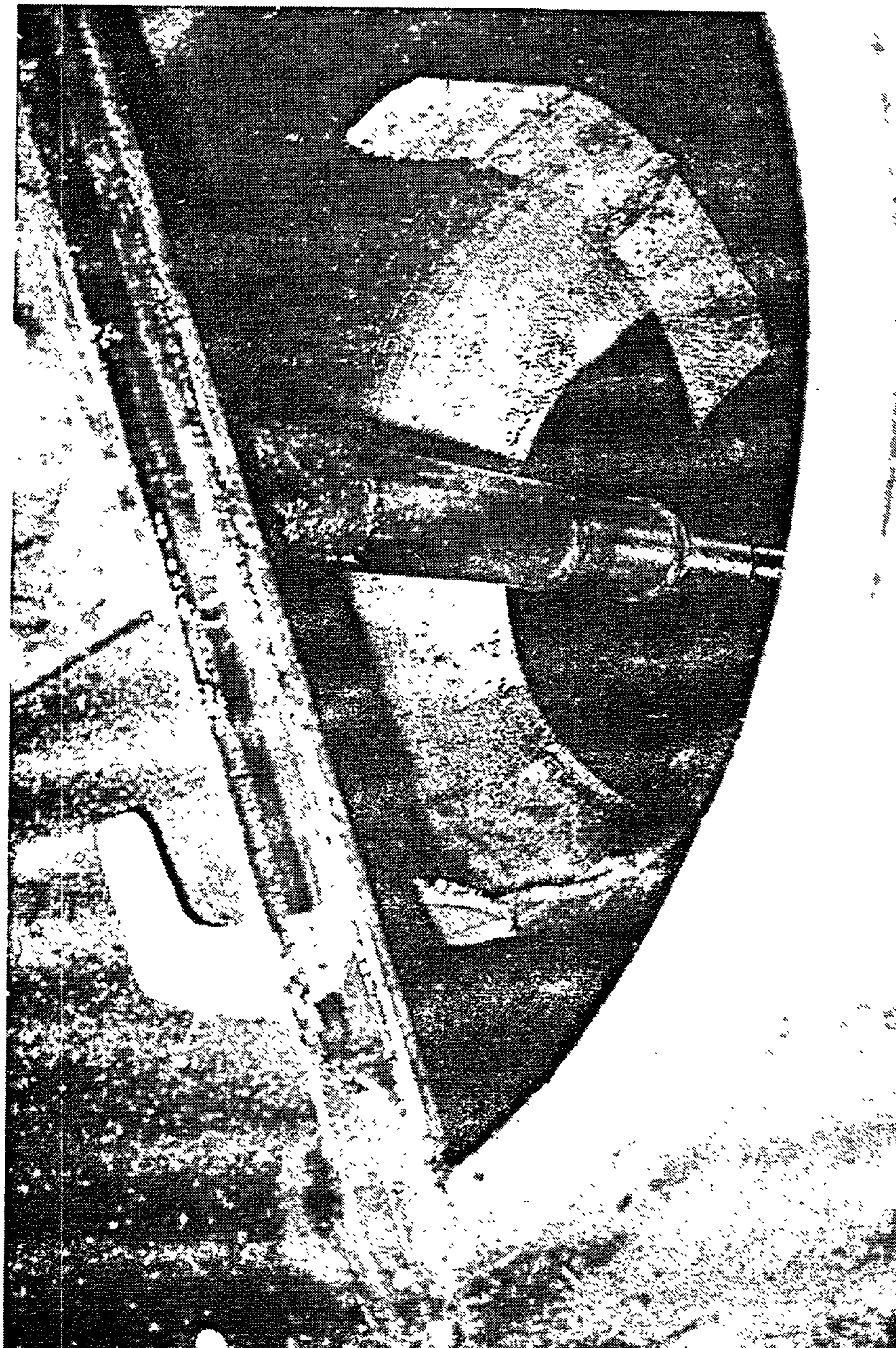


Figure 26. Hydraulic Oil Shown in a UO_3 Pot Calciner (1993).

Figure 27. Workers Remove Contaminated Hydraulic Oil From UO_3 Calciner (1994).

10.0 STAKEHOLDER INVOLVEMENT

The PUREX/UO_3 deactivation project recognized very early that stakeholder involvement would be crucial to the success of the project. Following DOE guidelines, the public involvement strategy was to involve DOE and contractor personnel (with employees viewed as key stakeholders), legislated authority structures such as state and federal regulators, the Defense Nuclear Facilities Safety Board, public advocates, advisory groups, Indian nations, and public opinion. Any group affected by, or able to affect, the PUREX/UO_3 deactivation project was considered a stakeholder. A key goal of the stakeholder involvement plan was to include stakeholders early in the concept formation stage and throughout the implementation phases.

The purpose of stakeholder involvement activities was first to establish a common information base from which interested parties could learn about the PUREX and UO_3 Plants, including their history and past missions, current status, condition, and needs. Next, the project recognized, stakeholders needed to be informed about key decision points and alternatives, including constraints, costs, and timetables. In turn, stakeholders needed to be given a chance to define their values and provide feedback about how the project and its alternatives would affect those values. The facilitation of information transfer, back and forth between stakeholders and project managers, was deemed to be essential. Additionally, the provision of progress reports was considered important.[76]

To begin their own public involvement learning process, PUREX/UO_3 deactivation managers and work planners attended a workshop in April 1993. At the same time, a historical report on the facilities was begun. For this informational document, over 300 formerly classified documents on plant operations were declassified and incorporated. A smaller brochure on the facilities and their major deactivation issues also was written and distributed through the public mailing lists associated with the Tri-Party Agreement. The original draft Project Management Plan was mailed to a shorter list of interest groups involved with the Hanford Advisory Board, a regional consortium organized by RL to provide input to key Hanford Site decisions. In December 1993, Ecology took the initiative to host a meeting with PUREX personnel and other interested parties to discuss deactivation issues, and a series of PUREX facility tours was conducted for members of the new Hanford Advisory Board in January and February of 1994. Also in early 1994, PUREX/UO_3 managers made a series of phone calls to several organizations on this list to solicit their comments on the plan and to invite open communications. A four page fact sheet was prepared and distributed to over 1,000 stakeholders.

In March, direct, face-to-face meetings began between PUREX/UO_3 personnel and interested stakeholders when managers traveled to the offices of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). CTUIR representatives in turn visited the PUREX Plant in July and September. In July, they met with a small group of PUREX personnel to explain their stake in the Hanford Site and to enunciate how their values could be affected by

Site Projects manager was the featured speaker at a PUREX/UO_3 All-Employee meeting and praised facility tribal involvement as "a model for the rest of the Hanford Site...They have bent over backwards to incorporate our concerns into their transportation plans."
In May 1994, PUREX/UO_3 managers traveled to Seattle to present information and answer questions about the deactivation project at a pre-meeting of the Hanford Advisory Board. PUREX management participated in another similar meeting held in Richland in October. In July, PUREX personnel traveled to Pendleton, Oregon to meet with the Transport Committee of the Oregon Hanford Waste Board. The end of FY 1994 found PUREX personnel planning an extensive series of public mailings and meetings with interested groups in states and Indian reservations across the nation that lay along the shipping route that would be followed by the nitric acid.[77]

Lesson No. 38. Public and tribal involvement is essential to the success of major deactivation projects. Such involvement should be started early, and should include initial efforts to assemble and distribute informational documents that allow non-technical people to understand the history, operations and condition of large, complex facilities. The provision of such documents can save enormous time for plant personnel that might otherwise have to be spent answering repetitive questions. It also can prevent a domino-effect of misunderstandings about the deactivation, based on basic misunderstandings of plant functions, layout, history, chemical and radiological inventory, and many other topics. Plant tours also are important to helping stakeholders understand the scope of the physical plant itself, the deactivation project, and the work being performed.

Lesson No. 39. Once the common information base is established (the first phase of public involvement), the public involvement process should become a dialogue. Two-way, iterative communication is essential. Plant personnel must truly listen to the values, motivations, and concerns of stakeholders, and must be willing to change their ideas based on the input of others. The era of singular federal decisions clearly is over, and leadership in the new era means flexibility and trust. Compromises can be reached, and the value of obtaining the buy-in of regional stakeholders can ensure the long-term success of deactivation projects and other DOE missions.

Lesson No. 40. Communication with facility employees (a key stakeholder group) is essential, especially in view of the fact that employees of a successful deactivation project literally work themselves out of their jobs. They must be kept appraised of project goals and their roles in achieving these goals, and they must be given guidance on how and where their "shutdown skills" may be applied in new, future positions.

Lesson No. 41. Stakeholder involvement extends to many external review groups that have an interest in various aspects of a complex, prototypical facility such as the PUREX Plant. During 1993 and 1994, the PUREX Facility was subject to a Spent Fuel Vulnerability Assessment, a Chemical Vulnerability Assessment, a Plutonium Vulnerability Assessment, reviews by the Defense Nuclear Facility Safety Board, the General Accounting Office, and DOE-HQ special safety teams. It also experienced a vast increase in requests for tours and media information associated with its being a deactivation project model. Support for all of these requests for information must be factored into deactivation project costs and personnel needs. However, one innovative cost saving method adopted at PUREX and available to other plants is to prepare video tours and information packages that can be duplicated and used many times.

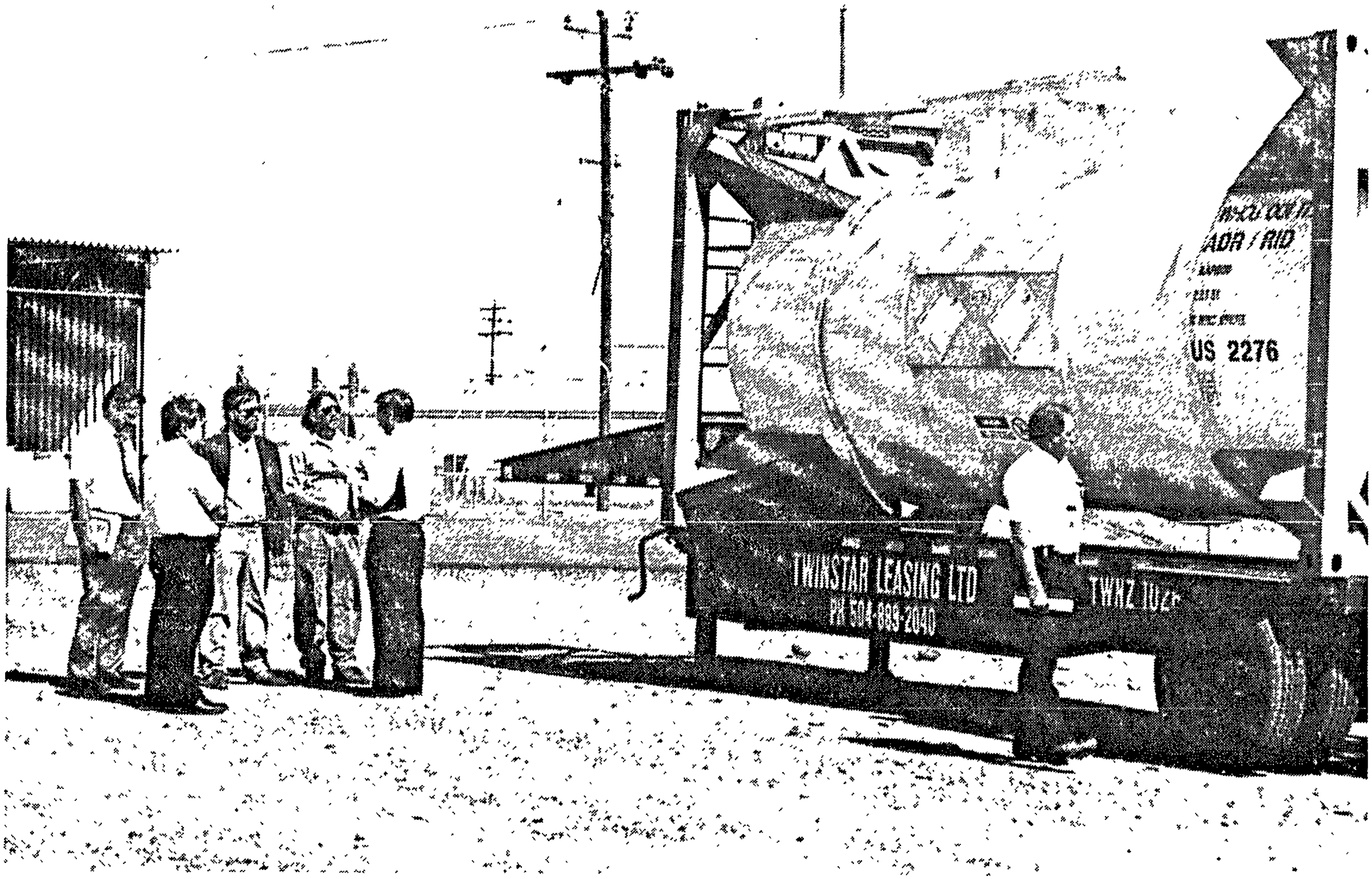


Figure 28. Confederated Tribes of the Umatilla Indian Reservation Representatives With DOE and WHC, Inspecting Nitric Acid Transfer Containers (July 1994).

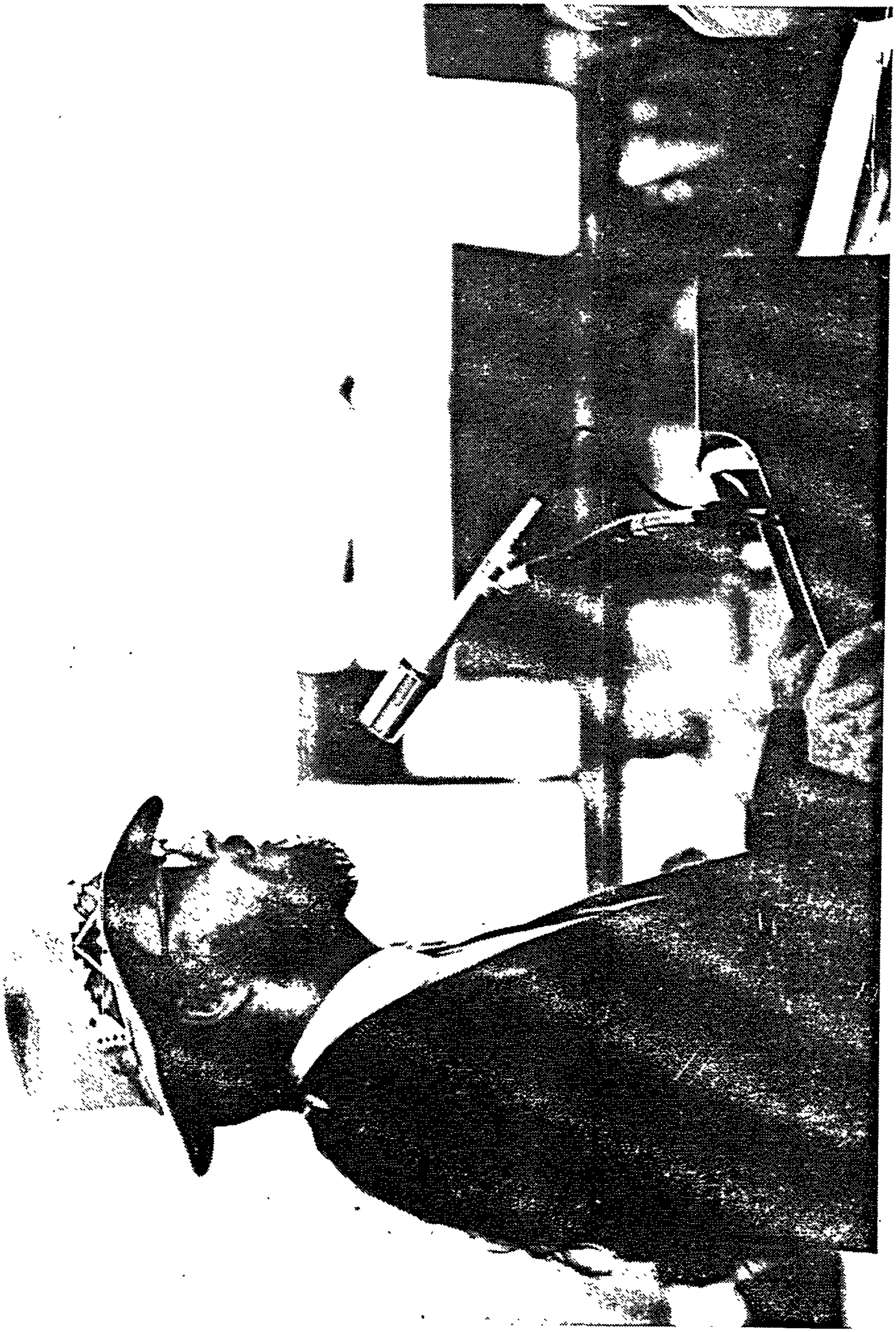


Figure 29. J. R. Wilkinson, Confederated Tribes of the Umatilla Indian Reservation Hanford Programs Manager Speaking at PUREX/UO_3 All-Employees Meeting (September 1994).

