# END POINT IMPLEMENTATION EXAMPLES

## End Point Implementation Examples

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## General Cleanup

General cleanup refers to minimizing the remaining "loose junk" left in the facility after deactivation. A reasonable best effort should be applied. This includes removal of items such as desks, chairs, vending machines, and stoves. Some equipment in a facility may be of use elsewhere in the government or may be sold on the commercial market. Decisions to pursue this must be cost beneficial. While these types of items may have resale or scrap value, the primary motivation is to remove items that either are potential tripping and bumping hazards for surveillance workers, or may become contaminated with minor migration. Further, the cost of disposal of contaminated items becomes more expensive with time.

Housekeeping from a standpoint of sweeping or mopping floors one last time should not necessary. However, it should be realized that sand, dirt, and debris could become a means for contamination migration.

**Hanford UO3 Plant General Cleanup**

**General Cleanup – SRS Metallurgical Lab**

**HANFORD $UO_3$ PLANT GENERAL CLEANUP**

Housekeeping routines for facilities being deactivated at Hanford were not much different from those for an operating facility. The principal objectives were to minimize hazards, to reuse serviceable equipment, to facilitate post-deactivation S&M, and to reduce downstream complications for the decommissioning contractor. At the UO3 plant, the deactivation housekeeping philosophy was two-pronged:

1. If something wasn't needed, it was disposed of without delay, because it would cost more to dispose of it later.
2. If something was easily removable -- defined as "capable of being picked up without tools"-- it was removed, either to be reused or to be discarded as waste.

Examples of reusable items removed from the UO3 plant included uncontaminated tools, jumpers[1] , telephones, status boards, a refrigerator, and a stove.

Housekeeping in a contaminated facility, such as the UO3 plant, posed the additional constraints of proper waste packaging and disposal, along with their attendant costs. Therefore, contaminated trash and some articles were removed, however, there was no general decontamination of contaminated surfaces.

Contaminated tools were retained for reuse and formally transferred to other contaminated facilities. Portable welding machines that were used in the UO3 plant were considered internally contaminated, because of the internal fan's intake of the facility's atmosphere; these were also formally transferred to other contaminated facilities.

**GENERAL CLEANUP – SRS METALLURGICAL LAB**

During the first and second quarters of FY95, the 322-M Metallurgical Laboratory was removed from operations and transitioned to a non-operating, inactive facility. At that time, a transition team was formed, a formal plan was prepared, systems were shutdown and clean-up initiatives where undertaken to deactivate the facility based on general knowledge of the hazards in the facility and good environmental stewardship. Though without formal DOE guidance, these initiatives placed the facility in a stable and safe condition for short-term surveillance and maintenance.

The following major equipment or classes of components were removed from the facility and released for reuse. No problems or difficulties were encountered in performing the release. Also summarized below are the bulk quantities of salvaged material.

| Type of Equipment/Material | Amount |
|---|---|
| Office furniture | 10 desks, 10 file cabinets, 5 tables |
| Fluorescent light fixtures | 12 2-tube, 62 4-tube |
| Exit Signs | 2 battery operated, 7 tritium powered |
| Fire Detection System | 16 smoke detectors, 2 fire alarm panels |
| Air Conditioners | 4 window units |
| Scrap Metal | 855 cubic feet |
| Emergency Light Ballasts | 7 nickel-cadmium |

Since the focus of the 322-M deactivation was stabilization with no demolition and minor cleanup, the generation of waste was minimal. Therefore, the focus of the pollution prevention and waste minimization measures taken to reduce the volume of waste sent to disposal during the 322-M deactivation was the reuse or recycling of as much material as possible. This included removal of ceiling panels and carpet tiles that were degraded due to mold growth resulting from increased levels of moisture since the HVAC was shutdown.

| Type of Waste | Amount |
|---|---|
| Fluorescent light ballasts w/ PCB contaminated oil | 112 |
| Rubble including carpet tiles (non-contaminated) | 400 cubic feet |
| Job Control Waste (radiologically contaminated) | 8 LLW bags (240 pounds) |
| Carpet Tiles (radiologically contaminated) | 6 LLW bags (180 pounds) |

## Decontamination Decisions

With respect to a facility's internally or externally contaminated surfaces, decisions will have to be made concerning appropriate decontamination efforts, including flushing, if any, prior to deactivation. A tradeoff point can be projected at which decontamination efforts would result in rapidly escalating decontamination waste products control, collection, packaging, and disposal costs. Experience has shown that in many locations within a facility, decontamination is not warranted for deactivation.

To avoid carrying decontamination efforts beyond a point of diminishing returns, end points need to be established. Unless there is a requirement to achieve free release, decontamination tasks need to have very clear reasons and requirements stated which are in support of either other deactivation work or post-deactivation S&M activities.

Decisions to decontaminate areas by flushing will depend on the hazard represented to post-deactivation S&M workers and possibly to future decommissioning workers. This must be carefully considered. Because of natural decay, radiation exposure for such actions can only be more during deactivation than that to which decommissioning workers will be subjected. (A possible exception for some facilities is the buildup of Am-241 from the decay of Pu-241). Therefore, unless there are some other factors at work, such as deterioration of a physical structure and the attendant release of contamination or the need to take advantage of the knowledge of the operations staff, it may be preferable to defer decontamination activities.

System flushing decisions are different than area decontamination because there may be additional requirements. Nevertheless, decisions to decontaminate systems by flushing should also be carefully considered. Some considerations are:

- Chemical hazards to post-deactivation S&M workers and, more importantly, to future decommissioning workers.
- Environmental regulations that govern hazardous materials and allowable residuals.
- Contribution of radioactively contaminated systems (hot spots) to high exposure rates in nearby corridors where access is required.
- Where a knowledge of system operation is important, it may be prudent to conduct flushing while the experienced staff is available.
- Where the structural boundary of the system is not expected to last through the S&M period and the consequences of a breach is not acceptable.

Each facility will require preparation of its own specific cleanout, draining and flushing procedures. The issue of "How clean is clean enough for the deactivation campaign?" must be reflected in the post-cleanout flushing and sampling regime chosen for that equipment or facility.

Flushing should be done until samples, measurements, and/or past experience indicate that the residual contamination (hazardous or radioactive) has been decreased to below concentrations which meet the specified requirements. The DQO (Data Quality Objectives) process for sampling and evaluation of results can be applied to avoid excessive sampling and measurements.

**Decision on Hanford PUREX Canyon Flush**

**Equipment Cleanout and Decontamination at Hanford $UO_3$ Plant**

**Exterior and Interior Contamination Areas – SRS Metallurgical Lab**

## DECISION ON HANFORD PUREX CANYON FLUSH

The original deactivation plan for PUREX called for three "canyon flushes" which would have required about a year of schedule and would generate substantial quantities of flush water to be processed. The original rationale was that "the flush nozzles were there, so why not." The aim was to remove radioactive contamination.

PUREX staff revisited this decision because there was no quarterly access planned for the canyon areas during post-deactivation S&M. In addition, it was difficult to first, establish an allowable residual contamination criterion as to when they could call flushing complete, and second, to be able to demonstrate that any such criterion would have been satisfied.

As a result, the canyon flushes were eliminated as a deactivation task.

## EQUIPMENT CLEANOUT AND DECONTAMINATION AT HANFORD $UO_3$ PLANT

The UO3 plant went through a cleanout campaign for deactivation of the facility. The cleanout was conducted in three phases:

- Phase I, an extension of operations, consisted of the removal of residual process material and the deactivation of most process equipment and instrumentation.
- Phase II consisted of the fixing or removal of contamination so storm water processing would no longer be required.
- Phase III consisted of the remaining activities that had to be completed before the facility could be turned over to the Surplus Facility Program.

Since the activities in Phases II and III were closely related, they were worked concurrently. Each cleanout and flushing campaign was completed under a detailed work procedure.

### Cleanout of Tanks TK-306-U, TK-307-U, and TK-308-U (Phase I)

These tanks comprised part of the 211-U Tank Farm. They were used to store nitric acid (50% in strength, 10 M) produced as a byproduct from the UO3 process. The volume of each tank is 100,000 gallons. The steps were:

1. The initial step in the flushing of these tanks was a cascade flushing using approximately 2,500 gallons of collected rainwater runoff stored in the first tank in the cascade. As the solution was being transferred to the final tank in the cascade, samples were taken to determine whether it could be processed. The cascade flushing was repeated three times.
2. The next step in the flushing of the tanks was to flush them with 1,000 gallons of collected runoff water and recirculate the water for one hour. Samples were collected.

3. After the cascade flushing, each tank was individually flushed with approximately 1,000 gallons of raw water. The water was brought in a tank truck.

The last part of this work plan was the cleaning of the P307 Pump Pit and the 211-U Pipe Trench. Using a water truck, water was sprayed on the pipes and the pipe trench and allowed to drain towards the pump pit. A sample was collected from the pit and the pit emptied. Then the pump pit and pipe hardware were sprayed with a hose to remove the acid residue. The solution was then sampled and discharged.

**Calciner Cleanout (Phase I)**

This work plan provided instructions for the cleanout of the calciners. The procedures invoked the removal of the calciners' lids, vacuuming the loose powder, and cleaning of the "45 elbows" and feed points. The steps were:

1. The first step in the cleanout involved insulation removal in order to get access to and to remove the calciner lids. Later, the powder temperature sensors, the calciner vacuum gages and sensor lines, thermocouple wells, feed points, and offgas 45 elbows were removed.
2. A vacuum hose with a screen to prevent vacuuming UO3 "clumps" was attached to the powder handling system to remove the loose UO3 powder from the calciners. This powder was then routed to a cyclone and then a storage bin. The clumps of UO3 were placed into a bucket for later rework with material in another type (H) calciner. A millwright replaced the calciners' lids and then sealed them with a caulking material.

The 45 elbows were cleaned in a decontamination sink. A mixture of $HNO_3$ (15% to 20%) and water was used for this purpose. Then the elbows were rinsed with water and the decontamination sink solution jetted to a tank and concentrated.

**Documentation of the Building 224-U "Legacy Equipment" (Phase II)**

The "legacy equipment" was that which had been used to calcine the UNH and handle the UO3 powder. The work plan documented the physical and radiological conditions of the equipment on videotape. It also resolved any problems which were found during the documentation which might have presented a hazard to workers in the future.

Calcining pots were opened and their insides were videotaped and photographed. The pots contained only a small amount of residual UO3 powder. Four of the pots contained oil that had leaked from the agitator gear boxes located over the pots. This oil was removed and disposed. A separate work package was then written to drain the oil from the agitator gear boxes.

Much of the equipment had view ports, but viewing the internals was not possible because of UO3 powder caked on the interior of the glasses. Estimates of the amount of UO3 powder remaining inside the equipment were recorded. Also found during this documentation was equipment on which special tests of thorium oxide had been run. For configuration purposes, unique numbers had to be assigned to the pieces of equipment. This equipment had alpha contamination levels up to 10,000 dpm. These areas were wrapped to contain the contamination and were later decontaminated.

An issue involving the UO3 plant and related to the completion of equipment cleanout and piping flushes involved an assessment of the need for the Facility Effluent Monitoring Plan (FEMP) which was then under revision. This assessment identified the former process and effluent streams that were now inactive. It also provided a conservative estimate of the holdup UO3 material left inside equipment. An analysis of resultant potential radiation dose to workers and the public under "upset" conditions was conducted. It was concluded there was insufficient material with attendant risk in the deactivated facility to require a FEMP.

## EXTERIOR/INTERIOR CONTAMINATION AREAS – SRS METALLURGICAL LAB

**Background**

The 322-M Metallurgical Laboratory is a 12,800 $ft^2$ single story building built in four separate sections on a concrete slab. The first section is the original laboratory built in 1956 which consists of 4,900 $ft^2$. The second section was added in 1961 and consists of 1,900 $ft^2$ of additional lab space. The third section is an entire laboratory wing which was added in 1982 and consists of 4,500 $ft^2$. The fourth section was added in 1986 and consists of 1,500 $ft^2$ of offices and a lunchroom.

The laboratory was removed from service in 1995 and was transitioned to a non-operating, inactive facility. At that time, all building systems were shutdown and cleanup initiatives were undertaken to deactivate the facility based on general knowledge of the hazards in the facility and good environmental stewardship. A Deactivation Project Plan was developed and issued in September 1998.

**Interior Radioactive Contamination Areas**

The 322-M facility has been placed into a passively safe and stable configuration with minimal surveillance and no scheduled maintenance requirements for an extended period of time. Any equipment remaining in the facility with no identified requirements or plans to remove was retired in place without being decontaminated. The facility was locked and de-energized completely, including the shutdown of all ventilation. All utilities were isolated from the facility at its boundary. All loose transferable radioactive contamination in the facility, including material in hold-up, was isolated or fixed in place. All possible pathways for the migration of contamination out of the facility into the environment were sealed.

At one time, radioactive material was handled in most of the laboratory rooms of the original 1956 section of 322-M. Over the years these rooms were "rolled back" to clean areas. For this reason, it is prudently assumed that the sub-flooring and walls behind the baseboards of these rooms may be contaminated. Therefore, the appropriate ESH & QA precautions will need to be taken when activities are initiated in these rooms that disturb the sub-wall behind the baseboards or the floor tile.

**Exterior Radioactive Contamination Areas**

Nine Contamination Areas (CAs) exist on the exterior of the 322-M Metallurgical Laboratory. These nine CAs originally had transferable contamination ranging from 1600 to 120,000 dpm/100 $cm^2$ alpha and 4000 to 300,000 dpm/100 $cm^2$ beta-gamma. Eight of the CAs are on the East side of the facility immediately adjacent to various Process Exhaust System blowers and HEPA filter housings. The other CA is on a building footing at the South end of the West side immediately outside of Room 127.

Of the eight CAs on the East side, all but one are associated with the footings and supports for the Process Exhaust System blowers and HEPA filter housings. The only exception is the CA that was caused by a leak in one of the two overhead lines that carry contaminated Process Waste and Process Coolant from 322-M to 340-M. The leak may also have contaminated an approximate 10 ft. by 3 ft. area of soil immediately adjacent to the building.

After limited decontamination, the exterior CAs were painted with two coats of paint during FY95, with the base coat being a magenta color, and the surfaces were then posted as fixed contamination areas.

In addition to these fixed contamination areas, all the HEPA filter housings and the duct that runs into the building are posted as having internal contamination. These postings are based on readings taken of the HEPA filters when the blowers were shutdown and the HEPA filters removed. These readings ranged from 400 to 6000 dpm/100 $cm^2$ alpha and 4000 to 300,000 dpm/100 $cm^2$ beta-gamma.

## Control of Contamination

After a facility has been deactivated, the opportunities for the spread or movement of loose surface contamination would be expected to be markedly decreased. Regardless, some equipment and surfaces may have their contamination fixed in place to minimize migration during post-deactivation S&M.

Rooms within deactivated facilities may be left with various levels of contamination. If there is potential for migration by ventilation flow or rainwater drainage, and such migration would be a serious consequence, then barriers should be considered.

Gloveboxes that have been used for handling of plutonium, uranium, or other alpha emitting material should be cleaned to some acceptable level (see examples at **Gloveboxes, Hot Cells, and Hoods**). After cleaning is complete, the gloveboxes should be isolated to prevent the spread of radioactive material outside of their boundaries.

**Bird and Animal Control**

**Sumps in Electrical Gallery at Hanford B-Plant**

**Sealants and Fixatives at Hanford $UO_3$ Plant**

**BIRD AND ANIMAL CONTROL**

**Experience at Hanford**

Exclusion of birds and small animals from the interior of a deactivated facility is desired to eliminate a "safe haven" wherein the population could multiply and potentially create health hazards for post-deactivation S&M and decommissioning workers. Additionally, since some parts of deactivated facilities may be highly contaminated, intrusion by birds and animals could spread the contamination internally, and also provide a pathway for contamination migration to the exterior environment as they forage.

While few, if any, deactivated facilities can be expected to be airtight, there are many engineering controls which may be considered to keep bird and animal intrusions to a manageable level.

1. All non-access, building exterior openings should be covered and sealed.
2. Intact windows may be left in place; broken panes should be covered with sheet metal and sealed.
3. Any non-solid exterior door should be covered with sheet metal, with an appropriate window to permit viewing (partially) the interior of the facility. Insulation "skirts" at the bottoms of exterior doors should be in good condition and provide an adequate "seal" to hinder pest intrusion.
4. Facility ventilation ducts and louvers can be covered with sheet metal, if the ventilation system is not being used to provide a negative pressure contamination migration barrier. If HVAC systems will remain in use, screening material over the louvers will assist in keeping out birds and animals.
5. Piping penetrations into facilities can be "sealed" at the exterior boundary with an expanding foam material to hinder access by birds and large animals.

Other methods of bird and animal control could include the reduction of food and nesting places around the exterior of deactivated facilities, and bird and animal population reduction.

Some of the specific attempts at Hanford over several years (with varying degrees of success, and not specifically related to the UO3 or PUREX plant deactivation) included:

1. Bird and animal "watering holes"--exposed sumps, trenches and retention basins--were covered, filled in, or excavated.
2. Strands of wire were installed at facility wall/eaves intersections around the perimeter of the buildings to keep birds from nesting.
3. Hardware cloth was installed over a warehouse dock to prevent birds from nesting.
4. Inactive HVAC unit motors and housings were removed to prevent birds from roosting and nesting.

Structural netting, wire prongs, and stretched wire barriers for ledges are among other tested devices for limiting bird roosting and nesting.

Population reduction of birds was conducted at Hanford with some success, primarily using trapping devices. Pellet or blow guns, ultrasonic devices, repellent, and "scare" devices were also used with limited success. Avicides were not used by the contractor because of potential cross-contamination impacts on the local raptor population.

## SUMPS IN ELECTRICAL GALLERY AT HANFORD B-PLANT

### End Point

The end point is "Remove/Fix/Contain Source Material in Sumps on the South Side". The objectives sought by selecting and implementing this end point include facilitation of S&M, protection of workers, and reduction in cost. Fixing contamination in the sumps eliminates the concern of its becoming airborne, thereby increasing worker safety and reducing the cost of S&M.

### Facility

The facility is the Hanford B-Plant electrical gallery. The electrical gallery is located in the basement of the B-Plant canyon and runs parallel to the canyon on its north side. It is separated from the canyon cells by shield walls. The gallery contains cable raceways, motor control centers, steam and other utility piping, and a series of 18 sumps and sump pumps spaced along the length of the gallery. The purpose of the sumps was to collect drainage from miscellaneous leakage from within the gallery and pump it to a holding tank for further disposition.

### End Point Implementation

The method chosen to implement the end point was to fill each sump with sand and apply a fixative on top of the sand. Work instructions were written to control and document the implementation.

The fixative chosen was PBS (Polymeric Barrier System), a product of Bartlett Services Inc. The fixative was applied in multiple layers by spraying on top of the sand. The fixative was then allowed to dry. Surveys verified that there was no loose contamination present after application of the fixative.

The work included isolating electrical power to the sump pumps and sump level alarms. Deactivation tags were issued and applied to the applicable circuit breakers at the motor control centers.

An engineering change notice (ECN) was written against the affected facility drawings.

**Closure Documentation**

A closure letter was written to formally close out the end point. The closeout documentation consists of the closure letter, the Work Document, a Survey Report, the ECN, and the Material Safety Data Sheet (MSDS) for the PBS fixative.

**Lessons Learned**

A lessons-learned from earlier deactivations at the Hanford site (e.g. PUREX) was applied in the implementation of this end point. In these earlier cases, sump and trench contamination had been fixed by filling them with concrete. However, it was realized that this method might increase the difficulty of decommissioning. Therefore, it was decided to use sand and the fixative which could be easily removed at a future date, if deemed necessary.

**Post Deactivation S&M**

The electrical gallery is walked down quarterly. The walkdown consists of checking for indications of structural defects; roof and wall deterioration; posting deficiencies; contamination migration; suspected hazardous materials; hazardous conditions; unidentified friable asbestos; failed lights; water, animal, or insect intrusion; and housekeeping problems. A surveillance lighting system has been provided, as well as a new, lower capacity, canyon ventilation system. The original electrical system and ventilation system were deactivated. The walkdown team consists of a Nuclear Chemical Operator, a Radiological Control Technician, an Electrician, and a Carpenter (for annual roof inspection).

### SEALANTS AND FIXATIVES AT HANFORD $UO_3$ PLANT

Examples of engineering controls put into place at the UO3 plant included the application of an expansion foam to seal all "no access" doors and large, roll-up type doors, the installation of snug-fitting door sweeps, the covering and sealing of broken windows and external accesses, the sealing of ventilation ducts and piping penetrations, and the capping and sealing of ventilation stacks. In addition to providing a barrier to contamination migration out of the facility, these types of barriers also served to seal out wind and animals and to keep liquid intrusion to a minimum.

One sealant applied to a contaminated, external area at the UO3 plant was paint; however, with exposure to the elements and the passage of time, the paint began to crack and peel, and eventually it had to be removed, as it was transposing the fixed contamination area into an external, loose surface contamination area. A "lesson learned" from UO3 was that the deactivation contractor's time would have been better spent in this instance by removing the source of contamination at the outset. After realizing the failure of this paint system as a sealant, the contractor utilized a portable blast system ("Blastrac"), which blasted shot onto the surface while immediately vacuuming the blast products into a chamber and exhausting the air used in the process through a HEPA filter. This "scrabbling" and vacuuming machinery successfully removed the fixed contamination. The deactivation contractor at Hanford subsequently decided to use paint as a sealant only in facility interiors.