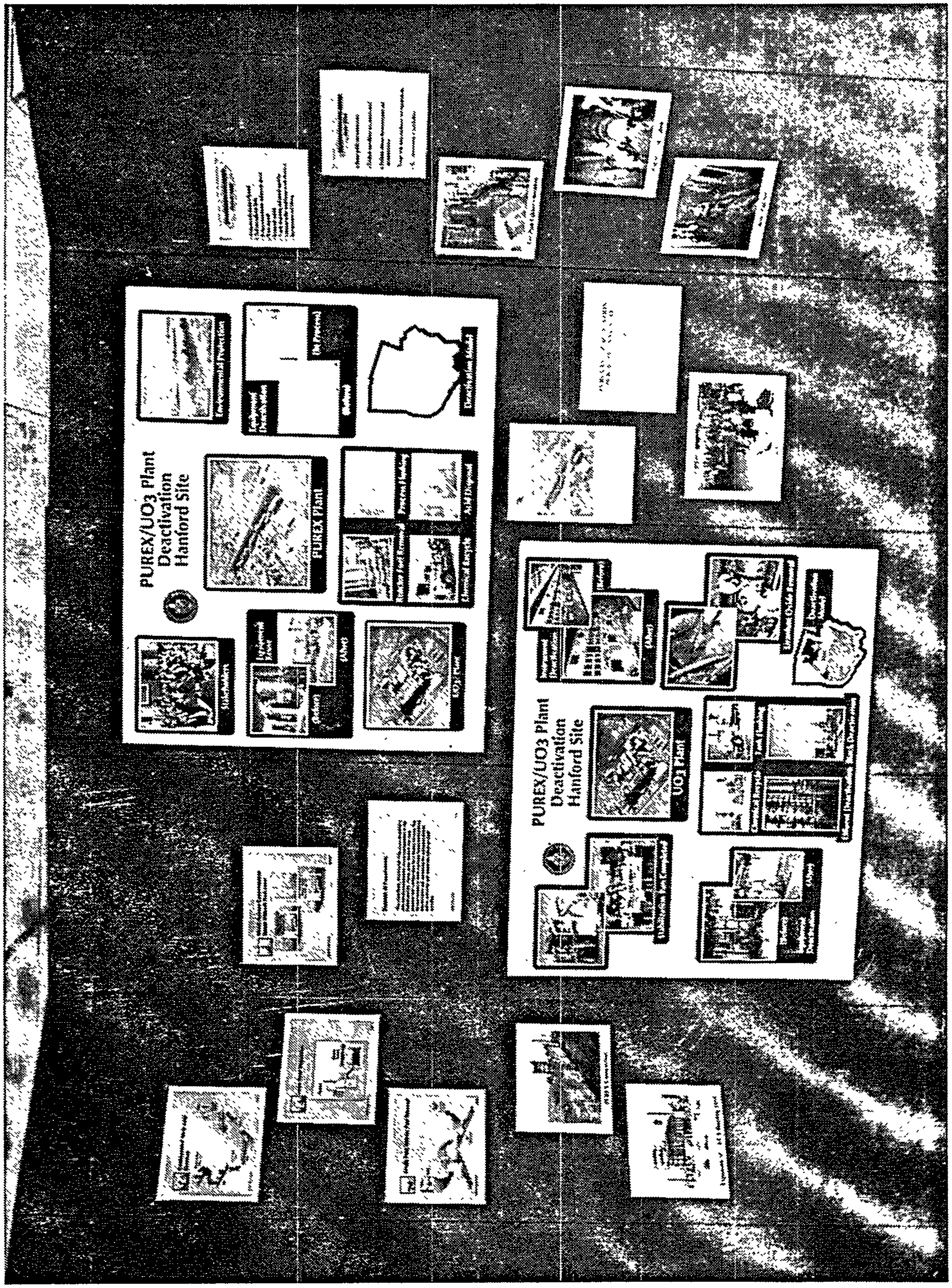


Figure 30. Visitors' Informational Display at the PUREX Guard House (1994).

11.0 PROJECT MANAGEMENT PLAN

Based on the 1992 advice of the Independent Technical Review Team, it was decided early that there would be no Project Plan, and that the information normally included in such a document would be fitted into the Deactivation Project Management Plan. As a result, the original *PUREX/UO_3 Deactivation Management Plan*, prepared under the guidance of DOE Order 4700.1, *Project Management*, was large. It attempted to encompass regulatory planning, safety strategy, scheduling and budgets, numerous technical plans, management and organizational structure, information and reporting requirements, safeguards and security plans, records management, a plan for managing critical skills and work force re-deployment, stakeholder involvement, an S&M plan, waste management, and provisions for quality assurance. When issued as a draft, the document filled over 220 pages. After stakeholder and DOE review, the document became even longer. Although useful as a comprehensive record, it was unwieldy to review and revise and thus lost much of its flexibility and usefulness to the project. Also, the work breakdown structure was not well defined nor structured for a true project in this document, and the plan did not contain the same level of detail for S&M activities as for deactivation activities. Limited detail was provided for the technical baseline as was integration with other Site management systems.

Lesson No. 42. A short, high-level Project Plan would be a better tool for setting overall deactivation strategy. Sub-plans dealing with various issues such as regulatory compliance, safety strategy, stakeholder involvement, etc., then could be issued as supporting or ancillary documents. Each document then would be more "alive" in that it could be revised and implemented more quickly without waiting for total consensus on all sectors of the project.

Lesson No. 43. A Deactivation Project Management Plan should focus primarily on the baseline, baseline control, reporting, management, and summary sections. The project control system is crucial and should be consistent with project management methods rather than with operating methods.

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12.0 LESSONS CONSOLIDATED

The PUREX/UO_3 Lessons Learned appear throughout the above document, but are presented here in consolidated form, for ease of access.

Lesson No. 1. It is better to find an alternate use for a material than to dispose of it as waste, even if the alternate use brings little or no monetary income. A designation as waste subjects a material to long-term regulatory control, and to the costs associated with disposal and regulatory surveillance and paperwork. Also, the creative process of thinking of alternative uses for materials can be expanded, and later was expanded at PUREX, with the idea of sending contaminated nitric acid to British Nuclear Fuels Limited (BNFL) (see Section 7.0).

Lesson No. 2. The early involvement of an independent technical review team to review a major deactivation operation and make overview recommendations provides healthy and useful input. It allows the operation to be viewed by those with experience in the commercial world, and by those not directly tied to, nor constrained by, the day-to-day concerns of facility operations and management. It also provides a challenge to the facility staff to think of the deactivation project in different terms. In terms of broad concepts, the value of independent oversight is immeasurable.

Lesson No. 3. The advice of an independent review term in attempting to scope and define specific work tasks and pathways within a large deactivation project is less helpful than the broad overview perspective brought by such a team. As it turned out, Washington State regulators, regional trustees and stakeholders, and the constraints imposed by the needs and requirements of other divisions on the Hanford Site actually shaped the PUREX deactivation project along the way.

Lesson No. 4. Creativity and forethought, such as was displayed in the PUREX sale of excess bulk chemicals, can be employed even in Standby periods, to the benefit of a facility. Even during periods when clear direction is lacking and when mission flexibility needs to be preserved, some steps can be taken to deactivate portions of a large facility on a temporary basis and bring down costs. Those who know the plant most intimately are best equipped to brainstorm the specific ways to implement cost-saving steps.

Lesson No. 5. The end point criteria process developed by the Value Engineering Study should have been in place before the draft PUREX schedules were developed. Such an approach could have set end point criteria to better guide decisions in terms of which specific tasks would and would not be scheduled.

Lesson No. 6. Because many years often pass, or can be expected to pass, between deactivation and ultimate D&D of major DOE facilities, the exact needs, methods, and end states of D&D in the 21st century cannot be anticipated. Therefore, a functional matrix-based approach to deciding which deactivation tasks add value to a project is better than establishing vague end point criteria. Such an approach must have joint participation and concurrence between the EM-60 and EM-40 organizations.

Lesson No. 7. The time that elapsed during the PUREX Plant's Standby period actually created additional work for the deactivation project because some instruments and equipment had deteriorated during that period. To prepare for the deactivation, significant work needed to be done to re-calibrate and upgrade instruments and machinery. As much fore-warning as possible should be given to facilities as a shutdown status approaches. Such warning would allow the facility engineers and work planners to begin the preparations for deactivation work in a timely and efficient manner.

Lesson No. 8. The practice of generating fully developed, integrated, resource-loaded schedules, while it is time-consuming in itself, saves money for a large project in the long run. The costs and efforts of producing the schedules are vastly surpassed by the cost savings that result from avoiding the work delays and duplication that would occur without such schedules.

Lesson No. 9. Organizations internal to old facilities and DOE sites often have strong emotional ties and commitments to these facilities. They are willing to learn new skills to stay with the facilities throughout deactivation. This loyalty produces a strong work ethic and is valuable to the project. Keeping the operating employees with the deactivation project also provides these employees with enhanced skills that can provide them with better career opportunities after the deactivating facility closes.

Lesson No. 10. Personnel who are intimately familiar with large and complex, aging DOE facilities need to be involved in every step of the planning for the deactivation of these plants. This knowledge base is invaluable in producing realistic schedules for performing deactivation work. To make the process work, everyone who is involved in planning deactivation work should receive training from or with the scheduling organization so that they can understand exactly what information the schedulers need. Such training allows all participants to "speak the same language" to produce accurate schedules.

Lesson No. 11. Because S&M tasks consume much of a facility's budget during the early years of a deactivation project, detailed scheduling attention should be given to these tasks as well as to deactivation tasks.

Lesson No. 12. Everyone involved in planning and scheduling deactivation work needs to understand that this work must be approached with a different mind set than that which functions for operations work. Changing the perspective from that of operations to that of a project is crucial to the success of deactivation endeavors.

Lesson No. 13. Schedules in large and complex deactivation projects need to have the capacity to easily incorporate change. They need to be "living" schedules because no person or collection of persons, however knowledgeable, can anticipate all of the various changes that will occur over the life of the project.

Lesson No. 14. The software package chosen for a large deactivation project should be evaluated carefully before it is adopted. The sheer size and complexity of integrated, resource-loaded schedules that guide thousands of tasks demands software of huge capacity and flexibility. In retrospect, a different software might have better served the needs of the PUREX project.

Lesson No. 15. Every effort should be made for facilities to coordinate their status and potential regulatory situations to DOE-HQ on a constant basis, to avoid sudden or unexpected shutdown orders. Better planning and communications between the DOE and its contractors should be instituted in the future, so that facility preparations for the consolidation and disposition of hazardous materials can begin prior to the arrival of formal closure orders. The PUREX Facility was in possession of a number of substances for which there were no RCRA permits after the operational/standby status of the facility changed. Likewise, NEPA documentation might/could have been prepared as part of the deactivation decision, and in support of that decision.

Lesson No. 16. It is essential to involve and inform regulators early in any regulatory process or negotiation. A cooperative spirit is established by such actions, and joint efforts then can be directed at solutions rather than into confrontational or penalty-based actions. The regulatory dilemmas inherent in the PUREX deactivation project were unique and first-of-a-kind. Early and open communication with regulators was crucial to finding acceptable solutions to these dilemmas.

Lesson No. 17. Regulatory issues and needs must be communicated by contractor and DOE experts to all of the managers, engineers, and work planners at a facility. Just as understanding the methods and needs of the scheduling professionals by the plant operating personnel contributed to better schedules, likewise understanding of regulatory requirements by facility operators will (and did at PUREX) help ensure that regulatory mistakes and violations are avoided.

Lesson No. 18. For facilities in states that have negotiated special agreements with state and federal regulators (such as the Hanford Site's Tri-Party Agreement), such agreements can serve to break regulatory impasses that might be encountered under RCRA and other statutes. Because the Hanford Site Tri-Party Agreement has legal precedence over some other environmental laws, it can be a useful tool in negotiating creative solutions in response to unique needs. One example of such a prototypical solution might be a two-phase Closure Plan for PUREX.

Lesson No. 19. Emissions Comparison Documents are a useful tool in saving the costs and time that would be necessary to prepare full new permit applications for deactivation actions. The unique and successful use of such documents at the PUREX and UO_3 Plants should be extended to other facilities undergoing deactivation.

Lesson No. 20. The NEPA screening approach taken in the PUREX and UO_3 Facility deactivations is an extremely helpful and precedent-setting activity. Because an operational EIS existed, it was possible to comply with NEPA requirements without preparing a new EIS for deactivation. This action saved enormous amounts of time and money, and in particular should be highlighted and used at other facilities that are undergoing deactivation and that possess existing EIS documentation.

Lesson No. 21. Existing safety documentation from facility operational periods should and can be used in creative and careful ways as the basis for deactivation project safety documentation. Revisions, comparisons, "crosswalks," and other types of screening procedures can be used to evaluate which deactivation actions may be covered in existing documentation, and which actions need supplementary coverage. However, such comparison efforts, performed by those who know the facility well, are more cost-effective and time-efficient than the preparation of all new safety documentation for facility shutdowns.

Lesson No. 22. Workshops and other joint working efforts that bring together the principals interested in safety documentation, DOE, the operating contractor, and ITEs and other consultants, are important early in a deactivation project for brainstorming and establishing the major cornerstones of consensus about the safety documentation.

Lesson No. 23. Worker health and safety, always a DOE and contractor concern, has been elevated in recent years to even more important status. Often, worker safety and health aspects of older facility safety documentation will prove to be the area wherein such documentation falls short of modern standards. It is extremely important that worker safety and health considerations, comparable to or exceeding the levels demanded by OSHA, be incorporated into newer revisions or supplements of safety documentation.

Lesson No. 24. Worker involvement and a graded approach to the levels of safety analysis required for various deactivation tasks are keys to making the safety analysis process useful, efficient, and satisfactory to all concerned. The graded approach is cost effective in that it does not demand a high level of analysis for simple jobs already covered in established procedures. Worker involvement is also cost-effective in that it provides a higher level of assurance that workers are participating willingly and without hesitation in the jobs that are required for facility deactivation.

Lesson No. 25. New techniques in contamination fixation and sealing can be used to reduce the possibility of contamination migration so that full removal and burial of contaminated equipment and duct work is not necessary during deactivation. Use of these innovative and cost-effective methods reduces the worker exposure that might be encountered in full equipment and duct removal, safeguards the environment from contamination migration, and retains flexibility for any and all future D&D decisions.

Lesson No. 26. Any unnecessary manipulations, separations, conversions, or handling of plutonium and uranium-bearing solutions should be avoided. The age of the process vessels (at least in the PUREX Plant, and also at many DOE facilities) activates the need for renewed regulatory involvement if any further or different uses are made of this equipment. Also, worker and environmental risk increases every time additional processes are performed on plutonium and uranium materials.

Lesson No. 27. The cost savings associated with timely deactivation of large facilities such as the PUREX Plant are so overwhelming and important that optional activities that involve keeping plant systems active must be declined. The PUREX Facility is so complex and its internal systems so intertwined that the need to perform any activities associated with plutonium/uranium solutions meant that nearly all of the plant's systems would have to remain active. The overall deactivation project itself thus would have been slowed, and the imperative need and desire of the DOE to proceed with deactivation would not have been realized.