Another type of sealant used at the UO3 plant was a "Polymeric Barrier System" (PBS). The chemicals used in this system dry to a clear solid state, although dyes could be added to increase the visibility of the resulting barrier.

## Nuclear Material Residuals

Deactivation of some facilities will have to address existing fissile and other nuclear material. Minimizing the resources required after deactivation points towards elimination of needs for accountability, special safeguards, or special security. The purpose of this section is to provide examples of such experience.

**Nuclear Material Accounting – Hanford $UO_3$ Plant**

**Glovebox Endpoint Criteria for Criticality Prevention**

**Accountable Nuclear Material – SRS Metallurgical Laboratory**

### NUCLEAR MATERIAL ACCOUNTING – HANFORD $UO_3$ PLANT

At deactivation, the inventory accounts at UO3 included approximately 500 kilograms of low enriched uranium trioxide held up as a solid powder glaze on the inner surface of the plant's calciners and within associated process equipment. All loose powder that could be dislodged was vacuumed out of this equipment. Additional equipment left over from another program included 20 pot calciners originally used for processing uranyl nitrate into $UO_3$ powder. Inspection of these calciners showed they were empty and apparently cleaned out with acid following their final use. It was not cost effective to recover the residual material; the value was estimated as $4000, if it were to be recovered and purified. When the UO3 plant is decommissioned, the residual uranium will most likely be disposed of with the processing equipment and plant rubble to low level waste disposal.

A request to transfer this material to NOL was approved in accordance with DOE Order 5633. It was recommended that the inventory in this account, which is uneconomical to recover and disposable, be transferred to an EM-40 account until such time as final decommissioning occurs.

When the deactivated UO3 Facility no longer had accountable quantities of SNM, vital equipment, or classified information, DOE Order 5632.2A, Physical Protection of Special Nuclear Material and Vital Equipment and DOE Order 5480.5 Safety of Nuclear Facilities no longer applied. It has been reclassified from a Nuclear Facility to the "Other Industrial Facilities" category. (However, access to the facility will be controlled to prevent radiation exposure or injury to personnel.)

The procedure governing a declaration of Normal Operating Loss (NOL) and subsequent administrative removal from active inventory to waste management is contained in DOE Order 5633.3B. DOE Order 5660.1B states: "Discarded material disposed of as waste shall be removed from the accountability system in accordance with DOE Orders 5633.3B, 5633.4, and 5633.5." These orders have been used as a basis for eliminating the accountability of material that is not chemically hazardous and which can be safely declared to be waste.

## GLOVEBOX ENDPOINT CRITERIA FOR CRITICALITY PREVENTION

*This has been adapted from material by A. Westra of the PUREX Staff. The description is extensive. However because of it somewhat unique nature, there is much value in the detail that has been retained.*

As part of the PUREX Transition project, residual plutonium is being removed from the N Cell gloveboxes to reduce the potential for a criticality, to reduce the potential for contamination spread before and during decommissioning activities, and to minimize the overall radiation dose rates to personnel during both deactivation and decommissioning. The following criteria will be used to determine when the residual plutonium inventory in a glovebox has been reduced enough that no further equipment removal or decontamination is required:

Cleanout of the gloveboxes for criticality prevention will be considered adequate when the following conditions are met:

1. All process tubing, piping, and equipment small enough to be bagged out of the bagout ports has been removed from the gloveboxes.
2. Any piping or vessels left inside the gloveboxes have been drained, or opened and inspected, to insure that there are no accumulations of plutonium left inside the gloveboxes.
3. Residual plutonium inventory for each isolated glovebox or glovebox system is less than 450 g Pu as determined by the most (highest) value from a nondestructive assay,

   or

   A criticality safety evaluation determines that a criticality during decommissioning will be prevented by the form or distribution of the fissionable materials that remain in the plant.

4. When equipment removal and decontamination is completed, residual plutonium on interior glovebox surfaces will be fixed with non-strippable paint.

The following gloveboxes or combination of gloveboxes are considered isolated systems:

- N7 Glovebox
- N6 Glovebox
- N1A/N2A/N1B/N2B/N2C Gloveboxes
- N3/N4/Maintenance Gloveboxes
- Loadout Glovebox

Since the N4 glovebox is considerably larger than the other N Cell gloveboxes and contains most of the residual plutonium inventory, it is unlikely that even extensive cleanout will reduce the plutonium inventory in the N3/N4/Maintenance glovebox system to the point that the most value of an NDA (nondestructive assay) measurement is less than 450 g. Therefore, it is assumed that a criticality safety evaluation will be needed to meet the endpoint criteria. Following is a description of the minimum cleanout work that will be done in the N3/N4 gloveboxes to reduce the plutonium inventory and provide a basis for the criticality safety evaluation.

Equipment in the N3/N4 gloveboxes will be disassembled and cleaned out. Disassembled equipment pieces small enough to be bagged out will be removed from the gloveboxes.

After the above equipment and accessible plutonium has been removed, the residual plutonium inventory will be estimated by NDA. Then an evaluation will be done to determine if additional equipment needs to be removed to further reduce the plutonium inventory. If additional plutonium needs to be removed, equipment will be cut up as necessary and removed from the gloveboxes.

**Basis for Criticality Prevention Endpoint Criteria**

The technical criteria in section 2.2.4 of the PUREX/UO3 Deactivation Project Management Plan provide the general basis for the criticality prevention endpoint criteria. One of the requirements in section 2.2.4 is:

- *"Fissile materials shall be removed sufficiently to eliminate the potential for a nuclear criticality excursion and the need for a criticality alarm system."*
- The specific criticality prevention endpoint criteria are based on the following 4 points:

1. The small equipment and piping that has handled plutonium product will be removed to provide access to residual plutonium that has been inside or behind equipment and to improve the accuracy of the NDA. Large equipment will not be removed from the wet gloveboxes for the following reasons:
    - The equipment has been flushed internally with nitric acid to remove residual plutonium.
    - The effort and risk involved to cut up the large equipment so it can be removed is not justified based on the plutonium inventory in the wet gloveboxes.
    - Removing small equipment will allow better access to the large equipment for decontamination.
2. The 450 g Pu limit in each isolated glovebox system is based on conditions that require a criticality alarm system (CAS) as specified in DOE Order 5480.24, the Nuclear Criticality Safety Manual, WHC-CM-4-29, chapter 11.0, and American National Standard ANSI/ANS-8.3. These documents specify that a criticality alarm system is not required if the inventory of fissionable material in individual unrelated areas is less than 450 g (an exception to this requirement is discussed below). See the discussion of Criticality Alarm Exemption in the box.
3. The exception to the 450 g Pu limit (if a criticality safety evaluation determines that a criticality during decommissioning will be prevented by the form or distribution of the fissionable materials that remain) is based on an exception given to the requirement for a CAS in DOE Order 5480.24 and Nuclear Criticality Safety Manual, WHC-CM-4-29, chapter 11.0, and on the definition of a limited control facility as defined in the Nuclear Criticality Safety Manual, WHC-CM-4-29.
    - Limited control facilities may contain more than 1/3 of a minimum critical mass of fissionable material, however, the form or distribution of fissionable material ensures that a safe mass can not be exceeded. For plutonium, 1/3 of a minimum criticality mass is equal to 177 g. More than a minimum critical mass of fissionable materials will be left in the PUREX plant at the end of deactivation, but the fissionable materials are expected to be in a form or distribution that will prevent a criticality. If this is confirmed by a safety analysis, then the PUREX plant can be reclassified from a fissionable material facility to a limited control facility as defined in the Nuclear Criticality Safety Manual, WHC-CM-4-29.
    - Once PUREX is classified as a limited control facility, it will be exempted from some of the criticality prevention requirements that apply to fissionable material facilities. Criticality prevention specifications are required for all fissionable material facilities, but are only required for limited control facilities if specified in the safety analysis report (SAR) or criticality safety evaluation report (CSER). Limited control facilities generally are exempted from requirements for a criticality alarm system, fissionable material handler training, managers and engineers criticality training, and special training for support personnel.
    - A criticality detection system without an immediate alarm is required if the mass of plutonium exceeds 450 g and the probability of a criticality is greater than $1 \times 10^{-6}$ per year, but there are no occupied areas in which the expected dose rate exceeds 12 rads in free air.
    - These exemptions generally include critical prevention specifications, a criticality alarm system, and some training requirements.

**Criticality Alarm Exemption**

Chapter 11.0 of the Nuclear Criticality Safety Manual, WHC-CM-4-29, and American National Standard ANSI/ANS-8.3 specify under what conditions a criticality alarm and detection system is required. The following paragraphs are excerpts from those documents.

**WHC-CM-4-29, Chapter 11.0, Section 5.1, Coverage**

Criticality alarm system (CAS) and criticality detection system shall be installed as follows:

1) In those cases where the mass of fissionable material exceeds the limits established in paragraph 4.2.1 of ANSI/ANS-8.3 [450 g $^{239}$Pu] and the probability of a criticality is greater than 1 x 10-6 per year (as documented in a DOE approved SAR), a CAS meeting ANSI/ANS-8.3 shall be provided to cover occupied areas in which the expected dose rate exceeds 12 rads in free air, where a CAS in defined to include a criticality accident detection device and personnel evacuation alarm.
2) In those cases where the mass of plutonium exceeds the limits established in paragraph 4.2.1 of ANSI/ANS-8.3 [450 g $^{239}$Pu], but a criticality accident is determined to be impossible due to the physical form of the fissionable material, or the probability of occurrence is determined to be less than 1x10-6 per year (as documented in a DOE-approved SAR), neither a criticality alarm system or a criticality detection system is required.

**ANSI/ANS-8.3, Paragraph 4.2.1**

The need for a criticality alarm system shall be evaluated for all activities in which the inventory of fissionable materials in individual unrelated areas exceed 700 g of $^{235}$U, 520 g of $^{233}$U, or 450 g of $^{239}$ Pu or 450 g of any combination of these three isotopes. For operations involving significant quantities of other fissionable isotopes, this evaluation shall be made whenever quantities exceed the safe limits specified in American National Standard Nuclear Criticality Control of Special Actinide Elements, ANSI/ANS-8.15-1984. Special attention shall be given to all processes in which neutron moderators or reflectors more effective than water are present.

For this evaluation, individual areas may be considered unrelated when boundaries between the areas are such that there can be no interchange of materials between areas, the minimum separation between material in adjacent areas is 10 cm, and the areal density of fissile material averaged over each individual area is less than 50 g/m$^2$.

4. Determining the amount of residual plutonium is difficult when it is distributed throughout several gloveboxes containing vessels, process lines, and other equipment. For inventory purposes, the plutonium in the gloveboxes is measured from outside the gloveboxes using portable gamma monitoring equipment to perform a NDA. There is a large amount of uncertainty associated with the NDA measurements. The results are given as a least value, a most value, and a best value, which falls somewhere between the least value and the most value.

   Although, the NDA best value is used for the official PUREX inventory of Special Nuclear Materials, the most (highest) value must be used when using NDA measurements for criticality analysis. This is based on the PUREX FSAR, SD-HS-SAR-001, section 11.3.1.4, the Nuclear Criticality Safety Manual, WHC-CM-4-29, chapter 2.0, section 5.1.4.2 and Criticality Prevention Specification CPS-P-465-60010, paragraph B.6. The most value from NDA measurements must be less than 450 g Pu in each isolated glovebox or glovebox system to meet the criticality prevention endpoint criteria for glovebox cleanout. See the discussion of NDA Uncertainty in the box.

**NDA Uncertainty**

PUREX FSAR, SD-HS-SAR-001, Chapter 11.0; the Nuclear Criticality Safety Manual, WHC-CM-4-29, chapter 2.0; and Criticality Prevention Specification CPS-P-465-60010, paragraph B.6 specify what uncertainty must be used when using NDA equipment to measure plutonium mass for criticality control. The following paragraphs are excerpts from those documents.

**SD-HS-SAR-001, Section 11.3.1.4 Basis**

Criticality prevention may be achieved by limiting fissile material mass, including allowances for measurement accuracy (particularly using NDA methods)

**WHC-CM-4-29, Chapter 2.0, section 5.1.4.2**

For measurements of fissionable material under a critical mass limit, where the accuracy of the fissile mass measurement method is controlled to within ±5% at the 95% confidence limit (CL), the reported mass may be used as the mass limit control value. If the methods accuracy is outside ±5% (at the 95% CL), as the case for certain nondestructive assay methods (NDA), then the allowance for a potentially higher mass due to inaccuracy shall be accounted for in one of these ways:

1. The sum of the measured mass and the mass corresponding to the uncertainty in the measurement method shall be less than the CPS limit.
2. The independent safety review organization shall give a written exemption to the requirement for considering the uncertainties in the measurement method at a given location for a given type of fissionable unit.

**CPS-P-465-60010, Paragraph B.6**

NDA values used as the amount of plutonium present in an equipment piece or container for criticality control shall include the measurement limit of error as defined in RHO-MA 136, Standard II.2.B.5.

**ACCOUNTABLE NUCLEAR MATERIAL – SRS METALLURGICAL LABORATORY**

**Background**

Since initial construction in 1956, the primary mission of the 322-M Metallurgical Laboratory was to support the M-Area production facilities, although metallurgical analyses were occasionally performed on material from other areas of the site. Specific work, in support of 313-M, Slug Fabrication Facility, included destructive examination of sample cores from each 100 slugs of depleted uranium metal received from the supplier. Cores were examined for grain size and structure, inclusion stringer factor, matrix inclusion size and distribution, and hardness. Clad slugs were subject to a stud-pull tensile test to determine cladding bond strength and defective slugs were examined to determine the cause of the defects. In addition to supporting Reactor Materials operations, the 322-M Metallurgical Laboratory supported Tritium production by performing metallographic evaluation of pinch, reclamation, and inert welds. Additional laboratory space was built in 1982 specifically to perform the metallurgical analysis of enriched uranium products being fabricated in 321-M, the Fuel Fabrication Facility.

The laboratory was removed from service in 1995 and was transitioned to a non-operating, inactive facility. At that time, all building systems were shutdown and cleanup initiatives were undertaken to deactivate the facility based on general knowledge of the hazards in the facility and good environmental stewardship. A Deactivation Project Plan was developed and issued in September 1998. For additional information on the facility, see **Structures and Roofs.**

**Accountability Determination**

The inventory of nuclear material (i.e., enriched and depleted uranium) stored in the 322-M Metallurgical Laboratory has been removed. However, the book value for the 322-M Metallurgical Laboratory Material Balance Area (MBA) shows 36 kg of depleted uranium. A radiological survey of the ductwork in the Process Exhaust Systems indicated a worse case accumulation of less than 15 grams of U-235 and 4.3 kilograms of U-238. A radiological survey and video inspection of the Process Drain Lines detected deposits of depleted and 0.939% enriched uranium. Analyses from discrete sections of the lines were extrapolated to the entire drain system and indicated a worst case accumulation of 10.4 kilogram of U-238. The data obtained from these surveys demonstrates the absence of fissionable amounts of U-235 and therefore the deposits in the ducts and drains have no potential for producing a nuclear criticality event.

Based on the two inspections, 14.7 kg of the U-238 identified as being in the MBA is believed to exist in the Process Exhaust Systems and the Process Drain Lines. The balance is attributed to the accumulations of normal operating losses and measurement errors over the 34 years of operation of the facility.

There is a low potential for a release of the U-238 in the Process Exhaust Systems and the Process Drain Lines to the environment. The 322-M Metallurgical Laboratory Process Drain Lines empty into the M-Area Process Sewer System and then flow to 341-M, the Dilute Effluent Treatment Facility (DETF), for processing. The majority of contamination in the Laboratory Process Exhaust System is in the ducts internal to the building and the high molecular weight of the contamination precludes its easy dispersion.

## Structures and Roofs

**Structural Assessment**

The purpose of a structural assessment for facilities to be deactivated is to determine and document the adequacy of the buildings and structures for some extended, non-operational period. A graded approach is appropriate with a level of detail based on future use (if any), and hazards that remain which are a potential danger to workers or the public. In general, there is no need to conduct a detailed structural analysis with modeling or other rigorous engineering methods.

An assessment is first conducted as a condition of turnover with the intent that a periodic future annual or bi-annual inspection be conducted, all with the aim of projecting adequacy for a period into the future, for example, 5 years.

The first stage of an assessment is a visual inspection, review of past assessments, past inspection reports, and technical documentation of the construction. This inspection should be conducted by a person knowledgeable in design and construction of structures, accompanied by representatives of the deactivation organization and the receiving organization. Based on these results, a more formal inspection by a qualified structural engineer, or immediate corrective action, may be appropriate. The inspection should:

1. List the structures that are to be inspected and their component parts. This should include buildings foundations, walls, framing, ceilings, decking, roofs, cover blocks, platforms, and others as appropriate.
2. Assess structural integrity.
   - For example, inspect for the following while addressing the subsequent questions.

     – destructive effects of expansion or contraction

     – evidence of continued settlement or lateral displacement

     – evidence of propagating cracks

     – massive surface spalling or corrosion

     – moisture stains indicating inleakage

     – physical damage

   - Is the structure acceptable for an extended period of S&M, say 5 years, without failure?
   - Is there any near term threat of collapse?
   - If there are radioactive or chemical hazards contained within the structure, does the structure prevent their spread to the outside?
   - Does the structure inhibit the intrusion of rain and vermin?
3. Identify conditions that interfere with or prohibit the performance of planned surveillance or maintenance work during the S&M period.
4. Identify administrative actions, such as the installation of warning signs, needed to protect the S&M workers or future inspectors.
5. Provide recommendations on items needing immediate attention.
6. Provide recommendations on needed corrective actions.

The above can be converted to a checklist. The results of the visual inspection should be recorded to establish a reference baseline for future surveillance and maintenance.

**Roof Integrity Evaluation**

The integrity of roofs for deactivated facilities which are internally contaminated is important. EM-40 guidance for acceptance of a facility specifies that a roofing system will serve its purpose of protecting the facility's interior for a minimum of five years.

Inspection plans and procedures should address criteria and methods of inspections, recommended periodic inspection intervals, and evaluations of the need for repair or replacement. Qualification and/or training of inspectors should also be addressed.

Assessments of the remaining service life of structures and roofing systems performed by a site's structural engineering group tend to rely to a great extent on the experience and judgment of individual inspectors. While the focus of these assessments is usually on engineering solutions to repair roof defects, deactivation considerations need to address additionally the financial implications of roof repair expenditures as they relate to extending the serviceability of the roofing systems.

An approach can be conducted similar to that for structural assessment. The subjects of a roof integrity inspection can include:

1. Roof Condition
   - General Appearance
   - Surface Condition
   - Membrane Condition
2. Condition
   - Roof Perimeter Base
   - Counter Flashing/Termination Base
   - Coping
   - Perimeter Walls
3. Roof Perimeter Edging/Facia
4. Roof Penetrations
   - Equipment Base Flashing Curbs
   - Equipment Housing
   - Equipment Operation
   - Roof Jacks, Vents, and Drains
5. Expansion Joint Covers
6. Pitch Pockets

This list has been compiled from the main topics of a comprehensive checklist used at Hanford. Each subject area has a detailed listing of potential conditions for which to inspect — all on a checklist which provides for recording observations and making recommendations.

**$UO_3$ Plant and PUREX Plant Roofs at Hanford**

**SRS Metallurgical Laboratory**

## $UO_3$ PLANT AND PUREX PLANT ROOFS AT HANFORD

Major end points associated with the deactivation of the UO3 and the PUREX plants at Hanford concerned the integrity of each structure and its roofing system. Roofing deficiencies left uncorrected could lead to moisture intrusion.

During the deactivation phase, the UO3 plant's Buildings 224-UA and 272-U roofing systems were assessed by a site structural assessments engineer as needing repairs to meet the five year requirement. Minor deficiencies identified at several other buildings, such as rust or minor cracking, were satisfactorily addressed by increasing the inspection frequency during post-deactivation S&M. For the two buildings needing roofing repairs, a coating of "SNOWCOAT" was applied to seal the roofs, and the periodicity of inspections was increased. SNOWCOAT applications were dependent upon the weather and, since facility deactivation was scheduled for the winter months, it was formally agreed between the deactivation manager and the decommissioning manager that roof repairs would be completed by a date certain after plant turnover. After coating, the roofs were posted with "No Access" signs to prevent damage to the SNOWCOAT layer.

At PUREX there are sections of buildings that are below grade and have cover block type roofs. These are prone to in-leakage. The cover blocks were sealed with a similar commercial sealant and level detection instrumentation was installed in the sump area of the building. The potential for a large volume of water gathering is low, so pumps are not needed. The post-deactivation contractor will either bring in a portable heater to evaporate any buildup, or install a portable pump if sealing the roof area is not effective.

## SRS METALLURGICAL LABORATORY

### Background

The 322-M Metallurgical Laboratory is a 12,800 $ft^2$ single story building built in four separate sections on a concrete slab. The first section is the original laboratory built in 1956 which consists of 4,900 $ft^2$. The second section was added in 1961 and consists of 1,900 $ft^2$ of additional lab space. The third section is an entire laboratory wing which was added in 1982 and consists of 4,500 $ft^2$. The fourth section was added in 1986 and consists of 1,500 $ft^2$ of offices and a lunchroom.