Lesson No. 28. Alternatives for the disposition of spent fuel are severely limited by considerations of the time and money it takes to satisfy regulatory requirements, safety considerations, and stakeholder concerns. Additionally, the requirements to permit the movement of even small amounts of spent fuel away from the DOE site of origin are very significant and perhaps not even achievable in today's climate. Therefore, spent fuel remaining at the end of processing activities should be dealt with onsite, and should be grouped with other existing spent fuel if it exists.

Lesson No. 29. It is better to find an alternate use for a slightly contaminated process chemical, with an interested buyer or consumer, than to have the material declared as a waste. The same lesson was learned, and for the same reasons, in connection with uncontaminated fresh chemicals that were sold from the PUREX Plant during the Standby period (see Lesson No. 1).

Lesson No. 30. There are some obstacles to movement of nuclear process materials, and to other types of deactivation alternatives, that cannot be controlled nor overcome by plant and DOE personnel. The historical/political climate with regard to nuclear materials is such that even the most preferred alternatives (from the technical perspective) sometimes cannot be implemented.

Lesson No. 31. The lessons learned in the deactivation of the PUREX analytical laboratory closely follow those learned in connection with N-Cell, the PR room, Q-Cell, and the Sample Gallery. Individual systems within large facilities cannot be kept open without the undue expense of maintaining at least portions of larger systems. There is an optimum time to deactivate a support facility and to move the needed services to other facilities. Also, modern contamination fixant techniques allow glove boxes and other large equipment pieces to be left inside facilities, while still controlling contamination migration.

Lesson No. 32. Careful planning, involving many knowledgeable plant people, as well as practice dry runs, are key elements in achieving smooth, efficient, and low exposure results when work is required in high radiation areas.

Lesson No. 33. While an early deactivation plan provides a good starting point for activities, facility managers and work planners should watch for opportunities to combine or accelerate tasks throughout the project. New and creative resolutions, resulting in cost and time savings, can present themselves as the facility representatives meet with regulators, crafts people, and others who may have input.

Lesson No. 34. At UO_3, the final flushes of the process vessels were included as part of the activities of the stabilization run. Because these flushes were considered part of operations, no RCRA permits were needed for the flush material and the RCRA "90-day clock" for the UO_3 Facility did not start ticking until the final flushes were completed. By that time, almost all hazardous materials that might have been considered wastes under a different timing structure had been removed from the plant. Other facilities should consider writing vessel and equipment flushes and other ancillary activities into their stabilization run plans.

Lesson No. 35. The disposition of small equipment, tools, furniture, and other miscellaneous supplies and items might be viewed as a private business opportunity as facilities deactivate across the DOE complex. The amount of time spent on such disposition was disproportionately large, in the view of facility management, and these activities had to compete with other deactivation tasks to capture the time of facility personnel. If such activities were privatized, more productive uses might be found for some of the equipment and waste burials might be minimized.

Lesson No. 36. The sophisticated and interwoven objectives, fundamental tasks, levels, cases, and matrixes developed in the UO_3 Deactivation End Point Criteria document should be a model for the entire DOE complex and beyond. This methodology, while it looks initially complicated, saves time and money in the long run because it forces all parties to take a justifiable, accountable look at **why** each task is done. Each task must have value to pass this test and to be approved and executed. This approach, in the words of one UO_3 official, "takes a D&D wish list and forces it into reality." Another advantage of this new methodology is its inherent ability to build consensus between deactivation and D&D programs, and to avoid costly disagreements at the time of facility turnover and beyond.

Lesson No. 37. End point criteria should be developed at the start of a deactivation project so that they can be available as tools to prioritize the work throughout the project.

Lesson No. 38. Public and tribal involvement is essential to the success of major deactivation projects. Such involvement should be started early, and should include initial efforts to assemble and distribute informational documents that allow non-technical people to understand the history, operations and condition of large, complex facilities. The provision of such documents can save enormous time for plant personnel that might otherwise have to be spent answering repetitive questions. It also can prevent a domino-effect of misunderstandings about the deactivation, based on basic misunderstandings of plant functions, layout, history, chemical and radiological inventory, and many other topics. Plant tours also are important to helping stakeholders understand the scope of the physical plant itself, the deactivation project, and the work being performed.

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13.0 ENDNOTES

1. U.S. Department of Energy, DOE/EIS-0089D and DOE/EIS-0089.

2. Gerber, WHC-MR-0437; Bixby, "Termination of the Plutonium-Uranium...".

3. Ibid.

4. Harty, WHC-SD-CP-PE-014, Rev. 0. Note: The recommendations, or "lessons learned" from the stabilization campaign appear on pp. 39-40 of this document.

5. Thompson, WHC-SD-CP-SSP-006, Rev. 0; Harlow, WHC-SD-CP-SSP-004, Rev. 0.

6. Work Plans WP-P-90-003 through WP-P-90-036; WHC Internal Memo 12124-90-11; WHC Internal Memo 12124-90-25; WHC Internal Memo 12124-90-29; WHC Internal Memo 12124-90-44; WHC Internal Memo 12124-90-49; WHC Internal Memo 17523-90-58; WHC Internal Memo 17523-90-61; WHC Internal Memo 17524-90-66; WHC Internal Memo 17523-90-78; WHC Internal Memo 17523-90-85; WHC Internal Memo 12124-90-41.

7. Harlow, WHC-SD-CP-SSP-004, Rev. 0; Thompson, WHC-SD-CP-SSP-006, Rev. 0.

8. Mecca, Correspondence #9004625B; PUREX Process Engineering, WHC-SD-CP-OSR-006, Rev. 2, pp. 2-4.

9. Work Plans WP-P-91-001, WP-P-91-003-017, WP-P-91-019-021, WP-P-91-023-025, WP-P-91-029-031, WP-P-91-033-034, WP-P-91-090, WP-P-91-094, WP-P-91-096-099, WP-P-91-101-104, WP-P-91-106-108, WP-P-91-110-111, WP-P-91-113-114, WP-P-91-116-118, WP-P-91-125, WP-P-91-134, WP-P-91-137, WP-P-91-141-143, WP-P-91-145-150, WP-P-91-152, WP-P-91-154; WHC Internal Memo 17523-91-02, WHC Internal Memo 17523-91-11, WHC Internal Memo 17523-91-030, WHC Internal Memo 17523-91-040, WHC Internal Memo 17523-91-049, WHC Internal Memo 17523-91-065, WHC Internal Memo 17523-91-066, WHC Internal Memo 17523-91-083, WHC Internal Memo 17523-91-083, WHC Internal Memo 17523-91-091.

10. Bhatia, WHC Internal Memo 17522-91-048; Midgett, Correspondence #9254568.

11. WHC Work Plans WP-P-92-003-004, WP-P-92-008, WP-P-92-011, WP-P-92-015, WP-P-92-017-022, WP-P-92-029-031, WP-P-92-034-036, WP-P-92-040, WP-P-92-048, WP-P-92-052053, WP-P-92-055, WP-P-92-060, WP-P-92-064; WHC Internal Memo 17523-92-007, WHC Internal Memo 17523-92-009, WHC Internal Memo 17523-92-015, WHC Internal Memo 17523-92-022, WHC Internal Memo 17523-92-028, WHC Internal Memo 17523-92-034, WHC Internal Memo 17523-92-040, WHC Internal Memo 17523-92-047, WHC Internal Memo 17523-92-061.

12. Independent Technical Review Team, "Independent Technical Review...," p. iii-1.

13. Ibid. pp. I-10-11.

14. Ibid., pp. I-16, 17, 20, ad I-1-12.

15. Hughes, WHC Internal Memo 85000-93-0012; Westinghouse Hanford Company, WHC-SP-1011 Draft, Appendix G; Westinghouse Hanford Company, WHC-SP-1011, Rev. 1.

16. Project, Time & Cost, Inc., "PUREX/UO3 Facilities Deactivation Project," Rev. 1.3; Cartmell, WHC-SP-1126, Vol. IV; Westinghouse Hanford Company, WHC-SP-1011D, Table 4.3.1, p. 4.3.2.

17. KCM, Inc., "Westinghouse Hanford Company, PUREX/UO3...".

18. KCM, Inc., "Westinghouse Hanford Company, PUREX/UO3...," p. 4 and Appendix F.

19. Hanford Site Drawing Numbers H-2-83605, Rev 1, H-2-83634, Rev. 0, H-1-50434, Rev. 0, H-2-821814, Rev. 0, H-2-821799, Rev. 0, H-2-821803, Sheets 1, 2, and 3, H-2-821804, Sheets 1, 2, 3, 4, 5, 6, 7, and 8, H-2-821831, H-2-821832, H-2-821833, H-2-821830.

20. Work Plans WP-P-93-003-005, WP-P-93-007-009, WP-P-93-012-013, WP-P-93-016-017, WP-P-93-021-024, WP-P-93-026-030, WP-P-93-032-034, WP-P-93-036-047, WP-P-93-051, WP-P-93-053-054.

21. Work Plans WP-P-94-003-008, WP-P-94-010-012, WP-P-94-015, WP-P-94-017-022, WP-P-94-024, WP-P-94-026, WP-P-94-028-029, WP-P-94-032-034, WP-P-94-038; Hamrick, Jasen, and Harlow, "PUREX/UO3 Deactivation Project Quarterly Review, October 31, 1994".

22. Project Software and Development, Inc., "Project Management...".

23. Mueller, WHC Internal Memo 17110-93-EAM-004; Project Software and Development, Inc., "PUREX/UO3 Facilities Transition Scheduling Review."

24. Quik-Net Graphics, "PUREX Transition Master Network"; Westinghouse Hanford Company, WHC-SP-1011D, pp. 4.2-2, 4.2-3.

25. Westinghouse Hanford Company, WHC-SP-1011.

26. Bliss, Correspondence #9259564D; U.S. Department of Energy, DOE/RL-88-21; Bauer, "Material Management Issues...".

27. Midgett, "PUREX Project Management Plan Workshop"; Wiley, "Meeting Minutes: PUREX Deactivation Regulatory Workshop"; Westinghouse Hanford Company, WHC-SD-EN-TI-283, Rev.0. Note: The EPA and the Washington State DOH also were invited to the April 12 to 16 workshop to discuss the PUREX regulatory strategy, but these agencies did not send representatives.

28. Westinghouse Hanford Company, WHC-SP-1011D, Table G-2, p. G-4; Hamrick, Correspondence #9454651D; Mecca, "Permitting and Interim Status Requirements...", with Enclosures 1, 2, and 3.

29. Ecology, EPA, and DOE, Hanford Federal Facility Agreement and Consent Order, Action Plan Section 3.1; Butler, "RE: Letter, R.G. Holt, DOE, R.E. Lerch, WHC...".

30. Hamrick, Correspondence #9354325.1, with Enclosures; Bauer, Correspondence #9306277; Bauer, Correspondence #9402907; Holt, "Applicability of WAC 173-303 to Nitric Acid..."; Mecca, "Permitting and Interim Status Requirements...".

31. Stanley/Tebb, Change Control #M-80-94-01 Draft; U.S. Department of Energy, DOE/RL-90-24, Rev. 1.

32. Rasmussen, Correspondence #9307041, with Enclosure RHO-CD-569; Pontius, Letter to J.E. Rasmussen, August 1993; Bauer, Correspondence #9400858 with Enclosure; Nylander, "RE: Letter, J.D. Bauer..."; Bauer, Correspondence #9400831 with Enclosure; Conklin, Correspondence #AIR 94-311; Conklin, Correspondence #AIR 94-313; Bauer, Correspondence #94000850; Westinghouse Hanford Co. Air and Water Permits, Internal Memo 88300-94-041; Wisness, Correspondence #9400891 with Enclosure; Bauer, Letter to J. McCormick, February 1994 with Enclosure; and Hamrick, Jasen, and Harlow, "PUREX/UO3 Deactivation Project Quarterly Review, October 31, 1994".

33. U.S. Department of Energy, DOE/EIS-0089.

34. Hamrick, Correspondence #9358853 with Attachment; Bracken, Mecca, Hunter, and Dunigan, "PUREX/UO3 Deactivation Project NEPA Compliance Strategy Information Memo"; Wagoner, DOE Memorandum 93-PPO-002; Engelmann, Internal Memo #88800-94-012 with Enclosure; Engelmann, Internal Memo #88800-94-037, Rev. 1; Archer, DOE/EA-0988; Harvey, "No Known Affected Historic Properties."

35. Reinkens, "PUREX/UO3 Weekly Status Report, 10/4/94"; Holt, Applicability of WAC 173-303 to Nitric Acid...".

36. Ecology, EPA, DOE, Hanford Federal Facility Agreement and Consent Order, Milestone M-17-00; Berriochoa, "Ground Broken...".

37. Engelmann, Internal Memo 88800-94-200 with Attachment; Rasmussen, "UO_3 Plant Storm Water Modification Information" with Enclosure.

38. Roemer, RHO-SD-HS-SAR-001; Yasutake, RHO-SD-CP-SAR-002; PUREX Process Control, RHO-CD-1540; Fox, RHO-RE-MA-5; Walser, WHC-CM-5-24, Addendum 1; Divencenzo and Peiffer, WHC-SD-CP-PLN-007; Mecca, "PUREX Safety Analysis Report Upgrade"; Walser, WHC-SD-CP-RD-020. NOTE: The full list of safety documentation that had been written for the PUREX Facility previous to RHO-SD-HS-SAR-001 and RHO-CD-1540 is too long to re-print herein. A complete list is available from Westinghouse Hanford Company Central Files.

39. Walser, WHC-SD-CP-RD-020; Risenmay, WHC-SD-CP-OSR-006, Rev. 1; PUREX Engineering Support, WHC-SD-CP-RD-021; Miska and Siemer, WHC-SD-CP-PHA-001; Westinghouse Hanford Company, OSD-P-154-00001.

40. Midgett, "PUREX Project Management Plan Workshop"; Walser, "Safety Analysis Strategy"; Johnson, "5480.23 Requirements Crosswalk..."; Kerr, "Results of Safety Documentation Strategy..."; Johnson, Kerr, and Walser, "Crosswalk Documentation"; Kerr, "Worker Health and Safety..."; Walser, "OSR Applicability for PUREX Plant Deactivation..."; Walser, "Applicability of the Unreviewed Safety Question Process to Non-Reactor Nuclear Facilities..."; Peiffer, "Meeting Minutes, PUREX Deactivation Project Safety Strategy Workshop"; Roemer, WHC-SD-HS-SAR-001, Rev. 5; Walser, WHC-CM-5-24, Rev. 18; Walser, WHC-SD-CP-RD-020; Parkman, WHC-SD-CP-OSR-006, Rev. 2; Westinghouse Hanford Company, WHC-SP-10011D, Appendix F.

41. Eng, "Worker Safety and Health Issues Related to the PUREX Deactivation Project."

42. Domnoske, WHC-SD-CP-TI-189; Wagoner, 94-PPO-001; Enghusen, WHC-SD-CP-RD-021, Rev. 3; Nuclear Safety and Radiological Analysis, WHC-CM-4-46, Rev. 10; PUREX/UO_3 Operations, WHC-CM-5-9, Rev. 48.

43. Dodd, WHC-SD-CP-HSP-002, Rev. 0; 29 CFR Section 1910.120 (1993); Los Alamos Technical Associates, "PUREX Hazards Baseline Document"; Los Alamos Technical Associates, "PUREX Hazards Identification Training"; American Institute of Chemical Engineers, Guidelines for Hazard Evaluation Procedures; Dodd, WHC Internal Memo 17700-94-017.

44. Bixby, "PUREX Deactivation Safety Strategy"; PHSA form in Dodd, WHC Internal Memo 17700-94-017.

45. Industrial Safety and Fire Protection, WHC-CM-4-3, Vols. 1, 2, 3; Alexander, WHC-CM-4-3, Vol. 4; Dodd, Hazards Assessment Chart, in WHC-SD-CP-HSP-002, Rev. 0; Harlow, WHC Internal Memo 17700-94-017; Walser, OSD--P-154-00001, Rev. A-0.