The laboratory was removed from service in 1995 and was transitioned to a non-operating, inactive facility. At that time, all building systems were shutdown and cleanup initiatives were undertaken to deactivate the facility based on general knowledge of the hazards in the facility and good environmental stewardship. A Deactivation Project Plan was developed and issued in September 1998. Implementation of the Project Plan has placed the 322-M facility into a passively safe and stable configuration with minimal surveillance and no scheduled maintenance requirements for an extended period of time.

### Facility Final Condition

#### General Building Structure

The building structure and the existing protective barriers are sound and serve as a good containment barrier for the facility's RBA and "inactive" contamination areas and high contamination areas (CA/HCAs) thus ensuring the safety of the worker, the public, and the environment. The exterior transite panels and exterior steel panels are in good shape with no visible degradation of paint or coatings. All penetrations in the exterior panels have been sealed.

The windows are intact and secured, the galvanized steel roof is leaktight, and all roof penetrations have been resealed. The floor (concrete slab) shows no signs of deterioration. The ceiling panels and carpet tiles that were degraded because of mold growth resulting from increased levels of moisture since the HVAC had been shutdown were removed. The building exterior is in good shape with no visible degradation of paint or coatings.

There are eight access doors to the facility. The four main access doors are locked; the two doors off the ends of the North-South corridor, the door off the East-West corridor and the door to the lunchroom. The three exterior doors to the two RBAs, Room 126 and Room 131, are radiological boundaries and therefore are permanently locked and no longer used for access to the facility. Also, there is an emergency exit out of Room 146. All doors have been locked and the keys controlled by the 322-M Building Custodian.

The original 1956 laboratory and the 1986 office space and lunchroom addition have a standup attic (approximately 10ft.) with a catwalk. Two wood retractable interior stairs off the main North-South corridor provide access to the attic. The large thermostatically controlled attic exhaust fan (approximately 3 ft. in diameter) is located on the South end of the facility is de-energized.

**Surveillance and Maintenance**

Its deactivation having been completed, the 322-M Metallurgical Laboratory has entered into a long-term surveillance and maintenance (S&M) phase commonly referred to as "Safe Storage." An annual facility surveillance will ensure the containment of residual radioactive material or hazardous material; provide physical safety and security; and control hazards to the workers, the public, and the environment. The S&M Plan will maintain the post-deactivation end state until the final disposition for the facility is determined.

A structural integrity inspection will be performed by the facility custodian and a qualified building inspector or structural engineer. The purpose of this type of surveillance is to identify problems before they result in the unexpected loss of the structure's containment/confinement qualities. The facility roof will be a prime target of this inspection.

## Electrical Systems

Some amount of electrical service will be needed in many deactivated facilities. The primary inputs to deciding what to do are the requirements for lighting and ventilation for post-deactivation S&M (see also **Ventilation** and **Worker Support and Protection during Post-Deactivation S&M**. There also may be need for contamination control and property protection systems, even if only for detection (such as ventilation system stop, high sump level, and smoke or heat).

This can take the form of:

- Isolating and reconfiguring sections of an existing system, and/or
- Adding alternative sources of power combined with abandoning all or portions of the existing system, or
- Complete abandonment and reliance on hand-held and portable equipment.

**UPS Batteries at Hanford B-Plant**

**Electrical System Deactivation – Hanford PUREX Plant**

**Electric Power for Hanford 105-C Reactor**

### UPS BATTERIES AT HANFORD B-PLANT

**End Point**

The end point is "Remove UPS Batteries". The objectives sought by selecting and implementing this end point include facilitation of S&M, protection of workers, and reduction in cost. Removal of the UPS (uninterruptible power supply) batteries eliminates the need to maintain the batteries, or removes concerns with acid leakage, corrosion, and possible worker injury if the batteries were not maintained.

**Facility**

The facility is the Hanford B-Plant electrical gallery. The electrical gallery is located in the basement of the B Plant canyon and runs parallel to the canyon on its north side. It is separated from the canyon cells by shield walls. The gallery contains cable raceways, steam and other utility piping, motor control centers, and an uninterruptible power supply which served the Facility/Process Monitor and Control System (FPMCS).

**End Point Implementation**

Work instructions were written to control and document the implementation. The work instructions called for a temporary eye wash station to be installed in the work area. Also, non-sparking tools were specified. For work near the batteries, personnel protective equipment was required for protection of face, hands, body, and feet. Included in the work instructions was a Material Safety Data Sheet (MSDS) for the sulfuric acid electrolyte. The MSDS was provided by YUASA EXIDE.

Power supply to the FPMCS was switched to the bypass AC source. The UPS was electrically isolated and tagged out. Work instructions specified which battery connection bars were to be removed and in what order such that there was never more than 50 volts DC available at any battery terminal. Insulating blankets were placed over batteries not being worked on to prevent accidental contact. The batteries were placed on wooden pallets and removed from the electrical gallery. A deactivation tag was placed on the AC input breaker to the UPS. The handle of the bypass switch was removed, leaving the UPS in the bypass state.

**Closure Documentation**

A closure letter was written to formally close out the end point. The closeout documentation consists of the closure letter, the Work Document, the record of work done, and the MSDS for the battery electrolyte.

**Lessons Learned**

Although the batteries were removed and the AC input breaker was tagged open as deactivated, there was still AC power on the UPS at the line side of the AC input breaker and at the bypass switch. Craft personnel recommended placing information signs on the equipment advising of this condition. This was done.

**Post Deactivation S&M**

The electrical gallery is walked down quarterly. The walkdown consists of checking for indications of structural defects; roof and wall deterioration; posting deficiencies; contamination migration; suspected hazardous materials; hazardous conditions; unidentified friable asbestos; failed lights; water, animal, or insect intrusion; and housekeeping problems. A surveillance lighting system has been provided, as well as a new, lower capacity, canyon ventilation system. The original electrical system and ventilation system were deactivated. The walkdown team consists of a Nuclear Chemical Operator, a Radiological Control Technician, an Electrician, and a Carpenter (for annual roof inspection).

## ELECTRICAL SYSTEM DEACTIVATION – HANFORD PUREX PLANT

The PUREX canyon facility is very large and includes many electrical systems and a complex distribution. For post-deactivation S&M, a minimal number of circuits is required for:

- Ventilation exhaust fans
- Monitoring systems (radiation, air flow)
- Lighting

After evaluating alternatives, the decision was to open the main feeder to the canyon facility and de-energize the entire facility. The reasons for this choice were:

- The equipment and material is old (vintage mid 1950's). Did not have to even address the possible need for upgrading.
- It obviated fire protection concerns since de-energizing removes the ignition sources.
- Reconfiguring the existing system to limit it to the provision of only lighting would have been very expensive.
- Reconfiguring would have had to be done after all other work was complete, thereby becoming critical path on the deactivation schedule.

In addition to opening the feeder, mineral oil coolant is to be drained from transformers in the facility.

## ELECTRIC POWER FOR HANFORD 105-C REACTOR

**Background**

A safe storage enclosure (SSE) has been installed over the deactivated Hanford 105-C reactor. The SSE is designed to provide safe storage for the reactor until its decommissioning and one-piece removal. The scope of the project included removal of the fuel storage basin, the fuel examination facility, ancillary support buildings, and all portions of the building structure outside the shield walls that surround the reactor. Steel walls and roof were built up over the reactor using the existing shield walls as the "new" outside walls. The SSE provides a weather-protected containment for the reactor. The reactor block is located near the center of the enclosure. The reactor consists of a graphite block enclosed in a cast iron thermal shield, a biological shield consisting of alternating layers of masonite and steel on the sides, and a seven-foot thick concrete shield on top. The entire block rests on a massive concrete foundation. The block is 46 by 46 by 40 feet deep.

**Electrical Power System for the SSE**

The normal power system for the 105-C reactor was totally deactivated by severing cables, pulling breakers and disconnecting loads. A new power system for the SSE was designed and installed. It consists of a pole-mounted, three-phase, 75 kVA, 13.8 kV/120-240V transformer and distribution panels located in a utility room external to the SSE. The new power system supplies lighting for surveillance and maintenance, flood detection level switches, and resistance temperature detectors. The flood detection and temperature detection instrumentation is monitored at a continuously manned, remote facility.

There is no backup for this electrical power system. However, a loss of power will result in alarms annunciating at the monitoring station.

**In the event that work beyond routine S&M inspections is required within the SSE, a temporary ventilation system is utilized. The ventilation equipment requires power beyond the capability of the installed power system. Therefore, a portable diesel generator will be provided to supply three-phase, 480V power to the temporary ventilation equipment. For further information on the ventilation system, see Ventilation.**

## Ventilation

Post-deactivation ventilation is an important area of concern for deactivated facilities. It will have to be addressed for many facilities. The basic options are:

- No installed ventilation need be operable - portable units can be used when necessary.
- Some installed ventilation is required to be started periodically, for example, for industrial safety prior to human entry into isolated spaces.
- Continuous ventilation is required, for example, for contamination control or prevention of buildup of mold, or temperature control to prevent freeze-thaw cycling.

Because of their age and methods of construction, many of the facilities being deactivated at Hanford are not airtight. Even containment type and air-locked facilities in which no ventilation system is operating can be expected to "breathe" as the atmospheric pressure changes. It is possible for contamination to migrate during this process if sufficient engineering controls are not present or mitigating conditions established.

Some non-leak tight deactivated facilities will require maintaining an internal pressure less than the external atmospheric pressure to provide assurance that internal contamination will not migrate to the exterior. One way to maintain a negative internal pressure would be to operate the installed ventilation system(s), possibly at a reduced flow rate.

Contamination filtering devices, such as high efficiency particulate air (HEPA) filters, can be considered to prevent contaminated effluents. Monitoring devices on ventilation exhausts may need to be installed and maintained to comply with regulatory permits.

**Hanford B-Plant Canyon Exhaust Deactivation**

**Deactivated Canyon Ventilation Exhaust System**

**Ventilation for Hanford 105-C Reactor SSE**

### HANFORD B-PLANT CANYON EXHAUST DEACTIVATION

**End Points**

This discussion covers the end points associated with the total shutdown of the canyon ventilation exhaust system at Hanford B-Plant. The B-Plant is a deactivated facility.

**End Point Classification**

The end points fall under various classifications including System, Abandoned in Place; Internal Spaces, No Access Expected; and External Spaces, Including Building Exterior Envelope.

**Facility**

The facility is the Hanford B-Plant canyon building. The last mission of B-Plant was the separation of strontium and cesium from fission product waste streams. As part of the deactivation project, an adjacent facility, the Waste Encapsulation and Storage Facility, has been functionally separated from B-Plant and remains in operation.