46. Bixby, "PUREX Deactivation Safety Strategy;" Eng, Letter to D.G. Hamrick, July 18, 1994; Dodd, WHC-SD-CP-HSP-002, Rev. 0.

47. Westinghouse Hanford Company, WHC-SP-1011, Rev. 0;

48. Cahow, RHO-CD-704; and Geier, WHC-SP-1479.

49. Westra, Tardiff, and Shrivastava, WHC-SD-CP-ES-159.

50. Westinghouse Hanford Company, WHC-SP-1011, Rev. 0, Appendix G; Work Plan WP-P-93-039; Bauer, Correspondence #9400831 with Enclosure.

51. Reberger, RHO-CD-1418; Geier, WHC-SP-0479; Work Plan WP-P-91-094.

52. Westinghouse Hanford Company, WHC-SP-1011, Rev. 0, Appendix G.

53. Duckworth, HW-77678; Work Plan WP-P-92-055.

54. Westinghouse Hanford Company, WHC-SP-1011, Rev. 0, Appendix G.

55. Geier, WHC-SP-0479; Hodges, TRAC-0672.

56. Westinghouse Hanford Company, WHC-SP-1011, Rev. 0, Appendix G; Work Plans WP-P-94-004-006.

57. Harty, WHC-SP-1072.

58. Bixby, "Termination of the Plutonium-Uranium..."; Harty, WHC-SP-1072; Roemer, WHC-SD-HS-SAR-001, Rev. 5.

59. Westinghouse Hanford Company, WHC-SP-1011D, Appendix G; Harty, WHC-SP-1072; Westinghouse Hanford Company, WHC-SP-1011, Rev. 0, Appendix G.

60. Archer, DOE/EA-0988; Bixby, "Termination of the Plutonium-Uranium..."; Enghusen, "Alternatives for the Disposition of Fuel Stored..."; Westinghouse Hanford Company, WHC-SP-1011D, Appendix G; Westinghouse Hanford Company, WHC-SP-1011, Rev.0; Appendix G; Spent Nuclear Fuel Project, WHC-EP-0830.

61. Westinghouse Hanford Company, WHC-SP-1011D, Appendix G; Coppinger, HW-77080; Bray, HW-76973 REV; Westinghouse Hanford Company, WHC-SP-1011, Rev. 0, Appendix G.

62. Mecca, Correspondence #94-ppo-016; Hamrick, Correspondence #9453904; Mecca, Concurrence to Correspondence #9453904; Westinghouse Hanford Company Traffic Operations, "U.S. Department of Energy LSA/Nitric..."; Clements, Letter to H. R. O'Leary"; Werner and Taub, "Disposition of PUREX Plant Nitric Acid: Technical, Cost and Policy Issues"; Grumbly, Memorandum to H.A. O'Leary"; Rasmussen, Correspondence #94-PCA-053 with Enclosure; O'Leary, "Disposition of Hanford Nitric Acid"; Donn, "Justification for Plant Modification Costs and Payment"; Feldt

and Weiner, "British Nuclear Fuels Facility Plant Modifications"; Westinghouse Hanford Company, WHC Subcontract No. MAR-SVV-382237; Nuclear Regulatory Commission, Export License #XSNM02827; U.S. Department of Energy, DOE/EA-1005.

63. Westinghouse Hanford Company, WHC-SP-1011 Rev. 0, Appendix G; Hunter, DOE Internal Memorandum 94-PPO-006; Dials, "Shipment of Solvent from Hanford..."; Conklin, "Approval for Transfer..."; Wendt, "Agreement by DOE-ID and the Idaho Department of Health..."; Hamrick, Correspondence #9357446; Halupa, WINCO Memorandum SMH-137-93; Romsos, Uniform Hazardous Waste Manifest #A3229; Associated press, "Idaho Accepts Last Load..."; Associated Press, "Andrus to Idaho's Senators..."; "The Navy Will Be Able to Send Spent Fuel...".

64. Duncan, "PUREX Organic Solvent Usage Variance Request"; Hunter, DOE Internal Memorandum 94-PPO-006; Jensen, DOE Internal Memorandum OPE-CPP-BSA-94055; Hamrick, Correspondence #9354325.1, with Enclosures; Wisness, Correspondence #9404281; Wagoner, Correspondence #9404847.

65. Courtney and Clark, HW-32413 DEL; Carr, HW-24800-105; Dale, "Isolation of the PUREX Analytical Laboratory"; Sivula, "Lab Fight a Battle..."; Westinghouse Hanford Company, WHC-SP-1011D, Appendix G.

66. Westinghouse Hanford Company, WHC-SP-1011, Rev. 0, Appendix G.

67. Carr, HW-24800-105; Barnard, "PUREX a Step Closer to D&D"; PUREX System Deactivation Engineering, Internal Memorandum 17710-94-020.

68. Millward, WHC-SD-CP-TA-005, Rev. 0; Westra and Willis, WHC-SD-CP-SSP-008, Rev. 0.

69. Westra and Willis, WHC-SD-CP-SSP-008, Rev. 0.

70. Work Plans WP-UO-92-0061, WP-UO-93-001, WP-UO-93-004, WP-UO-93-005, WP-UO-93-013, WP-UO-93-006, WP-UO-0055, WP-UO-94-002; McKenna, "UO_3 Completes Deactivation Milestone Ahead of Schedule."

71. Rasmussen, Correspondence #9455363D; Reinkens, "PUREX/UO3 Weekly Status Report, 9/27/94."

72. Work Plans WP-UO-94-010, WP-U-94-012, WP-UO-94-008; Reinkens, "PUREX/UO_3 Plant Weekly Status Reports for 9/20/94, 10/4/94."

73. Stefanski, WHC-SD-WM-TPP-052, Rev. 0.

74. Ibid.

75. Ibid.; Hamrick, Correspondence #9456181.

76. DOE, "Headquarters Public Participation..."; Westinghouse Hanford Company, WHC-SP-1011D, Appendix D.

77. Forehand, "PUREX PMP Workshop..."; Gerber, WHC-MR-0437; U.S. Department of Energy, "PUREX/UO_3 Plant Deactivation: The Transition..."; Gerber, "Umatilla Indian Involvement...", citing J.R. Wilkinson; Jasen, "PUREX/UO_3 Deactivation Project...".

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14.0 REFERENCES

Alexander, D. J., "Industrial Safety Manual: Health and Safety Programs for Hazardous Waste Operations," WHC-CM-4-3, Vol. 4 (Richland, Washington: Westinghouse Hanford Company, January 28, 1992.

American Institute of Chemical Engineers (Center for Chemical Process Safety), "Guidelines for Hazard Evaluation Procedures," 2nd ed. (New York: American Institute of Chemical Engineers, 1992).

Archer, B. F., "Environmental Assessment: Transfer of Plutonium-Uranium Extraction Plant and 105-N Reactor Irradiated Fuel for Encapsulation and Storage at the 105-KE and 105-KW Reactor Fuel Storage Basins, 100 and 200 Areas, Hanford Site: Richland, Washington," DOE/EA-0988, U.S. Department of Energy, Richland, Washington, October 1994.

Associated Press, "Idaho Accepts Last Load of Waste," in Tri-City Herald (Kennewick, Washington), August 19, 1989, p. A7.

Associated Press, "Andrus to Idaho's Senators: Help Us Fight A-Waste," in Tri-City Herald, October 4, 1991, p. A7.

Barnard, S. K., "PUREX a Step Closer to D&D," in Hanford Reach, (Richland, Washington: Westinghouse Hanford Company, June 13, 1994), p.6.

Bauer, J. D. "Materials Management Issues Associated with the Plutonium-Uranium Extraction Plant," Letter to D. B. Jansen (Richland, Washington: U.S. Department of Energy, January 1993).

Bauer, J. D., "Application for Variance from the State of Washington Dangerous Waste Regulations," Letter to D. C. Nylander, Correspondence #9306277 (Richland, Washington: U.S. Department of Energy, November 5, 1993).

Bauer, J. D., "Proposed Deactivation of Plutonium Uranium Extraction Plant - Requests for Concurrence," Letter to A. W. Conklin, Correspondence #9400831 (Richland, Washington: U.S. Department of Energy, February 7, 1994), with Enclosure: "Evaluation of Proposed PUREX Plant Deactivation Activities with Reference to Radionuclide Airborne Releases."

Bauer, J. D., "Application for Approval of Modification for Plutonium-Uranium Extraction Deactivation," letter to J. McCormick (Richland, Washington: U.S. Department of Energy, February 1994), with Enclosure: "40 Code of Federal Regulations 61 Application for Approval of PUREX Deactivation."

Bauer, J. D., "Application for Approval of Modification for Plutonium-Uranium Extraction Deactivation," Letter to J. McCormick, Correspondence #9400850 (Richland, Washington: U.S. Department of Energy, March 2, 1994).

Bauer, J. D., "Request for Concurrence with Emissions Evaluation for Approval of Deactivation of PUREX Plant Pursuant to Washington Administrative Codes 173-400 and 173-460," Letter to D. Butler, Correspondence #9400858 (Richland, Washington: U.S. Department of Energy, March 10, 1994), with Enclosure: "Evaluation of Proposed PUREX Deactivation Activities with Reference to Potential Toxic Air Pollutant Releases."

Bauer, J. D., "Information to Support State of Washington Department of Ecology Response to Request for Variance from Solid Waste Designation for Organics from the Plutonium-Uranium Extraction Facility," Letter to J. Stohr, Correspondence #9402907 (Richland, Washington: U.S. Department of Energy, April 1, 1994).

Berriochoa, M. V., "Ground Broken for Treated Effluent Facility This Week," in Hanford Reach, June 14, 1993.

Bhatia, R. K., 1991, "Closure of Chemical Addition in P&O Gallery," WP-P-91-007, (Richland, Washington: Westinghouse Hanford Company, February 19, 1991).

Bhatia, R. K., 1991, "Drain/Flush 211-1 to AMU XTU Lines," WP-P-91-024, (Richland, Washington: Westinghouse Hanford Company, April 19, 1991).

Bhatia, R. K., 1991, "Calibrate F Cell Sumps," WP-P-91-025, (Richland, Washington: Westinghouse Hanford Company, April 23, 1991).

Bhatia, R. K., 1991, "TK-11 Drain & Flush," WP-P-91-106, (Richland, Washington: Westinghouse Hanford Company, July 23, 1991).

Bhatia, R. K., "Drain & Flush 211-A," WP-P-91-107 (Richland, Washington: Westinghouse Hanford Company, July 26, 1991).

Bhatia, R. K., "Removal Order of Excess Chemicals," WHC Internal Memo #17522-91-048 (Richland, Washington: Westinghouse Hanford Company, August 21, 1991).

Bhatia, R. K., "Hydrogen Peroxide Loadout," WP-P-91-137 (Richland, Washington: Westinghouse Hanford Company, October 1, 1991).

Bhatia, R. K., "D Cell Sump Integrity Assessment," WP-P-91-147 (Richland, Washington: Westinghouse Hanford Company, November 22, 1991).

Bhatia, R. K., "E Cell Sump Integrity Assessment," WP-P-91-148 (Richland, Washington: Westinghouse Hanford Company, November 22, 1991).

Bhatia, R. K., "SFB Sump Integrity Assessment," WP-P-91-149 (Richland, Washington: Westinghouse Hanford Company, November 22, 1991).

Bhatia, R. K., "AVN TK-42 Drain & Flush," WP-P-91-150 (Richland, Washington: Westinghouse Hanford Company, December 6, 1991).

Bhatia, R. K., "Nitric Acid (TK-12) Loadout," WP-P-92-018 (Richland, Washington: Westinghouse Hanford Company, March 31, 1992).

Bhatia, R. K., "TBP Loadout," WP-P-92-019 (Richland, Washington: Westinghouse Hanford Company, March 31, 1992).

Bhatia, R. K., "NPH Loadout," WP-P-92-020 (Richland, Washington: Westinghouse Hanford Company, March 31, 1992).

Bhatia, R. K., "Bulk Tank Sampling - Tributyl Phosphate Loadout," WP-P-92-021 (Richland, Washington: Westinghouse Hanford Company, April 3, 1992).

Bixby, W. W., "Termination of the Plutonium-Uranium Extraction (PUREX) Plant and Guidance to Proceed with Shutdown Planning and Terminal Cleanout Activities," Memorandum to J.D. Wagoner (Washington, DC: U.S. Department of Energy, December 21, 1992).

Bixby, W. W., "PUREX Deactivation Safety Strategy," U.S. Department of Energy Internal Memo to Assistant Manager for Waste Management, Richland, Operations Office (Washington, DC: U.S. Department of Energy, June 26, 1994).

Bliss, R. J., "Material Management Issues Associated with the Plutonium-Uranium Extraction Plant," Letter to J. R. Hunter, Correspondence #9259564D (Richland, Washington: Westinghouse Hanford Company, January 5, 1993).

Bouten, J. S., "Panel B-1 Instrument Deactivation," WP-P-93-009 (Richland, Washington: Westinghouse Hanford Company, March 2, 1993).

Bracken, G. J., J.E. Mecca, J.R. Hunter, and P.F.X. Dunigan, "PUREX/UO_3 Deactivation project National Environmental Policy Act Compliance Strategy Information Memo" (Richland, Washington: U.S. Department of Energy, November 1993).

Bray, L. A., "Denitration of PUREX Wastes with Sugar," HW-76973 REV (Richland, Washington: General Electric Hanford Company, April 1963).

Buckley, L. L., "J-Cell Canyon Floor Samples," WP-P-90-023 (Richland, Washington: Westinghouse Hanford Company, July 17, 1990).

Buckley, L. L., "TK-J1 Functional Test," WP-P-90-030 (Richland, Washington: Westinghouse Hanford Company, September 25, 1990).

Butler, D., "RE: Letter, R.G. Holt, U.S. Department of Energy, R.E. Lerch, WHC, to D. Butler, Ecology, 'Development of PUREX Deactivation Regulatory Compliance Approach' DOE/RL 93-RPS-326,dated September 30, 1993," Letter to R. G. Holt and R. E. Lerch (Olympia, Washington: Washington State Department of Ecology, March 14, 1994).

Cahow, D. L., "PUREX Oxide Conversion Facility, Preliminary Safety Analysis Report," RHO-CD-704 (Richland, Washington: Rockwell Hanford Operations, 1979).

Carr, P. S., Jr., "Completion Report: Expansion of 200 Area Facilities," HW-24800-105 (Richland, Washington: General Electric Hanford Company, July 1, 1958).

Cartmell, D. B., "Transition projects FY 1995 Multi-Year Program Plan (MYPP)/Fiscal Year Work Plan (FYWP) WBS 1.3.1 and 7.1," WHC-SP-1126, Vol. IV (Richland, Washington: Westinghouse Hanford Company, September 1994).

Carville, R. R., "Pre-Filter Changeout, White Room Exhaust," WP-P-90-004 (Richland, Washington: Westinghouse Hanford Company, March 5, 1990).

Carville, R. R., "Perform 291-AE Filter Changeout," WP-P-90-009 (Richland, Washington: Westinghouse Hanford Company, April 10, 1990).

Clements, T., Letter to H. R. O'Leary (Washington DC: Greenpeace, August 11, 1994).

Code of Federal Regulations, "Hazardous Waste Operations and Emergency Response," 29 CFR Section 1910.120 (Washington, DC: U.S. Occupational Safety and Health Administration, 1993).

Conklin, A. W., "Approval for Transfer of 20,200 Gallons of Solvent from PUREX Facility (A PUREX Deactivation Activity)" (Olympia: Washington State Department of Health, September 3, 1993).

Conklin, A. W., Letter to J. D. Bauer, #AIR-94-311 (Olympia, Washington: Washington State Department of Health, March 18, 1994).

Conklin, A. W., Letter to J. D. Bauer, #AIR-94-313 (Olympia, Washington: Washington State Department of Health, March 30, 1994).

Coppinger, E. A., "Pilot Plant Denitration of PUREX Waste with Sugar," HW-77080 (Richland, Washington: General Electric Hanford Company, March 29, 1963).