The B-Plant canyon building is a reinforced concrete structure designed for shielding of radiation and containment of radioactive contamination. The ventilation exhaust system maintained the building at a negative pressure with respect to the outside ambient, and provided a progressively clean-to-contaminated air flow direction. The exhaust air was filtered by HEPA filters before discharge to the environment through a 200 foot high stack. A parallel sand filter was maintained in standby to the HEPA filters. In the event of a fire, the operational status of the HEPA filters and sand filter would be automatically reversed; the sand filter being placed in service and the HEPA filters taken out of service. The filters were installed below grade. Underground tunnels (wind tunnels) conducted the exhaust air from the canyon to the filters and from the filters to the exhaust fans.

To facilitate S&M, and to ensure confinement of residual contamination, the B-Plant canyon building has been provided with a new, reduced capacity ventilation exhaust system. This system is described separately under **Deactivated Canyon Ventilation Exhaust System**.

**End Point Implementation**

**1.0 Isolation of HEPA Filters**

The HEPA filters were abandoned in place because of their large inventory of radioactivity (estimated to be as much as 500,000 curies of strontium and cesium). Six HEPA filters, A through F, were installed for B-Plant and were arranged in parallel. As one filter became loaded, it was isolated and the next one was brought on line. Water seals were used to isolate one filter from another and from the environment. To avoid the necessity of maintaining the water seals during the period of deactivation, the decision was made to devise a more passive isolation method.

The filters were isolated on the inlet side by pouring a concrete plug in the wind tunnel between the canyon building and the filters. A remote pouring method was developed. There was no form work placed in the tunnel and no personnel entries were made. To ensure that the concrete would be distributed over the 4' x 7' cross section of the tunnel and create an effective seal, a mock up of the system and trial pours were made.

The filters were isolated on their outlet sides by blanking the exhaust fan inlet and outlet ductwork that connects the exhaust fans to the wind tunnel and exhaust stack.

**2.0 Isolation of the Sand Filter**

The isolation described above for the HEPA filters also serves to isolate the sand filter. In addition, the 48" motor operated inlet butterfly valve was closed and electrically deactivated, and the 48" filter outlet duct was blanked.

**3.0 Passive Venting of HEPA Filter Vaults**

Because of the large inventory of radioactive cesium and strontium contained in the deactivated HEPA filters, concerns arose over the possible evolution and accumulation of hydrogen in the filter vaults. Since the vaults are underground and water intrusion is possible (although remote), and since organic materials were used in the filter construction, radiolytic hydrogen generation is a theoretical possibility. To prevent a dangerous accumulation of hydrogen in the vaults, a passive ventilation system was designed and installed. The passive vent system consists of 2" piping connecting the vaults to the ambient atmosphere through two HEPA filters in series. The system is designed to prevent hydrogen concentrations in the vaults from exceeding 2% by volume. The driving potential for air changes is the daily atmospheric temperature and pressure swings. A purge connection is provided on the vent piping. As an additional precaution, the S&M plan calls for periodic checks for water accumulation in the vaults. Provisions have been made for these checks to be done remotely.

**4.0 Isolation of Water and Steam Supplies to HEPA filter Vaults**

Water lines were connected to the HEPA filter water seals. Steam lines were connected to eductors which were used to pump out sumps in the filter vaults. Both of these piping systems represented sources of water which could potentially enter the filter vaults. To prevent this possibility, this piping was disconnected and blanked.

**Closure Documentation**

A closure letter was written to formally close out the end points. The closeout documentation consists of the closure letter, Work Documents, Survey Reports, and ECNs.

**Post-Deactivation S&M**

The B-Plant yard area is walked down quarterly. Areas checked that pertain to the isolated filters include the exteriors of the filter instrument buildings (see the separate end points category **Structures and Roofs**), indications of ground subsidence, and standing water. The HEPA filter vaults are checked for the presence of water during the quarterly walkdown. To enable this, capacitance probes were installed. The readouts are local.

## DEACTIVATED CANYON VENTILATION EXHAUST SYSTEM

**End Points**

For the Hanford B-Plant, a new canyon ventilation exhaust system was designed and installed to replace the original system, permitting its deactivation. For a discussion of the deactivation of the original system, see **Hanford B-Plant Canyon Exhaust Deactivation**.

**Facility**

The facility is the Hanford B-Plant canyon building. The mission of B-Plant was the separation of strontium and cesium from fission product waste streams. An adjacent facility, the Waste Encapsulation and Storage Facility, has been functionally separated from B-Plant and remains in operation.

The B-Plant canyon building is a reinforced concrete structure designed for shielding of radiation and containment of radioactive contamination. To avoid the S&M activities attendant to the continued operation of the original canyon ventilation system, which would have included maintaining water seals on the inlets and outlets of the underground HEPA filters, the decision was made to deactivate that system.

To facilitate S&M, and to ensure confinement of residual contamination, the B-Plant canyon building has been provided with a new, reduced capacity ventilation exhaust system.

**End Point Implementation**

The design and construction of the new canyon exhaust system was approached as a formal, multi-disciplinary engineering and construction project. It was included within the scope of the overall project to deactivate the original ventilation system and isolate and vent the original HEPA filters. A Functional Design Criteria document was written to establish the design bases which include conformance to DOE 6430.1A and ANSI/ASME N509. New drawings were prepared as required, and existing drawings were revised by ECNs to document the project.

The following are the principal design features of the new canyon exhaust system:

- Maintains the canyon at a negative pressure of approximately 0.4 in. $H_2O$ with respect to the outside ambient.
- Provides an exhaust rate of 15,000 cfm.
- Two electric motor driven exhaust fans are provided. The fans are redundant. Each fan has manually positioned inlet guide vanes.
- Two HEPA filters are installed in parallel upstream of the fans. Both are normally in operation. Ventilation rate is reduced to approximately 8500 cfm when one filter is off-line for change-out or testing. Canyon is maintained negative at the reduced flow.
- New ductwork connects the fans and filters to Cell 10 in the canyon. Air flow within the canyon remains in the direction of least-to-most contaminated.
- The fans discharge through a new stack. The stack is equipped with a continuous sampling system designed in accordance with ANSI N13.1.
- The new fans and filters are located on-grade, outside the canyon building.
- A metal-sided instrument building is located adjacent to the fans. The building contains the stack sampler cabinet, a PLC, and other system instrumentation. The building is heated and cooled. The motor starters for the fans are mounted externally adjacent to one wall.
- System instrumentation readouts and alarms are monitored in a nearby manned facility.

**Post-Deactivation S&M**

Facility entry is performed quarterly. However, the air cleanup train components (fans, HEPA filters, instrumentation and controls) are readily accessible at any time. In addition, automatic monitoring is continuous, and alarms are forwarded to a paging system to provide remote notification of system problems. The following alarms are provided:

- Low system air flow.

- Exhaust fan bearing temperature.
- Stack emission concentrations.
- Liquid level in canyon cell 10 (low point of canyon).

In addition, radionuclide sampling of the stack discharge is performed monthly.

**VENTILATION FOR HANFORD 105-C REACTOR SSE**

**Background**

A safe storage enclosure (SSE) has been installed over the deactivated Hanford 105-C reactor. The SSE is designed to provide safe storage for the reactor until its decommissioning and one-piece removal. The scope of the project included removal of the fuel storage basin, the fuel examination facility, ancillary support buildings, and all portions of the building structure outside the shield walls that surround the reactor. Steel walls and roof were built up over the reactor using the existing shield walls as the "new" outside walls. The SSE provides a weather-protected containment for the reactor. The reactor block is located near the center of the enclosure. The reactor consists of a graphite block enclosed in a cast iron thermal shield, a biological shield consisting of alternating layers of masonite and steel on the sides, and a seven-foot thick concrete shield on top. The entire block rests on a massive concrete foundation. The block is 46 by 46 by 40 feet deep.

**Normal Ventilation**

The 105-C SSE is a deactivated facility that is uninhabited and locked except during S&M activities. Many of the reactor's components were removed as part of the stabilization effort to place the facility into interim safe storage. Remaining equipment and components that contain a radiological inventory have been sealed. Many accessible areas of the interior of the building have had a fixative applied to limit the spread of contamination.

Therefore, there is no mechanical ventilation of the SSE, either during S&M or the intervening periods, which are planned to be of 5-years duration. The enclosure will breath, but there are no openings intended specifically for ventilating air exchange.

HEPA-filtered inlet air openings are provided but are normally covered with sheet metal. During S&M inspections, the sheet metal covers can be removed to provide passive ventilation if determined necessary by sampling at the time of entry. The covers will be re-installed after completion of the inspections.

**Supplemental Ventilation**

Provisions have been made to force-ventilate the SSE in the event that work of a non-routine nature is required within the enclosure. Portable, skid-mounted ventilation equipment will be utilized. It consists of an exhauster fan of 9,000 cfm capacity, exhaust HEPA filters, and ß-? monitoring instrumentation. Stainless steel flanged openings have been provided for connection of the exhauster. The sheet metal covers on the inlet air HEPA filters are removed to provide a path for inlet air.

Power for the ventilation equipment is provided by a portable diesel generator rated at 75 kVA, three-phase, 480V.

When forced ventilation is no longer required, the portable exhauster is disconnected and bolted flanges are attached to the ventilation outlet. The sheet metal covers for the inlet HEPA filters are replaced. The outlet is also fitted with welded stainless steel bars for security reasons.

## Fire Protection Systems

For facilities to be deactivated, the maximum fire protection strategy would be to eliminate all fire hazards. However, because the costs of removing all fire hazards prior to deactivation could be prohibitive in all but the most basic of facilities, such an approach in large facilities is unrealistic. For example, some oils and greases may remain inside system components; tanks and sumps, although emptied and flushed, may not be thoroughly cleaned; and electrical cabling and insulation will, in most cases, remain in place.

**Fire Detection and Protection Systems at SRS Metallurgical Lab**

**Removal of Fire Protection - Hanford $UO_3$ Plant**

**Fire Protection for Hanford 105-C Reactor SSE**

**FIRE DETECTION AND PROTECTION SYSTEMS AT SRS METALLURGICAL LAB**
**(Draft)**

## Background

The 322-M Metallurgical Laboratory is a 12,800 $ft^2$ single story building built in four separate sections on a concrete slab. The first section is the original laboratory built in 1956 which consists of 4,900 $ft^2$. The second section was added in 1961 and consists of 1,900 $ft^2$ of additional lab space. The third section is an entire laboratory wing which was added in 1982 and consists of 4,500 $ft^2$. The fourth section was added in 1986 and consists of 1,500 $ft^2$ of offices and a lunchroom.

The laboratory was removed from service in 1995 and was transitioned to a non-operating, inactive facility. At that time, all building systems were shutdown and cleanup initiatives were undertaken to deactivate the facility based on general knowledge of the hazards in the facility and good environmental stewardship. A Deactivation Project Plan was developed and issued in September 1998.

Implementation of the Project Plan has placed the 322-M facility into a passively safe and stable configuration with minimal surveillance and no scheduled maintenance requirements for an extended period of time. Any equipment remaining in the facility with no identified requirements or plans to remove was retired in place without being decontaminated. The facility was locked and de-energized completely, including the shutdown of all ventilation. All utilities were isolated from the facility at its boundary. All loose transferable radioactive contamination in the facility, including material in hold-up, was isolated or fixed in place. All possible pathways for the migration of contamination out of the facility into the environment were sealed.