Courtney, J. J., and B. E. Clark, Jr., "An Introduction to the PUREX Plant," HW-32413-DEL (Richland, Washington: General Electric Hanford Company, July 15, 1954).

Dale, T. R., "Isolation of the PUREX Analytical Laboratory" (Richland, Washington: Westinghouse Hanford Company, May 17, 1993).

DeVries, M. L., "Splitting Tanks D-5/E-6 Solution for Cold Standby," WP-P-91-114 (Richland, Washington: Westinghouse Hanford Company, August 29, 1991).

DeVries, M. L., "Drain Lines from TK-105 to TK-324," WP-P-92-015 (Richland, Washington: Westinghouse Hanford Company, March 20, 1992).

DeVries, M. L., "Clean of First Stage Calciner," WP-P-92-031 (Richland, Washington: Westinghouse Hanford Company, May 14, 1992).

DeVries, M. L., "Drying and Packing N-Cell Powder," WP-P-92-040 (Richland, Washington: Westinghouse Hanford Company, June 22, 1992).

DeVries, M. L., "Clean Up for Second Stage Calciner," WP-P-92-052 (Richland, Washington: Westinghouse Hanford Company, August 11, 1992).

DeVries, M. L., "Clean Out of Tanks TK-306-U, TK-307-U and TK-308-U," WP-UO-93-001 (Richland, Washington: Westinghouse Hanford Company, January 26, 1993).

Dials, G. E., "Shipment of Solvent from Hanford to the Idaho Chemical Processing Plant at the INEL (NP-MB-93337)," Letter to D. L. Humphrey (Idaho Falls: U.S. Department of Energy, September 2, 1993).

Divencenzo, E. P., and W. A. Peiffer, "Program Plan to Upgrade the PUREX Final Safety Analysis Report," WHC-SD-CP-PLN-007 (Richland, Washington: Westinghouse Hanford Company, December 1990).

Dodd, E. N., "PUREX Deactivation Health and Safety Plan," WHC-SD-CP-HSP-002, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, November 1994).

Dodd, E. N., "PUREX Integrated Safety Comparison," Internal Memo 17700-94-022 (Richland, Washington: Westinghouse Hanford Company, August 15, 1994).

Domnoske, L. A., "Technical Information for the PUREX Facility in Standby," WHC-SD-CP-TI-189 (Richland, Washington: Westinghouse Hanford Company, January 1994).

Donn, S. G., "Justification for Plant Modifications Costs and Payment," Letter to L. Weiner (Richland, Washington: British Nuclear Fuels, Ltd., October 17, 1994).

Drivdahl, K. S., "TK-J2 Transfer to UGS," WP-P-92-055 (Richland, Washington: Westinghouse Hanford Company, September 3, 1992).

Drivdahl, K. S., "Tank PS Transfer to Tank P3," WP-P-92-064 (Richland, Washington: Westinghouse Hanford Company, November 16, 1992).

Drivdahl, K. S., "Measure Heels in 211-A Tanks," WP-P-93-007 (Richland, Washington: Westinghouse Hanford Company, February 24, 1993).

Drivdahl, K. S., "Video Tape 211-A Tanks," WP-P-93-008 (Richland, Washington: Westinghouse Hanford Company, February 25, 1993).

Drivdahl, K. S., "Flush 211-ATKS (11,12 42)," WP-P-94-038 (Richland, Washington: Westinghouse Hanford Company, October 19, 1994).

DuBois, D. P., "Approval of Application to Construct No. PSD-XOO-14" (Seattle, Washington: U.S. Environmental Protection Agency, 1980).

Duckworth, J. P., "PUREX Neptunium Recovery and Purification Information Manual," HW-77678 (Richland, Washington: General Electric Hanford Company, April 1, 1963).

Duncan, R. A., "PUREX Organic Solvent Usage Variance Request" (Richland, Washington: Westinghouse Hanford Company, January 6, 1994).

Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Eiholzer, S. M., "Transfer of Flush Solution in Canyon Process Vessels," WP-P-90-036 (Richland, Washington: Westinghouse Hanford Company, December 20, 1990).

Eiholzer, S. M., "Transfer of Flush Solution in Canyon Process Vessels, K&R Cell" WP-P-91-008 (Richland, Washington: Westinghouse Hanford Company, February 20, 1991).

Eiholzer, S. M., "Transfer of Waste Solution in F Cell to UGS," WP-P-91-009 (Richland, Washington: Westinghouse Hanford Company, February 22, 1991).

Eiholzer, S. M., "Transfer of Flush Solution in Canyon Process Vessels Final Layup," WP-P-91-015 (Richland, Washington: Westinghouse Hanford Company, March 13, 1991).

Eiholzer, S. M., "Wet GB Flush N Cell, Wet Glove Box Flush," WP-P-91-016 (Richland, Washington: Westinghouse Hanford Company, March 20, 1991).

Eiholzer, S. M., "Transfer of Solutions from TK-L11 to TK-E6," WP-P-92-017 (Richland, Washington: Westinghouse Hanford Company, March 30, 1992).

Eiholzer, S. M., "Video Tape TK-P3-UNH/Organic Phase," WP-P-93-012 (Richland, Washington: Westinghouse Hanford Company, March 16, 1993).

Eiholzer, S. M., "Drainage of Acid Line at P&O Gallery Nozzle KG-70," WP-P-93-026 (Richland, Washington: Westinghouse Hanford Company, June 15, 1993).

Eiholzer, S. M., "Transfer of Solution from UNH Tanker to TK-P2," WP-P-93-029 (Richland, Washington: Westinghouse Hanford Company, September 2, 1993).

Eiholzer, S. M., "H & J Cell Solution Transfer," WP-P-93-034 (Richland, Washington: Westinghouse Hanford Company, September 27, 1993).

Eiholzer, S. M., "Operate Lab Water Still," WP-P-93-041 (Richland, Washington: Westinghouse Hanford Company, October 22, 1993).

Eiholzer, S. M., "L-Cell Package Solution Transfer," WP-P-93-044 (Richland, Washington: Westinghouse Hanford Company, November 2, 1993).

Eiholzer, S. M., "Flush UNH Tank Trailer," WP-P-94-026 (Richland, Washington: Westinghouse Hanford Company, May 15, 1994).

Eiholzer, S. M., "Load 55-Gallon Drum with NaOH," WP-P-94-032 (Richland, Washington: Westinghouse Hanford Company, August 22, 1994).

Eng, C. C., "Worker Safety and Health Issues Related to the PUREX Deactivation Project," U.S. Department of Energy Memorandum to R. Martinez, Draft (Washington, DC: U.S. Department of Energy, July 1, 1993).

Eng., C. C., Letter to D. G. Hamrick (Washington, DC: U.S. Department of Energy, July 18, 1994).

Engelmann, R. H., "Categorically Excluded Actions: Plutonium-Uranium Extraction Facility Deactivation, 200 East Area, Hanford Site, Richland, Washington," WHC Internal Memo 88800-94-012 (Richland, Washington: Westinghouse Hanford Company, March 3, 1994), with Enclosure: "Categorically Excluded Actions, PUREX Facility Deactivation, 200 East Area, Hanford Site, Richland, Washington."

Engelmann, R. H., "Information Bulletin: Plutonium-Uranium Extraction Plant Heating, Ventilation and Air Conditioning Modifications, 200 East Area, Hanford Site, Richland, Washington," WHC Internal Memo 88800-94-037, Rev. 1 (Richland, Washington: Westinghouse Hanford Company, June 14, 1994).

Engelmann, R. H., "Categorically Excluded Actions: UO_3 Facility Deactivation, 200 East [sic] Area, Hanford Site, Richland, Washington," WHC Internal Memo 88800-94-200 (Richland, Washington: Westinghouse Hanford Company, September 26, 1994), with Attachment: "Categorically Excluded Actions: UO_3 Facility Deactivation, 200 East [sic] Area, Hanford Site, Richland, Washington."

Enghusen, M. B., "Flush TK20 for Coil Replacement," WP-P-90-003 (Richland, Washington: Westinghouse Hanford Company, March 5, 1990).

Enghusen, M. B., "Vent Hydrazine Drums," WP-P-90-027 (Richland, Washington: Westinghouse Hanford Company, August 6, 1990).

Enghusen, M. B., "Load 55-Gallon Drum with 25 NY.% NaOH," WP-P-90-031 (Richland, Washington: Westinghouse Hanford Company, December 6, 1990).

Enghusen, M. B., "PUREX Chapter 11 Implementation Plan for Revision 6 of the PUREX Final Safety Analysis Report," WHC-SD-CP-RD-021, Rev. 3 (Richland, Washington: Westinghouse Hanford Company, April 30, 1992).

Enghusen, M. B., "Dissolver Heels Inspection," WP-P-93-030 (Richland, Washington: Westinghouse Hanford Company, September 7, 1993).

Enghusen, M. B., "Perform Three Well Cask Car PM Check," WP-P-94-019 (Richland, Washington: Westinghouse Hanford Company, March 23, 1994).

Enghusen, M. B., "Transfer of Water from the Slug Storage Basin," WP-P-94-024 (Richland, Washington: Westinghouse Hanford Company, April 26, 1994).

Enghusen, M. B., "Perform SPR Fuel Basket Load Test and Removal Evap," WP-P-94-028 (Richland, Washington: Westinghouse Hanford Company, June 29, 1994).

Enghusen, M. B., "Alternatives for the Disposition of Fuel Stored in the PUREX Facility" (Richland, Washington: Westinghouse Hanford Company, July 1994).

Enghusen, M. B., and M. C. Hatch, "Fuel Rod Rinse Table Assembly, Sheets 1 and 2," H-2-821804.Sht 1 and Sht 7 (Richland, Washington: Westinghouse Hanford Company, 1994).

Enghusen, M. B., and M. C. Hatch, "Fuel Rod Rinse Table Main Frame Assembly," H-2-821804.Sht 2 (Richland, Washington: Westinghouse Hanford Company, 1994).

Enghusen, M. B., and M. C. Hatch, "Fuel Rod Rinse Table Sub-Frame Assembly," H-2-821804.Sht 3 (Richland, Washington: Westinghouse Hanford Company, 1994).

Enghusen, M. B., and M. C. Hatch, "Fuel Rod Rinse Table, Assembly and Details," H-2-821804.Sht 4 (Richland, Washington: Westinghouse Hanford Company, 1994).

Enghusen, M. B., and M. C. Hatch, "Fuel Rod Rinse Table Lifting Bail Assembly," H-2-821804.Sht 5 (Richland, Washington: Westinghouse Hanford Company, 1994).

Enghusen, M. B., and M. C. Hatch, "Fuel Rod Rinse Table Dumping Trunnion Assembly," H-2-821804.Sht 6 (Richland, Washington: Westinghouse Hanford Company, 1994).

Enghusen, M. B., and L. T. Aikin, "Fuel Rod Rinse Table Lifting Stirrup," H-2-821804.Sht 8 (Richland, Washington: Westinghouse Hanford Company, 1994).

Enghusen, M. B., and M. C. Hatch, "Fuel Canister Capping Station, Assembly," H-2-821831 (Richland, Washington: Westinghouse Hanford Company, 1994).

Ethington, P. R., "Clean Up Dry Glove Boxes," WP-P-91-003 (Richland, Washington: Westinghouse Hanford Company, February 6, 1991).

Ethington, P. R., "Perform Flush of the Backup Facility," WP-P-91-014 (Richland, Washington: Westinghouse Hanford Company, March 11, 1991).

Ethington, P. R., "PR Room Cleanup," WP-P-91-094 (Richland, Washington: Westinghouse Hanford Company, June 24, 1991).

Ethington, P. R., "Control B-2 Instrument Deactivation," WP-P-93-003 (Richland, Washington: Westinghouse Hanford Company, February 11, 1993).

Ethington, P. R., "Control B-3 Instrument Deactivation," WP-P-93-004 (Richland, Washington: Westinghouse Hanford Company, February 16, 1993).

Ethington, P. R., "Instruments Deactivation," WP-P-93-005 (Richland, Washington: Westinghouse Hanford Company, February 17, 1993).

Ethington, P. R., "Inhibit CAS System," WP-P-93-013 (Richland, Washington: Westinghouse Hanford Company, March 17, 1993).

Ethington, P. R., "Personal Area Radiation Monitor Deactivation," WP-P-93-016 (Richland, Washington: Westinghouse Hanford Company, March 31, 1993).

Ethington, P. R., "CAS Maintenance Work Plan," WP-P-93-017 (Richland, Washington: Westinghouse Hanford Company, April 8, 1993).

Ethington, P. R., "Concentrate Waste in Concentrator E-F11," WP-P-93-046 (Richland, Washington: Westinghouse Hanford Company, November 2, 1993).

Ethington, P. R., "Pump Out SX3," WP-P-94-021 (Richland, Washington: Westinghouse Hanford Company, April 5, 1994).

Everett, B. K., "Cleanout of Water Separator Tank F-620-1," WP-P-93-028 (Richland, Washington: Westinghouse Hanford Company, August 16, 1993).

Farren, J. D., "P-Tank Heel Consolidation," WP-P-93-021 (Richland, Washington: Westinghouse Hanford Company, May 10, 1993).

Farren, J. D., "211-A Facility Deactivation Activities," WP-P-93-040 (Richland, Washington: Westinghouse Hanford Company, October 22, 1993).

Farren, J. D., "Flush Back-Cycle Waste and Neptunium Package Vessel," WP-P-93-043 (Richland, Washington: Westinghouse Hanford Company, November 1, 1993).

Farren, J. D., "Organic Solvent Transfer to Tank-40," WP-P-93-051 (Richland, Washington: Westinghouse Hanford Company, December 8, 1993).

Farren, J. D., "Removal of NaOH Tanks from 215-A Facility," WP-P-94-010 (Richland, Washington: Westinghouse Hanford Company, January 27, 1994).

Farren, J. D., "Removal of Pumps from 211-A Facility," WP-P-94-011 (Richland, Washington: Westinghouse Hanford Company, January 27, 1994).

Farren, J. D., "Flush Neptunium Storage Tank, Tank J-2," WP-P-94-029 (Richland, Washington: Westinghouse Hanford Company, August 8, 1994).

Farren, J. D., "Flush U-Cell Vessels," WP-P-94-033 (Richland, Washington: Westinghouse Hanford Company, August 23, 1994).

Feldt, L., and L. Weiner, "British Nuclear Fuels Facility Plant Modifications," Memorandum to File (Washington, DC: U.S. Department of Energy, October 19, 1994).

Forehand, G. D., "PUREX PMP Workshop: Stakeholder Working Session" (Richland, Washington: Westinghouse Hanford Company, April 14, 1993).

Fox, R. D., "PUREX Process Control Manual," RHO-RE-MA-5 (Richland, Washington: Rockwell Hanford Operations, July 13, 1983).

Geier, R. G., "PUREX Technical Manual: Chemical Processing," WHC-SP-0479 (Richland, Washington: Westinghouse Hanford Company, September 1979).

Geiger, J. L., "Combined Flush For Ventilation System 1," WP-P-91-020 (Richland, Washington: Westinghouse Hanford Company, March 28, 1991).

Geiger, J. L., "Install Cascade Impacter on PR Stack Sampler System," WP-P-92-003 (Richland, Washington: Westinghouse Hanford Company, January 13, 1992).

Geiger, J. L., "Install Cascade Impacter on PR Stack," WP-P-92-004 (Richland, Washington: Westinghouse Hanford Company, January 14, 1992).

Geiger, J. L., "Install Cascade Impacter on PUREX Main Stack," WP-P-92-022 (Richland, Washington: Westinghouse Hanford Company, April 8, 1992).

Geiger, J. L., "Install Laser Spectrometer on PR 296-A-1 Stack Cam," WP-P-92-029 (Richland, Washington: Westinghouse Hanford Company, May 14, 1992).

Geiger, J. L., "Install Laser Spectrometer on PR 296-A-1 Roof Location," WP-P-92-030 (Richland, Washington: Westinghouse Hanford Company, May 14, 1992).

Gerber, M. S., "A Brief History of the PUREX and UO_3 Facilities," WHC-MR-0437 (Richland, Washington: Westinghouse Hanford Company, November 1993).

Gerber, M. S. "Umatilla Indian Involvement at PUREX Praised" in Hanford Reach, October 10, 1994, p. 11.

Gonsalves, E., "Description of the 224-U Legacy Equipment," WP-UO-94-008 (Richland, Washington: Westinghouse Hanford Company, July 12, 1994).

Gore, D., "Dissolver Heels Passivation," WP-P-93-047 (Richland, Washington: Westinghouse Hanford Company, November 2, 1993).

Gregonis, R. A., "Perform HEPA Filter Changeout (FH-V11-4-10/291-AE)," WP-P-91-029 (Richland, Washington: Westinghouse Hanford Company, May 7, 1991).

Gregonis, R. A., "Assembly of PUREX Canyon Exhaust Fan EF-U11-1," WP-P-93-023 (Richland, Washington: Westinghouse Hanford Company, May 25, 1993).

Gregonis, R. A., "Perform HEPA Filter Change-Out (FH-V11-4-9/291-AE)," WP-P-93-038 (Richland, Washington: Westinghouse Hanford Company, October 21, 1993).

Gregonis, R. A., "Drain Water from BT#2 Exhaust System (EF-V-12-1/296-A)," WP-P-93-054 (Richland, Washington: Westinghouse Hanford Company, December 30, 1993).

Gregonis, R. A., "Disassembly of PUREX Exhaust Fan EF-V-11-2," WP-P-94-007 (Richland, Washington: Westinghouse Hanford Company, January 10, 1994).

Gregonis, R. A., "Assembly of PUREX Exhaust Fan EF-V-11-2," WP-P-94-008 (Richland, Washington: Westinghouse Hanford Company, January 10, 1994).

Grumbly, T. P., Memorandum to H.R. O'Leary (Washington, DC: U.S. Department of Energy, September 3, 1994).

Halupa, S. ., "Plutonium Uranium Extraction Plant Organic," Memorandum to D. G. Hamrick, Memorandum #SMH-137-93 (Idaho Falls: Westinghouse Idaho Nuclear Company, Inc., September 2, 1993).

Ham, J. E., "Nitric Acid Transfer from U1 & U2 to F3,"WP-P-92-053 (Richland, Washington: Westinghouse Hanford Company, August 31, 1992).

Ham, J. E., "Instrument Deactivation Test,"WP-P-92-060 (Richland, Washington: Westinghouse Hanford Company, October 27, 1992).

Hamrick, D. G., "Plutonium Uranium Extraction Plant Organic," Letter to S. M. Halupa, Correspondence #9357446 (Richland, Washington: Westinghouse Hanford Company, August 31, 1993).

Hamrick, D. G., "National Environmental Policy Act Compliance for Deactivation of the Plutonium-Uranium Extraction Plant and the Uranium Oxide Plant," Letter to J. E. Mecca, Correspondence #9358853 (Richland, Washington: Westinghouse Hanford Company, October 12, 1993), with Enclosure: "PUREX/UO_3 Deactivation."

Hamrick, D. G., "Information Bulletin: Disposal of Tri-N-Butylphosphate from the Plutonium-Uranium Extraction Facility, 200 East Area, Hanford Site, Richland, Washington," Letter to J. E. Mecca, Correspondence #9354325.1 (Richland, Washington: Westinghouse Hanford Company, April 12, 1994), with Enclosures: Categorical Exclusion for the Disposal of Tri-N-Butylphosphate from the Plutonium-Uranium Extraction Facility, 200 East Area, Hanford Site, Richland, Washington; Information Bulletin; Signature Page; National Environmental Policy Act Categorical Exclusion Determination.

Hamrick, D. G., "Memorandum of Understanding - Plutonium-Uranium Extraction Plant Low-Specific Activity Nitric Acid Shipments," Letter to J. E. Mecca, Correspondence #9453904 (Richland, Washington: Westinghouse Hanford Company, June 3, 1994).

Hamrick, D. G., "Cold Standby Operating Specifications," OSD-P-154-00001, Rev. A-0 (Richland, Washington: Westinghouse Hanford Company, June 30, 1994).

Hamrick, D. G., "Permitting and Interim Status Requirements Associated with Deactivation of the Plutonium-Uranium Extraction Facility," Letter to J. E. Mecca, Correspondence #9454651D (Richland, Washington: Westinghouse Hanford Company, July 11, 1994).

Hamrick, D. G., "Request for the U.S. Department of Energy, Richland Operations Office (RL) Plateau Remediation Division Approval of the Uranium Trioxide (UO_3) Deactivation End Point Criteria," Letter to O. A. Farabee, Correspondence #9456181 (Richland, Washington: Westinghouse Hanford Company, September 15, 1994).

Hamrick, D. G., Jasen, W.G., and Harlow, D.G., "PUREX/UO_3 Deactivation Project Quarterly Review, October 31, 1994" (Richland, Washington: Westinghouse Hanford Company, October 31, 1994).

Harlow, D. G., "PUREX Transition to Standby Subprogram Plan," WHC-SD-CP-SSP-004, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, February 7, 1991).

Harlow, D. G., "Unreviewed Safety Question Procedure Changes," Internal memo 17700-94-017 (Richland, Washington: Westinghouse Hanford Company, June 9, 1994).

Harrow, D. G., "L-Cell Entry I," WP-P-90-020 (Richland, Washington: Westinghouse Hanford Company, July 5, 1990).

Harrow, D. G., "L-11 Criticality Drain Recovery Plan," WP-P-90-033 (Richland, Washington: Westinghouse Hanford Company, December 17, 1990).

Harty, D. P., "PUREX Stabilization Run," WHC-SD-CP-PE-014, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, August 1990).

Harty, D. P., "Flush L-Cell," WP-P-93-042 (Richland, Washington: Westinghouse Hanford Company, October 26, 1993).

Harty, D. P., "Disposition of PUREX Facility Tanks D5 and E6 Uranium and Plutonium Solutions," WHC-SP-1072 (Richland, Washington: Westinghouse Hanford Company, December 1993).

Harty, D. P., "Preliminary Support Activities for D5/E6 Flushing," WP-P-94-018 (Richland, Washington: Westinghouse Hanford Company, March 16, 1994).

Harty, D. P., "Transfer D5/E6 Material to Tank Farms," WP-P-94-022 (Richland, Washington: Westinghouse Hanford Company, April 6, 1994).

Harvey, D. W., "No Known Affected Historic Properties," Letter to W. J. Jasen (Richland, Washington: Pacific Northwest Laboratories, February 28, 1994).

Hauber, R. D. "U.S. Nuclear Regulatory Commission Export License," #XSNM02827 (Washington, DC: U.S. Nuclear Regulatory Commission, November 22, 1994).

Hobart, R. L., "SCD Effluent Heater Source Blanking, 202-A," WP-P-91-030 (Richland, Washington: Westinghouse Hanford Company, May 8, 1991).

Hobart, R. L., "CWL Flow Test," WP-P-92-035 (Richland, Washington: Westinghouse Hanford Company, June 5, 1992).

Hobart, R. L., "Chiller," WP-P-92-036 (Richland, Washington: Westinghouse Hanford Company, June 5, 1992).

Hobart, R. L., "CWL Effluent Heater Source Blanking, 202-A," WP-P-91-031 (Richland, Washington: Westinghouse Hanford Company, May 22, 1991).

Hobart, R. L., "PUREX HVAC Supply Air Data Collection," WP-P-93-036 (Richland, Washington: Westinghouse Hanford Company, October 12, 1993).

Hobart, R. L., "White Room Flow Diversion," WP-P-94-012 (Richland, Washington: Westinghouse Hanford Company, January 27, 1994).

Hodges, W. R., "Radiological History of the PUREX Facility, 1955 to 1989," TRAC-0672 (Richland, Washington: Westinghouse Hanford Company, August 1989).

Holt, R. G., "Applicability of WashingtonC 173-303 to Nitric Acid at PUREX and Planned Transfer to British Nuclear Fuels Ltd. (BNFL)," Letter to D. Lundstrom (Richland, Washington: U.S. Department of Energy, September 23, 1994), with Enclosure: "White Paper, Regulatory Status of Nitric Acid at PUREX identified in a contract for Use by BNFL."

Hughes, M. C., "PUREX Deactivation Criteria for Acceptance by Decontamination and Decommissioning (D&D)," WHC Internal Memo 85000-93-0012 (Richland, Washington: Westinghouse Hanford Company, March 25, 1993).

Hunter, J. R., "Beneficial Use of PUREX Plant Organic Solvent Inventory," Memorandum to T.F. Burns, 94-PPO-006 (Richland, Washington: U.S. Department of Energy, February 8, 1994).

Hunter, J. R., "Energy Policy Act of 1982 Impact Upon Proposal to Make PUREX LEU Nitric Acid Available for Use by Others," Letter to President, Westinghouse Hanford Company, Correspondence #94-PPO-016 (Richland, Washington: U.S. Department of Energy, March 31, 1994).

Independent Technical Review Team, "Independent Technical Review of the Hanford PUREX Plant Transition to Deactivation," (Washington, DC: U.S. Department of Energy, October 1992).

Industrial Safety and Fire Protection, "Industrial Safety Standards," WHC-CM-4-3, Vol 1 (Richland, Washington: Westinghouse Hanford Company, December 1987).

Industrial Safety and Fire Protection, "Industrial Safety Manual Safety Guides," WHC-CM-4-3, Vol 2 (Richland, Washington: Westinghouse Hanford Company, December 1987), and Manual Revision July 19, 1994.

Industrial Safety and Fire Protection, "Industrial Safety Manual," WHC-CM-4-3, Vol 3 (Richland, Washington: Westinghouse Hanford Company, December 1987), and Manual Revision May 25, 1993.

Jasen, W. G., "PUREX/UO_3 Deactivation Project Public Involvement Process" (Richland, Washington: Westinghouse Hanford Company, April 6, 1994).

Jensen, W. D., "Confirmation of Intended Reuse of Excess PUREX Material, OPE-CPP-BSA-94055," Memorandum to J.R. Hunter (Idaho Falls: U.S. Department of Energy, February 17, 1994).

Johnson, D. L., "Main Stack Flow Probe Examination," WP-P-93-022 (Richland, Washington: Westinghouse Hanford Company, May 25, 1993).

Johnson, D. L., "Main Stack Characterization Work Plan," WP-P-93-024 (Richland, Washington: Westinghouse Hanford Company, June 11, 1993).

Johnson, D. L., "Main Stack Measurement Validation Work Plan," WP-P-93-027 (Richland, Washington: Westinghouse Hanford Company, July 14, 1993).

Johnson, D. L., "Main Stack Sampler Installation for DOH," WP-P-93-033 (Richland, Washington: Westinghouse Hanford Company, September 21, 1993).

Johnson, D. L., "Flush F and U Cell Equipment," WP-P-94-015 (Richland, Washington: Westinghouse Hanford Company, February 7, 1994).

Johnson, L. E., "5480.23 Requirements Crosswalk (Strategy and Process), PUREX Deactivation Project Safety Strategy Workshop" (Richland, Washington: Westinghouse Hanford Company, June 11, 1993).

Johnson, L. E., N.R. Kerr, and R.L. Walser, "Crosswalk Documentation," (Richland, Washington: Westinghouse Hanford Company, June 1993).

KCM., Inc., "Westinghouse Hanford Company, PUREX/UO_3 Deactivation Project Modified Value Engineering Study" (Seattle, Washington: KCM, Inc., March 1994).

Kerr, N. R., "Results of 5480.23 Crosswalk: PUREX Deactivation Projects Safety Documentation Strategy" (Richland, Washington: Westinghouse Hanford Company, June 11, 1993).

Kerr, N. R., "Worker Health and Safety: PUREX Deactivation Projects Safety Documentation Strategy" (Richland, Washington: Westinghouse Hanford Company, June 11, 1993).

Lobsenz, G., "O'Leary OKs Contested Nitric Acid Sale," in Energy Daily (Washington, DC), Vol. 22, #200, October 19, 1994.

Los Alamos Technical Associates, "PUREX Hazards Identification Training" (Kennewick, Washington: Los Alamos Technical Associates, June 30, 1994)

Los Alamos Technical Associates, "PUREX Hazards Baseline Document" (Kennewick, Washington: Los Alamos Technical Associates, July 1, 1994).

Margolin, D., "U-Cell Preparation for NDE," WP-P-91-096 (Richland, Washington: Westinghouse Hanford Company, June 24, 1991).

Margolin, D., "NDE of U-Cell Waste Tank System," WP-P-91-097 (Richland, Washington: Westinghouse Hanford Company, June 24, 1991).

Margolin, D., "NDE of M-Cell Waste Tank System, ES F-11," WP-P-91-098 (Richland, Washington: Westinghouse Hanford Company, June 24, 1991).

Margolin, D., "M-Cell Prep Work (E5,F15," WP-P-91-104 (Richland, Washington: Westinghouse Hanford Company, July 22, 1991).

Matheison, W. E., "Facility Work Plan for Inhibiting CAS for Repair in PIV Rm," WP-P-93-032 (Richland, Washington: Westinghouse Hanford Company, September 20, 1993).

McBride, D. J., "Flush Duct from 291-AE to Exhaust Fan Plenum," WP-P-91-019 (Richland, Washington: Westinghouse Hanford Company, March 22, 1991).

McBride, D. J., "Sample Ductwork for Elevated main Stack Release," WP-P-91-101 (Richland, Washington: Westinghouse Hanford Company, June 27, 1991).

McElfresh, A. J., and K. A. Williams, "Lifting Yoke Slug Bucket," H-2-83605, Rev. 1 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and M. C. Hatch, "Fuel Rod Retrieval Device," H-2-83634, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and K. S. Williams, "Basket Yoke Assembly," H-1-50434, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and M. C. Hatch, "Slug Bucket Overpak Assembly," H-2-821814, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and M. C. Hatch, "Lifting Yoke Overpak Assembly and Details," H-2-821799, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and M. C. Hatch, "Fuel Grabber, Assembly and Details," H-2-821803.Sht 1 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and M. C. Hatch, "Fuel Grabber, Assembly and Details," H-2-821803.Sht 2 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and M. C. Hatch, "Fuel Grabber, Assembly and Details," H-2-821803.Sht 3 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and L. T. Aikin, "Canister Cover Installer, Assembly and Details," H2-821832 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and L. T. Aikin, "Canister Cover Installer Impact Wrench Extension," H-2-821833 (Richland, Washington: Westinghouse Hanford Company, 1994).

McElfresh, A. J., and L. T. Aikin, "Fuel Rod Wash Bucket Assembly," H2-821830 (Richland, Washington: Westinghouse Hanford Company, 1994).

McKenna, W. J., "UO_3 Completes Deactivation Milestone Ahead of Schedule," in Hanford Reach (Richland, Washington: Westinghouse Hanford Company, March 7, 1994).

Mecca, J. E., "Production Planning Assumptions for PUREX," Letter to Westinghouse Hanford Company, #9004625B (Richland, Washington: U.S. Department of Energy, October 1990).

Mecca, J. E., "PUREX Final Safety Analysis Report Upgrade," Letter to President, Westinghouse Hanford Company (Richland, Washington: U.S. Department of Energy, January 25, 1991).

Mecca, J. E., "Memorandum of Understanding - Plutonium Uranium Extraction Plant (PUREX) Low-Specific Activity Nitric Acid Shipments," Letter to D. G. Hamrick, Concurrence to Correspondence #9453904 (Richland, Washington: U.S. Department of Energy, June 17, 1994).

Mecca, J. E., "Permitting and Interim Status Requirements Associated with Deactivation of the Plutonium-Uranium Extraction Facility," Letter to D. L. Lundstrom (Richland, Washington: U.S. Department of Energy, 1994), with Enclosure 1: "PUREX Vessel Regulatory Status," Enclosure 2: "PUREX Process Codes and Descriptions," and Enclosure 3: "Justification for Excluding Certain Units from the PUREX Part A Permit Application."

Meehen, D., "Clean Out of Tanks TK-302 and TK-303," WP-UO-92-0061 (Richland, Washington: Westinghouse Hanford Company, August 18, 1992)

Midgett, J. C., "Sale of Plutonium-Uranium Extraction Plant Bulk Chemicals," Letter to J. E. Mecca, #9254568 (Richland, Washington: Westinghouse Hanford Company, June 23, 1992).