## Fire Protection – Graded Approach

Facility Deactivation Division (FDD) applies a graded approach to fire protection in the inactive facilities it manages. The *FDD Fire Protection Plan* describes how FDD implements its graded approach while remaining in compliance with the WSRC Procedure Manual 2Q, *Fire Protection Program*. Owing to its non-occupied and non-operational state with no current or future mission, a Fire Hazard Analysis is not required for 322-M. The *322-M Fire Control Preplan* delineates the information available to the WSRC Emergency Response personnel in responding to a fire.

## Elimination of Fire Hazards

Metal fines from grinding and lathe operations were a Class D fire concern during operations, but are no longer present in significant quantities, which makes a Class D fire an incredible event. All readily removable paper, wood, and oil were removed during FY95. Wood studs and ceiling rafters in the 1956 and 1961 sections still remain and are covered by sheet rock on the interior which minimizes the potential for a fire in an interior room to spread to the wooden structures in the attic.

Electrical power is isolated exterior to the facility.

## Deactivation of Fire Detection and Protection Systems

The 322-M Metallurgical Lab fire detection system consisted of a main fire alarm panel, a matrix of heat and smoke detectors, and a sprinkler system (Room 130). The fire detection system is deactivated and the fire water supply to 322-M has been disconnected and capped below grade where it T's off the Fire Main for M-Area. All portable fire extinguishers have been removed.

**REMOVAL OF FIRE PROTECTION – HANFORD $UO_3$ PLANT**

For the UO3 plant at Hanford, the following prerequisites had to be satisfied before fire protection could be removed from the facility:

1. The property book value of the facility (including the buildings and their contents) had to be devalued below levels which would require certain fire protection features. Even where the property had no inherent value, but property is shown to have record value, fire protection was maintained until the recorded value was lowered below protection requirements.
2. Prior to deactivation, a Fire Hazards Analysis conducted in accordance with the criteria in DOE 5480.7A[2], Fire Protection, was conducted. The purpose of the Fire Hazards Analysis was to comprehensively and quantitatively assess the risk from a fire within individual fire areas of the facility to ascertain whether the objectives stated in Paragraph 4 of the DOE Order were met. This analysis included a determination of the fuel loading of various parts of the facility, as well as an evaluation of ignition sources. The analysis had to demonstrate that a radiological or hazardous material release, beyond DOE guidelines, was not possible. The analysis had to be performed or reviewed by a qualified Fire Protection Engineer. If fire protection features were determined necessary to prevent a

radiological or hazardous release, those fire protection features had to be kept active until the radiological or hazardous materials were removed.

3. For life safety purposes, fire protection features could be deactivated only after personnel were no longer occupying the facility. The facility was considered occupied if it satisfied the definition of the Life Safety Code of the National Fire Protection Association (NFPA 101).
4. As a condition for removal of fire protection, post-deactivation S&M planning was coordinated with local Fire Department organizations for fire and emergency medical response services.

For the UO3 plant at Hanford, the local DOE Operations Office issued a letter, in response to a contractor request, for a devaluation of the facility to "zero value." The letter approved a "zero" valuation and stated that the facility had no future mission. Once assigned a "zero value," fire alarm and suppression systems could be deactivated, permitting the termination of electrical and water utilities to the facility.

During final UO3 plant cleanout, NFPA 101 permitted a limited number of workers performing a light work load, including appropriately equipped fire watches when necessary, consistent with a facility classification of "light industrial construction." This limited work force could use lights and utilities, if available, or could carry their own lights when utilities were not available. Adequate escape facilities had to be maintained at all times. In addition, the facility public announcing system was required to remain operational in order to provide safety notices to workers, up to the point of electrical disconnection.

### FIRE PROTECTION FOR HANFORD 105-C REACTOR SSE

**Background**

A safe storage enclosure (SSE) has been installed over the deactivated Hanford 105-C reactor. The SSE is designed to provide safe storage for the reactor until its decommissioning and one-piece removal. The scope of the project included removal of the fuel storage basin, the fuel examination facility, ancillary support buildings, and all portions of the building structure outside the shield walls that surround the reactor. Steel walls and roof were built up over the reactor using the existing shield walls as the "new" outside walls. The SSE provides a weather-protected containment for the reactor. The reactor block is located near the center of the enclosure. The reactor consists of a graphite block enclosed in a cast iron thermal shield, a biological shield consisting of alternating layers of masonite and steel on the sides, and a seven-foot thick concrete shield on top. The entire block rests on a massive concrete foundation. The block is 46 by 46 by 40 feet deep.

**Fire Protection Measures**

There are no fire protection systems installed within the SSE. However, there are active hydrants outside of the enclosure. All combustible materials were removed from the enclosure, and all sources of ignition were eliminated. There are no energized electrical circuits except those used for flooding detection and temperature detection. Lightning protection is provided.

Two resistance temperature detectors are installed and are continuously monitored. One is located at grade level and the other at the 45-foot level. Each detector has an installed spare that can be externally switched on in the event of failure of the primary. The temperatures are monitored and alarmed at the continuously manned operation supervisor workstation in the 271-U Building.

Power for the temperature detectors is provided by a new electrical power supply and distribution system designed especially for the SSE. The original system was totally disabled by completely severing cables, pulling breakers, and disconnecting loads. The new electrical system is described in **Electrical Systems**.

## Drainage, Sumps, and Flood Protection

Sump and drain systems in deactivated facilities may need to remain functional to handle rainwater, groundwater, or condensation. This may require sumps or tanks, level detection, pumps, and monitoring instruments. The degree to which systems are left active or reconfigured is a decision that will depend to a large extent on the geographical location, groundwater level, and building tightness.

**Hanford B-Plant Electrical Gallery Sumps**

**Flooding Detection for Hanford 105-C Reactor SSE**

## HANFORD B-PLANT ELECTRICAL GALLERY SUMPS

### End Point

The end point is "Remove/Fix/Contain Source Material in Sumps on the South Side." The objectives sought by selecting and implementing this end point include facilitation of S&M, protection of workers, and reduction in cost. Fixing contamination in the sumps eliminates the concern of its becoming airborne, thereby increasing worker safety and reducing the cost of S&M.

### End Point Classification

This end point is grouped in Case 1, Internal Spaces for which Routine Access will be Required.

### Facility

The facility is the Hanford B-Plant electrical gallery. The electrical gallery is located in the basement of the B-Plant canyon and runs parallel to the canyon on its north side. It is separated from the canyon cells by shield walls. The gallery contains cable raceways, motor control centers, steam and other utility piping, and a series of 18 sumps and sump pumps spaced along the length of the gallery. The purpose of the sumps was to collect drainage from miscellaneous leakage from within the gallery and pump it to a holding tank for further disposition.

### End Point Implementation

The method chosen to implement the end point was to fill each sump with sand and apply a fixative on top of the sand. Work instructions were written to control and document the implementation.

The fixative chosen was PBS (Polymeric Barrier System), a product of Bartlett Services Inc. The fixative was applied in multiple layers by spraying on top of the sand. The fixative was then allowed to dry. Surveys verified that there was no loose contamination present after application of the fixative.

The work included isolating electrical power to the sump pumps and sump level alarms. Deactivation tags were issued and applied to the applicable circuit breakers at the motor control centers.

An engineering change notice (ECN) was written against the affected facility drawings.

### Closure Documentation

A closure letter was written to formally close out the end point. The closeout documentation consists of the closure letter, the Work Document, a Survey Report, the ECN, and the Material Safety Data Sheet (MSDS) for the PBS fixative.

### Lessons Learned

A lessons-learned from earlier deactivations at the Hanford site (e.g. PUREX) was applied in the implementation of this end point. In these earlier cases, sump and trench contamination had been fixed by filling them with concrete. However, it was realized that this method might increase the difficulty of decommissioning. Therefore, it was decided to use sand and the fixative which could be easily removed at a future date, if deemed necessary.

### Post Deactivation S&M

The electrical gallery is walked down quarterly. The walkdown consists of checking for indications of structural defects; roof and wall deterioration; posting deficiencies; contamination migration; suspected hazardous materials; hazardous conditions; unidentified friable asbestos; failed lights; water, animal, or insect intrusion; and housekeeping problems. A surveillance lighting system has been provided, as well as a new, lower capacity, canyon ventilation system. The original electrical system and ventilation system were deactivated. The walkdown team consists of a Nuclear Chemical Operator, a Radiological Control Technician, an Electrician, and a Carpenter (for annual roof inspection).

## FLOODING DETECTION FOR HANFORD 105-C REACTOR SSE

### Background

A safe storage enclosure (SSE) has been installed over the deactivated Hanford 105-C reactor. The SSE is designed to provide safe storage for the reactor until its decommissioning and one-piece removal. The scope of the project included removal of the fuel storage basin, the fuel examination facility, ancillary support buildings, and all portions of the building structure outside the shield walls that surround the reactor. Steel walls and roof were built up over the reactor using the existing shield walls as the "new" outside walls. The SSE provides a weather-protected containment for the reactor. The reactor block is located near the center of the enclosure. The reactor consists of a graphite block enclosed in a cast iron thermal shield, a biological shield consisting of alternating layers of masonite and steel on the sides, and a seven-foot thick concrete shield on top. The entire block rests on a massive concrete foundation. The block is 46 by 46 by 40 feet deep.

**Detection of Flooding**

Two float-type level switches (one is an installed spare) are installed at the base of the stairwell at the –17'-6" level, the low point of the SSE. If sufficient water were to accumulate, the switch would open and an alarm would annunciate at the continuously manned operation supervisor workstation in the 271-U Building. Loss of power or continuity would also result in an alarm, prompting investigation. In the event of a failure of the primary switch, the standby unit can be switched on from outside the SSE.

Power for the level switches is provided by a new electrical power supply and distribution system designed especially for the SSE. The original system was totally disabled by completely severing cables, pulling breakers, and disconnecting loads. The new electrical system is described in **Electrical Systems**.

## Process Systems and Equipment

Systems in facilities being deactivated should be drained and isolated to:

1. Minimize the amounts of possibly hazardous materials prior to imposing a state of minimum surveillance and monitoring.
2. Minimize the potential spread of contamination during post-deactivation S&M or when decommissioning activities commence.
3. Reduce general area radiation exposure rates.
4. Utilize the existing process knowledge and operating experience of currently assigned facility technicians and managers to place systems in their safe, end point configurations prior to deactivation.