Midgett, J. C., "PUREX Project Management Plan Workshop" (Richland, Washington: Westinghouse Hanford Company, April 12-16, 1993).

Millward, G. E. "Safety Evaluation to Support the Planned UO_3 Stabilization Campaign," WHC-SD-CP-TA-005, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, April 1992).

Miska, C. R., and J. M. Siemer, "PUREX Preliminary Hazards Analysis," WHC-SD-CP-PHA-001 (Richland, Washington: Westinghouse Hanford Company, June 27, 1991).

Mueller, E. A., "CY-93 Shutdown Schedule," Internal Memo 17110-93-EAM-004 (Richland, Washington: Westinghouse Hanford Company, January 20, 1993).

Nelson, D. W., "L-Cell Entry Gross Characterization," WP-P-94-020 (Richland, Washington: Westinghouse Hanford Company, March 29, 1994).

Nuclear Safety and Radiological Analysis, "Non-Reactor Facility Safety Analysis Manual," WHC-CM-4-46, Rev. 10 (Richland, Washington: Westinghouse Hanford Company, August 3, 1994).

Nylander, D. C., "RE: Letter, J.D. Bauer to D. Butler, "Request for Concurrence with Emissions Evaluation for Approval of Deactivation of PUREX Plant Pursuant to WashingtonC 173-400 and 173-460," dated March 10, 1994," Letter to J. D. Bauer (Olympia, Washington: Washington State Department of Ecology, April 11, 1994).

O'Leary, H. R., "Disposition of Hanford Nitric Acid," Memorandum to T.P. Grumbly (Washington, DC: U.S. Department of Energy, October 11, 1994).

Pajunen, A. L., and R. L. Dirkes, "NOx Emissions from Hanford Nuclear Fuels Reprocessing Plants," RHO-CD-569 (Richland, Washington: Rockwell Hanford Operations, September 15, 1978).

Parkman, D. B., "Flushing and Draining AMU Tanks," WP-P-90-035 (Richland, Washington: Westinghouse Hanford Company, December 19, 1990).

Parkman, D. B., "Tank-207 (AFAN) Loadout," WP-P-91-001 (Richland, Washington: Westinghouse Hanford Company, January 8, 1991).

Parkman, D. B., "Raw Water and Air/Stream Sparger Isolation," WP-P-91-005 (Richland, Washington: Westinghouse Hanford Company, February 14, 1991).

Parkman, D. B., "Demin Water and TK Coil Isolation," WP-P-91-006 (Richland, Washington: Westinghouse Hanford Company, February 14, 1991).

Parkman, D. B., "Sampler Raw Water Isolation," WP-P-91-010 (Richland, Washington: Westinghouse Hanford Company, February 26, 1991).

Parkman, D. B., "Chemical Addition Isolation," WP-P-91-011 (Richland, Washington: Westinghouse Hanford Company, February 26, 1991).

Parkman, D. B., "Transfer TK-G7 to UGS," WP-P-91-012 (Richland, Washington: Westinghouse Hanford Company, February 27, 1991).

Parkman, D. B., "Transfer TK-F16 to UGS," WP-P-91-013 (Richland, Washington: Westinghouse Hanford Company, March 8, 1991).

Parkman, D. B., "Process Tank Isolation," WP-P-91-021 (Richland, Washington: Westinghouse Hanford Company, April 2, 1991).

Parkman, D. B., "Transfer NPH Drums to TK-55," WP-P-91-090 (Richland, Washington: Westinghouse Hanford Company, June 5, 1991).

Parkman, D. B., "KOH Loadout," WP-P-91-103 (Richland, Washington: Westinghouse Hanford Company, July 19, 1991).

Parkman, D. B., "SCD Isolation (Continue)," WP-P-91-108 (Richland, Washington: Westinghouse Hanford Company, July 31, 1991).

Parkman, D. B., "Tank Farm 215-A Isolation," WP-P-91-116 (Richland, Washington: Westinghouse Hanford Company, September 6, 1991).

Parkman, D. B., "Drain and Flush TK-50," WP-P-91-117 (Richland, Washington: Westinghouse Hanford Company, September 6, 1991).

Parkman, D. B., "Flush TK-151," WP-P-91-118 (Richland, Washington: Westinghouse Hanford Company, September 6, 1991).

Parkman, D. B., "Transfer TK-R1A to TK-G5," WP-P-91-152 (Richland, Washington: Westinghouse Hanford Company, December 10, 1991).

Parkman, D. B., "Drum Out NaOH," WP-P-91-154 (Richland, Washington: Westinghouse Hanford Company, December 26, 1991).

Parkman, D. B., "Flush TK-204 & N243 Header," WP-P-92-034 (Richland, Washington: Westinghouse Hanford Company, June 1, 1992).

Parkman, D. B., "Applicability of PUREX Operational Safety Requirements During Shutdown/Standby," WHC-SD-CP-OSR-006, Rev. 2 (Richland, Washington: Westinghouse Hanford Company, June 18, 1992).

Parkman, D. B., "Organic Removal From P-Tanks," WP-P-92-048 (Richland, Washington: Westinghouse Hanford Company, July 27, 1992).

Parkman, D. B., "Flushing the UNH Concentration System," WP-UO-93-004 (Richland, Washington: Westinghouse Hanford Company, April 30, 1993).

Parkman, D. B., "Flush the Acid Recovery System," WP-UO-93-005 (Richland, Washington: Westinghouse Hanford Company, April 30, 1993).

Parkman, D. B., "Transfer TK-X-30 and TK-C-2 to TK-C-1," WP-UO-93-013 (Richland, Washington: Westinghouse Hanford Company, July 26, 1993).

Parkman, D. B., "Flush K-Cell," WP-P-93-037 (Richland, Washington: Westinghouse Hanford Company, October 18, 1993).

Parkman, D. B., "Flush Cladding Waste Cycle," WP-P-93-045 (Richland, Washington: Westinghouse Hanford Company, November 2, 1993).

Parkman, D. B., "Flush G and R Cells," WP-P-93-053 (Richland, Washington: Westinghouse Hanford Company, December 14, 1993).

Parkman, D. B., "Flush HA Column and Associated Equipment," WP-P-94-003 (Richland, Washington: Westinghouse Hanford Company, January 10, 1994).

Peiffer, W. A., "Meeting Minutes, PUREX Deactivation Project Safety Strategy Workshop" (Richland, Washington: Westinghouse Hanford Company, June 11, 1993).

Pontius, A., Letter to J. E. Rasmussen (Seattle, Washington: U.S. Environmental Protection Agency, August 25, 1993).

Praga, A. N., "M-Cell Prep Work (F16,F18)," WP-P-91-110 (Richland, Washington: Westinghouse Hanford Company, August 16, 1991).

Praga, A. N., "NDE of M-Cell Waste Tanks (F16,F18)," WP-P-91-111 (Richland, Washington: Westinghouse Hanford Company, August 16, 1991).

Project Software and Development, Inc., "PUREX/UO_3 Facilities Transition Scheduling Review" (Cambridge, MA: Project Software and Development, Inc., 1993).

Project Software and Development, Inc., "Project Management: PUREX/UO_3 Outage Planning" (Cambridge, MA: Project Software and Development, Inc., July 1993).

Project Time & Cost, Inc., "PUREX/UO_3 Deactivation Project," Estimate Revision 1.3 (Atlanta, GA: Project, Time & Cost, Inc., December 1, 1993).

PUREX Effluent Systems, "BiWeekly Briefing Report, 1-13-90 to 2-9-90," Internal Memo 12124-90-11 (Richland, Washington: Westinghouse Hanford Company, February 16, 1990).

PUREX Effluent Systems, "BiWeekly Report for Period Ending April 6, 1990," Internal Memo 12124-90-25 (Richland, Washington: Westinghouse Hanford Company, April 9, 1990).

PUREX Effluent Systems, "Bi-Weekly Report for Period Ending April 20, 1990," Internal Memo 12124-90-29 (Richland, Washington: Westinghouse Hanford Company, April 24, 1990).

PUREX Effluent Systems, "Monthly Report for June," Internal Memo 12124-90-41 (Richland, Washington: Westinghouse Hanford Company, June 21, 1990).

PUREX Effluent Systems, "Bi-Monthly Briefing," Internal Memo 12124-90-44 (Richland, Washington: Westinghouse Hanford Company, July 6, 1990).

PUREX Effluent Systems, "Monthly Report for July," Internal Memo 12124-90-49 (Richland, Washington: Westinghouse Hanford Company, July 20, 1990).

PUREX Effluent Systems, "Monthly Report for September," Internal Memo 17523-90-58 (Richland, Washington: Westinghouse Hanford Company, September 19, 1990).

PUREX Effluent Systems, "Bi-Monthly Report," Internal Memo 17523-90-61 (Richland, Washington: Westinghouse Hanford Company, October 5, 1990).

PUREX Effluent Systems, "October Monthly Report," Internal Memo 17523-90-66 (Richland, Washington: Westinghouse Hanford Company, October 23, 1990).

PURREX Effluent Systems, "Monthly Report for November," Internal Memo 17523-90-78 (Richland, Washington: Westinghouse Hanford Company, November 19, 1990).

PUREX Effluent Systems, "Bi-Weekly Report for November," Internal Memo 17523-90-85 (Richland, Washington: Westinghouse Hanford Company, December 7, 1990).

PUREX Effluent Systems, "Monthly Report, January," Internal Memo 17523-91-02 (Richland, Washington: Westinghouse Hanford Company, January 17, 1991).

PUREX Effluent Systems, "Monthly Report for February 1991," Internal Memo 17523-91-11 (Richland, Washington: Westinghouse Hanford Company, February 19, 1991).

PUREX Effluent Systems, "Monthly Report for April 1991," Internal Memo 17523-91-30 (Richland, Washington: Westinghouse Hanford Company, April 15, 1991).

PUREX Effluent Systems, "Monthly Report for May 1991," Internal Memo 17523-91-040 (Richland, Washington: Westinghouse Hanford Company, May 20, 1991).

PUREX Effluent Systems, "Monthly Report for June 1991," Internal Memo 17523-91-049 (Richland, Washington: Westinghouse Hanford Company, June 18, 1991).

PUREX Effluent Systems, "PUREX Raw Water Pipe Rupture," Internal Memo 17523-91-065 (Richland, Washington: Westinghouse Hanford Company, August 8, 1991).

PUREX Effluent Systems, "Monthly Report for August 1991," Internal Memo 17523-91-066 (Richland, Washington: Westinghouse Hanford Company, August 19, 1991).

PUREX Effluent Systems, "Operational Excellence - October 1991," Internal Memo 17523-91-083 (Richland, Washington: Westinghouse Hanford Company, October 18, 1991).

PUREX Effluent Systems, "Operational Excellence Report - November 1991," Internal Memo 17523-91-091 (Richland, Washington: Westinghouse Hanford Company, November 18, 1991).

PUREX Effluent Systems, "Operational Excellence Report - February 1992" Internal Memo 17523-92-007 (Richland, Washington: Westinghouse Hanford Company, February 18, 1992).

PUREX Effluent Systems, "Operational Excellence Report - March 1992" Internal Memo 17523-92-009 (Richland, Washington: Westinghouse Hanford Company, March 16, 1992).

PUREX Effluent Systems, "Operational Excellence Report - April 1992" Internal Memo 17523-92-015 (Richland, Washington: Westinghouse Hanford Company, April 21, 1992).

PUREX Effluent Systems, "Operational Excellence Report - May 1992" Internal Memo 17523-92-022 (Richland, Washington: Westinghouse Hanford Company, May 19, 1992).

PUREX Effluent Systems, "Operational Excellence Report - June 1992" Internal Memo 17523-92-028 (Richland, Washington: Westinghouse Hanford Company, June 17, 1992).

PUREX Effluent Systems, "Operational Excellence Report - July 1992" Internal Memo 17523-92-034 (Richland, Washington: Westinghouse Hanford Company, July 23, 1992).

PUREX Effluent Systems, "Operational Excellence Report - August 1992" Internal Memo 17523-92-040 (Richland, Washington: Westinghouse Hanford Company, August 18, 1992).

PUREX Effluent Systems, "Operational Excellence Report - September 1992" Internal Memo 17523-92-047 (Richland, Washington: Westinghouse Hanford Company, September 16, 1992).

PUREX Effluent Systems, "Operational Excellence Report - November 1992" Internal Memo 17523-92-061 (Richland, Washington: Westinghouse Hanford Company, December 10, 1992).

PUREX Engineering Support, "Chapter 11 Implementation Plan for Revision 6 of the PUREX Final Safety Analysis Report," WHC-SD-CP-RD-021 (Richland, Washington: Westinghouse Hanford Company, 1991).

PUREX Process Control, "PUREX Plant Operations Safety Requirements," RHO-CD-1540 (Richland, Washington: Rockwell Hanford Operations, September 30, 1981).

PUREX System Deactivation Engineering, "L Cell Floor Plutonium Estimates," Internal memo 17710-94-020 (Richland, Washington: Westinghouse Hanford Company, October 19, 1994).

PUREX/UO_3 Operations, "PUREX/UO_3 Plant Administration," WHC-CM-5-9, Rev. 48 (Richland, Washington: Westinghouse Hanford Company, April 4, 1994).

Quik-Net Graphics, "PUREX Master Logic Network" (Richland, Washington: Westinghouse Hanford Company, August 17, 1993).

Rasmussen, J. E., "Request for Concurrence with Interpretation of Applicability of Permit PSD-X80-14 to Deactivation of PUREX Facility," Letter to A. Pontius, Correspondence #9307041 (Richland, Washington: U.S. Department of Energy, July 29, 1993), with Enclosure #1: "PUREX Goal Statement," Enclosure #2: Dubois, "Approval of Application to Construct No. PSD-XOO-14," and Enclosure #3: Pajunen and Dirkes, RHO-CD-569.

Rasmussen, J. E., "UO_3 Plant Storm Water Modification Information," Letter to A. W. Conklin, Correspondence #9455363D (Richland, Washington: U.S. Department of Energy, August 1994), with Enclosure: "UO_3 Plant Storm Water Modification Information."

Rasmussen, J. E., "Applicability of WashingtonX 173-303 to Nitric Acid at PUREX and Planned Transfer to British Nuclear Fuels Ltd. (BNFL)," Letter to D. L. Lundstrom, Correspondence #94-PCA-053 (Richland, Washington: U.S. Department of Energy, September 23, 1994), with Enclosure: "Whitepaper: Regulatory Status of Nitric Acid at PUREX Identified in a Contract for Use by BNFL."

Rasmussen, J. H., "Clean Out ED-6 Concentrator," WP-UO-93-015 (Richland, Washington: Westinghouse Hanford Company, October 4, 1993).

Rasmussen, J. H., "Powder Handling System Cleanout," WP-UO-93-014 (Richland, Washington: Westinghouse Hanford Company, January 13, 1994).

Rasmussen, J. H., "Flush Out Neutralization System," WP-UO-94-012 (Richland, Washington: Westinghouse Hanford Company, September 22, 1994).

Reberger, D. W., "PUREX Product Removal Room Upgrade," RHO-CD-1418 (Richland, Washington: Rockwell Hanford Operations, April 1981).

Reberger, D. W., "TBP Spill Clean-Up, 211-A," WP-P-90-021 (Richland, Washington: Westinghouse Hanford Company, July 6, 1990).

Reberger, D. W., "D4 Solids Sampling," WP-P-90-028 (Richland, Washington: Westinghouse Hanford Company, August 28, 1990).

Reberger, D. W., "PM on 4 80 V West Normal #1 Cubicle 9A," WP-P-91-034 (Richland, Washington: Westinghouse Hanford Company, June 6, 1991).

Reinkens, M. M., "PUREX/UO_3 Weekly Status Report, 9/20/94" (Richland, Washington: Westinghouse Hanford Company, September 20, 1994).

Reinkens, M. M., "PUREX/UO_3 Weekly Status Report, 9/27/94" (Richland, Washington: Westinghouse Hanford Company, September 27, 1994).

Reinkens, M. M., "PUREX/UO_3 Weekly Status Report, 10/4/94" (Richland, Washington: Westinghouse Hanford Company, October 4, 1994).

Risenmay, H. R., "TK-05 Isolation and Restoration," WP-P-90-005 (Richland, Washington: Westinghouse Hanford Company, March 15, 1990).

Risenmay, H. R., "TK-05 Tank and Dip Tube Flush for Calibration," WP-P-90-006 (Richland, Washington: Westinghouse Hanford Company, March 15, 1990).

Risenmay, H. R., "TK-D5 Calibration," WP-P-90-007 (Richland, Washington: Westinghouse Hanford Company, March 15, 1990).

Risenmay, H. R., "TK-E5 Calibration," WP-P-90-008 (Richland, Washington: Westinghouse Hanford Company, April 9, 1990).

Risenmay, H. R., "TK-F15 Calibration," WP-P-90-010 (Richland, Washington: Westinghouse Hanford Company, April 12, 1990).

Risenmay, H. R., "TK-F18 Calibration," WP-P-90-011 (Richland, Washington: Westinghouse Hanford Company, April 25, 1990).

Risenmay, H. R., "TK-F16 Integrity Assessment," WP-P-90-012 (Richland, Washington: Westinghouse Hanford Company, May 2, 1990).

Risenmay, H. R., "TK-A3-4 Integrity Assessment," WP-P-90-013 (Richland, Washington: Westinghouse Hanford Company, May 3, 1990).

Risenmay, H. R., "TK-B3-4 Integrity Assessment," WP-P-90-015 (Richland, Washington: Westinghouse Hanford Company, May 7, 1990).

Risenmay, H. R., "TK-C3-4 Integrity Assessment," WP-P-90-016 (Richland, Washington: Westinghouse Hanford Company, May 7, 1990).

Risenmay, H. R., "TK-E3-2 Integrity Assessment," WP-P-90-017 (Richland, Washington: Westinghouse Hanford Company, May 8, 1990).

Risenmay, H. R., "TK-F12 Integrity Assessment," WP-P-90-018 (Richland, Washington: Westinghouse Hanford Company, June 29, 1990).

Risenmay, H. R., "E-F11 Integrity Assessment," WP-P-90-022 (Richland, Washington: Westinghouse Hanford Company, July 11, 1990).

Risenmay, H. R., "TK-G7 Integrity Assessment," WP-P-90-024 (Richland, Washington: Westinghouse Hanford Company, July 23, 1990).

Risenmay, H. R., "TK-U3 Integrity Assessment," WP-P-90-025 (Richland, Washington: Westinghouse Hanford Company, July 27, 1990).

Risenmay, H. R., "TK-U4 Integrity Assessment," WP-P-90-026 (Richland, Washington: Westinghouse Hanford Company, July 27, 1990).

Risenmay, H. R., "TK-G6 Calibration," WP-P-90-029 (Richland, Washington: Westinghouse Hanford Company, August 30, 1990).

Risenmay, H. R., "Pump S-PA & S-PC Pumps to CSL," WP-P-91-004 (Richland, Washington: Westinghouse Hanford Company, February 6, 1991).

Risenmay, R. R., "Applicability of PUREX Operational Safety Requirements During Shutdown/Standby," WHC-SD-CP-OSR-006, Rev. 1 (Richland, Washington: Westinghouse Hanford Company, February 6, 1991).

Risenmay, H. R., "Calciner Clean Out," WP-UO-93-006 (Richland, Washington: Westinghouse Hanford Company, May 10, 1993).

Risenmay, H. R., "H Calciner Clean Out," WP-UO-0055 (Richland, Washington: Westinghouse Hanford Company, January 19, 1994).

Risenmay, H. R., "UO_3 Plant Instrument Inactivation," WP-UO-94-002 (Richland, Washington: Westinghouse Hanford Company, February 22, 1994).

Risenmay, H. R., "Clean Acid Header Drop Legs," WP-UO-94-010 (Richland, Washington: Westinghouse Hanford Company, May 26, 1994).

Roemer, J. J., "PUREX Plant Final Safety Analysis Report," RHO-SD-HS-SAR-001 (Richland, Washington: Rockwell Hanford Operations, 1983).

Roemer, J. J., "PUREX Plant Final Safety Analysis Report, Rev. 5" WHC-SD-HS-SAR-001, Rev. 5 (Richland, Washington: Westinghouse Hanford Company, 1990).

Romsos, M. R., "Uniform Hazardous Waste Manifest," No. A3229 (Richland, Washington: U.S. Department of Energy, August 1993).

Sheehan, J. S., "Work Plan (Drum Repack)," WP-P-90-014 (Richland, Washington: Westinghouse Hanford Company, May 7, 1990).

Shrivastava, N., "Removal of Small Equipment from N-Cell Glove Boxes," WP-P-93-039 (Richland, Washington: Westinghouse Hanford Company, October 22, 1993).

Shrivastava, N., "Flush N-Cell Closed Loop Cooling System," WP-P-94-017 (Richland, Washington: Westinghouse Hanford Company, February 28, 1994).

Sivula, C., "Lab Fight a Battle in War Over Cleanup Schedule" in Tri-City Herald, September 23, 1992, p. A8.

Slaathaug, E. J., "Installation of Heaters in Tank 34," WP-P-90-032 (Richland, Washington: Westinghouse Hanford Company, December 7, 1990).

Slaathaug, E. J., "Flushing and Draining of P&O Gallery Headers," WP-P-90-034 (Richland, Washington: Westinghouse Hanford Company, December 19, 1990).

Spent Nuclear Fuel Project, "Hanford Spent Nuclear Fuel Project Recommended Path Forward," WHC-EP-0830 (Richland, Washington: Westinghouse Hanford Company, October 1994).

Stanley, R., and T. Tebb, "Federal Frailty Agreement and Consent Order Change Control Form," Change #M-80-94-01 Draft (Olympia, Washington: Washington State Department of Ecology, September 28, 1994).

Stefanski, L. D., UO_3 Deactivation End Point Criteria," WHC-SD-WM-TPP-052, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, September 1994).

Tardiff, G. R., "Process Tank Isolation," WP-P-91-017 (Richland, WA: Westinghouse Hanford Company, March 20, 1991).

Tardiff, G. R., "Neutralization of Oxalate Ion in TK-E6," WP-P-91-141 (Richland, Washington: Westinghouse Hanford Company, October 18, 1991).

"The Navy Will Be Able To Send Spent Fuel to INEL," in Nuclear News (LaGrange, IL), Vol. 36, #11, September 1993, pp. 83-84.

Thompson, R. J., "PUREX Environmental/Waste Management Subprogram Plan," WHC-SD-CP-SSP-006, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, March 11, 1991).

U.S. Department of Energy, "PUREX Storage Tunnels Dangerous Waste Permit Application," DOE/RL-90-24, Rev. 1 (Richland, Washington: U.S. Department of Energy, December 1991).

U.S. Department of Energy, "Draft Environmental Impact Statement, Operation of PUREX and Uranium Oxide Facilities," DOE/EIS-0089D (Richland, Washington: U.S. Department of Energy, May 1982).

U.S. Department of Energy, "Hanford Facility Dangerous Waste Part A Permit Application," Form 3, Rev. 2, for the PUREX Plant, DOE/RL-88-21 (Richland, Washington: U.S. Department of Energy, 1992).

U.S. Department of Energy, "Addendum to Environmental Impact Statement, Operation of PUREX and Uranium Oxide Facilities," DOE/EIS-0089 (Richland, Washington: U.S. Department of Energy, February 1983).

U.S. Department of Energy, "Headquarters Public Participation Implementation Plan" (Washington, DC: U.S. Department of Energy, 1994).

U.S. Department of Energy, "PUREX/UO_3 Plant Deactivation: The Transition to Decontamination and Decommissioning" (Richland, Washington: U.S. Department of Energy, March 1994).

U.S. Department of Energy, "Environmental Assessment: Disposition and Transportation of Surplus Low Specific Activity Nitric Acid," DOE/EA-1005 (Richland, Washington: U.S. Department of Energy, November 1994).

Von Bargen, B. H., "TK-R1 Oxalic-HNO3 Flush," WP-P-90-019 (Richland, Washington: Westinghouse Hanford Company, July 2, 1990).

Wagoner, J. D., "PUREX/UO_3 Deactivation Project National Environmental Policy Act (NEPA) Compliance Strategy," U.S. Department of Energy Memorandum 93-PPO-002 (Richland, Washington: U.S. Department of Energy, December 2, 1993).

Wagoner, J. D., "Approval of Hanford PUREX Authorization Basis for Deactivation," Letter to President, Westinghouse Hanford Company, 94-PPO-001 (Richland, Washington: U.S. Department of Energy, March 2, 1994).

Wagoner, J. D., "Categorical Exclusion for Disposal of Tri-N-Butylphosphate for the Plutonium-Uranium Extraction Facility, 200 East Area, Hanford Site, Richland, Washington," Letter to R. H. Engelmann, Correspondence #9404847 (Richland, Washington: U.S. Department of Energy, August 2, 1994).

Walser, R. L., "PUREX Process Control Manual," WHC-CM-5-24, Addendum 1 (was RHO-RE-MA-5) (Richland, Washington: Westinghouse Hanford Company, 1991).

Walser, R. L., "Application of Standardized Operational Safety Requirement Criteria to PUREX Operational Safety Criteria," WHC-SD-CP-RD-020 (Richland, Washington: Westinghouse Hanford Company, September 1991).

Walser, R. L., "PUREX Process Control Manual," WHC-CM-5-24, Rev. 18 (Richland, Washington: Westinghouse Hanford Company, December 1992).

Walser, R. L., "Safety Analysis Strategy" (Richland, Washington: Westinghouse Hanford Company, April 14, 1993).

Walser, R. L., "OSR Applicability Statements for PUREX Plant Deactivation: PUREX Deactivation Project Safety Strategy Workshop" (Richland, Washington: Westinghouse Hanford Company, June 11, 1993).

Walser, R. L., "Application of the Unreviewed Safety Question Process to Non-Reactor Nuclear Facilities: PUREX Deactivation Project" (Richland, Washington: Westinghouse Hanford Company, June 11, 1993).

Wendt, K. M., "Agreement by DOE-ID and the Idaho Department of Health and Welfare for Receiving Organic Solvent from the Hanford Reservation as Fuel for the Idaho Chemical Processing Plant (ICPP) Calciner," Memorandum to M.B. Hinman (Idaho Falls: Westinghouse Idaho Nuclear Company, Inc., August 31, 1993).

Werner, J. D., and S. Taub, "Disposition of PUREX Plant Nitric Acid: Technical, Cost and Policy Issues," Memorandum to W.W. Bixby (Washington, DC: U.S. Department of Energy, August 16, 1994).

WHC, "Cold Standby Operating Specifications," OSD-P-154-00001 (Richland, Washington: Westinghouse Hanford Company, 1991).

WHC, "PUREX/UO_3 Deactivation Project Management Plan," WHC-SP-1011D (Richland, Washington: Westinghouse Hanford Company, September 1993).

Westinghouse Hanford Company Air and Water Permits, "Activity Report for Week Ending March 18, 1994," WHC Internal Memo 88300-94-041 (Richland, Washington: Westinghouse Hanford Company, March 18, 1994).

Westinghouse Hanford Company Traffic Operations "U.S. Department of Energy LSA/Nitric Acid Transportation Plan to British Nuclear Fuels, Ltd." (Richland, Washington: Westinghouse Hanford Company, June 7, 1994).

WHC, "PUREX/UO_3 Deactivation Project Management Plan," WHC-SP-1011, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, August 1994).

WHC, "Agreement Between BNFL, Inc. and Westinghouse Hanford Company for the Use of PUREX LSA Nitric Acid," WHC Subcontract No. MAR-SVV-382237 (Richland, Washington: Westinghouse Hanford Co, October 24, 1994).

WHC, "Data Quality Objective for PUREX Deactivation Flushing," WHC-SD-EN-TI-283, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, January 1995).

Westra, A. G., and Willis, W. L., "UO_3 Plant Terminal Cleanout and Deactivation Plan," WHC-SD-CP-SSP-008, Rev. 0 (Richland, Washington: Westinghouse Hanford Company, July 1993).

Westra, A. G., Tardiff, G. R., and Shrivastava, N., "N-Cell Deactivation Study," WHC-SD-CP-ES-159 (Richland, Washington: Westinghouse Hanford Company, November 1993).

Westra, A. G., "Flush and Deactivate Type C Samples," WP-P-94-004 (Richland, Washington: Westinghouse Hanford Company, January 10, 1994).

Westra, A. G., "Stabilize and Deactivate Type B&B Modified Samples," WP-P-94-005 (Richland, Washington: Westinghouse Hanford Company, January 10, 1994).

Westra, A. G., "Stabilize and Deactivate Type A&A Modified Samples," WP-P-94-006 (Richland, Washington: Westinghouse Hanford Company, January 10, 1994).

Westra, A. G., "Flush Recovered Acid Headers," WP-P-94-034 (Richland, Washington: Westinghouse Hanford Company, September 1, 1994).

Wiley, K. L., "Meeting Minutes: PUREX Deactivation Regulatory Workshop" (Richland, Washington: Westinghouse Hanford Company, April 22, 1993).

Wisness, S. H., "Toxic Air Pollutant Inventory for Deactivation of the Plutonium Uranium Extraction Plant," Letter to D. C. Nylander, Correspondence #9400891 (Richland, Washington: U.S. Department of Energy, May 12, 1994), with Enclosure: "TAPs Inventory in Pipe and Operating Gallery, Deactivation Vs. Operation."

Wisness, S. H., "Response to Voluntary Compliance Letter Concerning Organic Waste in a Tank Trailer at the Plutonium-Uranium Extraction Facility," Letter to D. L. Lundstrom, Correspondence # 9404281 (Richland, Washington: U.S. Department of Energy, June 28, 1994).

Woodworth, H. R., "Changeout Pre-filter PR Room Exhaust," WP-P-91-023 (Richland, Washington: Westinghouse Hanford Company, April 16, 1991).

Woodworth, H. R., "Disassembly of EF-V11-01 Fan," WP-P-91-033 (Richland, Washington: Westinghouse Hanford Company, May 29, 1991).

Woodworth, H. R., "Reassembly of EF-1-/EF-V11-1 Fan," WP-P-91-099 (Richland, Washington: Westinghouse Hanford Company, June 26, 1991).

Woodworth, H. R., "Reassembly of SF-V10-1A/SF-1A," WP-P-91-102 (Richland, Washington: Westinghouse Hanford Company, July 12, 1991).

Woodworth, H. R., "Exhaust Plenum Entry Decon," WP-P-91-146 (Richland, Washington: Westinghouse Hanford Company, November 18, 1991).

Yasutake, K. M., "UO_3 Plant Safety Analysis Report," RHO-SD-CP-SAR-002 (Richland, Washington: Rockwell Hanford Operations, September 1983).

Young, K. J., "Assessment of Dangerous Waste Pipe in U-Cell," WP-P-91-113 (Richland, Washington: Westinghouse Hanford Company, August 28, 1991).

Young, K. J., "Assessment of Dangerous Waste Piping in the Lab," WP-P-91-125 (Richland, Washington: Westinghouse Hanford Company, September 16, 1991).

Young, K. J., "Assessment of Dangerous Waste Piping in U-Cell Sumps," WP-P-91-134 (Richland, Washington: Westinghouse Hanford Company, October 1, 1991).

Young, K. J., "Assessment of Dangerous Waste Piping From F-18," WP-P-91-142 (Richland, Washington: Westinghouse Hanford Company, October 22, 1991).

Young, K. J., "Assessment of Dangerous Waste Piping From F-16," WP-P-91-143 (Richland, Washington: Westinghouse Hanford Company, October 25, 1991).

Young, K. J., "Assessment of Dangerous Waste Piping in E-Cell," WP-P-91-145 (Richland, Washington: Westinghouse Hanford Company, October 31, 1991).

Young, K. J., "Assessment of TK-U3, U4 Supports," WP-P-92-011 (Richland, Washington: Westinghouse Hanford Company, March 5, 1992).

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L. C. Zinsli	T7-20
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