Some systems to be drained and flushed may come under the purview of Federal and State environmental laws and regulations (e.g., NEPA, CERCLA, RCRA). Such was the case at Hanford when the PUREX facility was formally shutdown and deactivation planning was started. Extensive planning and coordination with the cognizant officials produced an agreement among the parties that gave rise to a document, produced by the deactivation contractor, describing in detail the Data Quality Objectives (DQO) and criteria for ensuring that vessels and systems had been drained and flushed and that dangerous waste constituents had been removed. The document specified the sampling and analysis methods to be used for decision variables (regulated constituents, e.g., arsenic, benzene, trichloroethylene, etc.) covered by the applicable environmental regulation (primarily RCRA).

When systems and equipment have no further use, they may be abandoned in place. The methods for doing so should address how this should be done, specifically with regard to the degree of removing hazards such as fluids, electrical supply, and interconnections with other systems.

**Process Systems and Equipment Abandoned In Place**

**Process Systems and Equipment – SRS Metallurgical Lab**

### PROCESS SYSTEMS AND EQUIPMENT ABANDONED IN PLACE

At Hanford, the term "Abandoned in Place" was applied to systems and components:

1. having no intended or postulated use during the post-deactivation S&M or decommissioning periods, and
2. to be left in place upon the deactivation of the facility after all applicable end points had been satisfied.

Some examples of systems and equipment that were abandoned in place at Hanford's deactivated Uranium Trioxide (UO3) plant were:

a) System pumps and motors, along with their contained greases and lubricating oils, were abandoned in place. Also, electrical switchgear, tanks, and other permanently attached equipment that were not considered part of the facility's construction materials (e.g., windows, walls, ceiling tiles, floors) were abandoned in place after meeting their end points (draining and flushing tanks, de-energizing electrical gear).

b) Most of the installed lighting systems were abandoned in place as part of a costs containment strategy to remove all existing power to deactivated buildings where possible. However, the lighting panels in the main building had been replaced only four years previously. Therefore, some of the circuits on these panels were retained for surveillance and maintenance lighting. These panels were fed by a new feeder and new circuit breaker which was located outside the building. Normally, the breaker is open. It is closed at the time of entry for surveillance and maintenance. Once inside the building, the breakers for the circuits selected for surveillance and maintenance lighting are closed.

c) External wooden and steel platform structures, with their associated ladders or rungs, were abandoned in place, with appropriate warning signs and engineering controls prohibiting access (such as chains, locks, and fencing).

In considering what equipment should be abandoned in place, and with uncertainties connected with the facility's final decommissioning plan, the deactivation manager at UO3 plant was required to make a reasonable assessment of a system's or a component's potential value toward a decommissioning effort (possibly two or three decades hence), and categorize the equipment appropriately: 1) maintain it operational, 2) mothball it, or 3) abandon it in place. The result was that, with exception of the elevator, everything was abandoned; nothing was mothballed or kept operational.

Specific types of deactivation considerations at UO3 and PUREX included the following:

1) Electrical Components - Electrical equipment deactivation criteria were specified in an end point that required plant personnel to "electrically de-energize equipment and instrumentation unless otherwise stated."

   At the UO3 plant, deactivation of electrical equipment was accomplished in one fell swoop by the de-energization of all power to the Plant's buildings at the main power supply breakers located outside the plant. On the other hand, electrical power at PUREX was terminated selectively by locking open appropriate breakers and switches for different areas. This latter process, was necessary because the rather lengthy duration (two years or so) of facility deactivation raised concerns for the safety and protection of workers and equipment remaining in the building during deactivation work. Retaining electrical power in some parts of a facility will also have ramifications for facility fire protection, maintenance activities, calibration of equipment, and area surveillance.

   Some electrical transformers contained PCBs and required draining after they were disconnected. In general, some form of "easy" physical isolation of the transformers was performed for visual verification to future decommissioning personnel that the transformer was de-energized. This was accomplished by removing fuses, wires, or portions of bus bars. This was not mandatory, but could ease decommissioning workers' minds several years later when they start their work and can actually see the isolation.

2) Instrumentation and Control Equipment - Most of the instrumentation and control equipment in the UO3 and PUREX plants relied on pneumatic and/or electrical power. Whereas all electrical power could be secured to the UO3 Plant, there are several instruments (primarily for environmental monitoring) that must remain operational at PUREX. Powering these instruments appropriately and identifying them for either continuous remote or periodic in-situ monitoring by post-deactivation S&M personnel was required.

   Deactivated instruments were either removed for possible use elsewhere, or were left in place. To prevent confusing deactivation and post-deactivation S&M personnel, abandoned instruments displays at PUREX had their faces covered with a uniquely colored blue paper. This is turned out to be a useful *LESSONS LEARNED.* The deactivation of the PUREX facility took place gradually over a period of approximately two years. During this period, some systems were taken out of service while others remained operational. Covering the instrument displays for the systems as they were removed from service tended to focus the attention of the operators on the active systems and reduce distractions created by the presence of superfluous instrumentation. Also, an indication of progress toward the goal of deactivation was provided as more and more instruments were covered.

3) Contaminated Piping - Most of the process equipment piping in the UO3 and PUREX Plants is contaminated. The primary reason for flushing any of these systems was to remove the hazardous chemicals. Unless there was a known radiation "hot spot" in the

piping, the only actions taken were to drain the piping and isolate the system using the installed system valves.

Known holdups of UO3 powder (caked to process equipment internals, for example) were estimated conservatively for future decommissioning purposes; however, mechanical scraping or cleaning of piping internals beyond vacuuming was not performed.

Some flushing of a system may be appropriate to reduce a local "hot spot" but, recognizing that process equipment and piping internal surfaces will never be "released" from a radiological controls viewpoint, it would be a waste of site resources to clean it.

Apart from the environmental concerns, the draining of systems is relatively straightforward. During the UO3 plant deactivation, for example, in order to minimize hazards to decommissioning workers in the future, systems draining procedures were reviewed carefully to identify any "dead legs" in piping that would not be completely drained using the normal, installed draining provisions. These dead legs were eventually drained by employing special, non-operational techniques; e.g., by opening flanged joints.

## PROCESS SYSTEMS AND EQUIPMENT – SRS METALLURGICAL LAB

### Background

The 322-M Metallurgical Laboratory is a 12,800 $ft^2$ single story building built in four separate sections on a concrete slab. The first section is the original laboratory built in 1956 which consists of 4,900 $ft^2$. The second section was added in 1961 and consists of 1,900 $ft^2$ of additional lab space. The third section is an entire laboratory wing which was added in 1982 and consists of 4,500 $ft^2$. The fourth section was added in 1986 and consists of 1,500 $ft^2$ of offices and a lunchroom.

The laboratory was removed from service in 1995 and was transitioned to a non-operating, inactive facility. At that time, all building systems were shutdown and cleanup initiatives were undertaken to deactivate the facility based on general knowledge of the hazards in the facility and good environmental stewardship.

The 322-M Metallurgical Laboratory contains a variety of laboratory equipment and process systems. All equipment and systems have been shutdown and isolated. The following is a description of the end points pertaining to the facility's process systems and equipment.

### End Points

*Process Exhaust System*

The process exhaust system for the 322-M Laboratory has been shutdown, all HEPA filters have been removed and the exhaust stacks capped or blanked. The Laboratory Process Exhaust System for the facility has twelve separate process exhaust ducts that exit the facility. On the depleted uranium side (the original section of 322-M built in 1956), there are eight ducts each with flows that ranged from 5,000 cfm to 7,000 cfm. On the enriched uranium side (the 1982 addition), there is a single duct whose flow was 22,000 cfm.

Some ducting has been sampled and contains contamination. Based on laboratory activities in years past, all ducting should be treated as contaminated. All duct penetrations have been sealed

*Process Drain Lines*

Process drains have not been plugged nor has the common, eight-inch line running to Process Sewer manhole 6A (just inside the North East corner of the 321-M protection area) been isolated. Some piping has been sampled and contains contamination. Based on laboratory activities in years past, all process drain lines should be treated as contaminated. The common eight-inch line into manhole 6A from322-M has been plugged.

*Process Water System*

System isolation valves immediately outside the facility (North West corner of 1982 addition, underground) have been shut (Drawing 719819, N-28). Process water loads have been drained. Process Water has been permanently blanked immediately inside the facility (Room 121). Isolation of Process Water will be accomplished by a common disconnect for 319-M, 321-M, 322-M and 341-M during FY00.

*Hot Cell*

A hot cell with manipulators and glove box access is located in Room 125. Miscellaneous material (e.g. broken saw blades, plastic & paper trash, pieces of bar stock) and tools were removed from the hot cell. The hot cell is sealed and the outer cell door tack welded shut.

*Grinders*

There are twenty-eight grinders (two per table) in the 322-M facility that were used for preparing samples for various tests. Based on laboratory activities in years past, all process grinders are considered contaminated and have been posted as internal/fixed contamination. All grinders are de-energized.

## Utility and Service Systems and Equipment

This refers to mechanical equipment and service piping systems. A few installed systems may be useful for future decommissioning work. Mothballing is an appropriate deactivation task for systems and equipment which will be used in the ultimate decommissioning of the facility. For example:

- Installed cranes may be useful for future decommissioning work. Alternately, portable cranes can be used.
- Elevators may be useful for future decommissioning work for portable equipment movement.
- Various installed systems may be useful for future decommissioning work. For example, a system to demineralize water for removal of radioactivity might be used for decontamination water.

Decisions to mothball must consider the age of the equipment, the availability of parts in the future, and the level of effort to re-activate the equipment. Unless it can be anticipated that work which will use mothballed equipment will be conducted within approximately two years, it is probably better to abandon the equipment. When systems and equipment have no further use, they may be abandoned in place. The methods for doing so should address how this should be done, specifically with regard to the degree of removing hazards such as fluids, electrical supply, and interconnections with other systems.

All sanitation fixtures (sinks, toilets, urinals) in deactivated facilities should normally be removed to remove the temptation to use them, since there will be no flushing source. Provisions to seal the discharge sewer lines should be made, since the facility in most cases would have used the site-wide sanitation/sewer discharge system, which remains in operation. Without adequate back flow protection, sewer gases containing methane, for example, could accumulate.

In considering what equipment should be abandoned in place, and with uncertainties connected with the facility's final decommissioning plan, the deactivation manager at the Hanford UO3 plant was required to make a reasonable determination of a system's or a component's potential value toward a decommissioning effort (possibly two or three decades hence), and categorize the equipment appropriately: 1) maintain it operational, 2) mothball it, or 3) abandon it in place. The result was that everything was abandoned; nothing was mothballed or kept operational.

**Utility Piping Isolation at Hanford**

**Equipment Mothballing Decisions at Hanford**

**Utility Systems at SRS Metallurgical Laboratory**

### UTILITY PIPING ISOLATION AT HANFORD

In general, this type of piping (water, air, sewer) was isolated at valves as far from the plant as practicable. The preferred point at Hanford was far enough away from the plant so that a piping failure or break would not damage or upset the condition of the deactivated plant. As an example, the water supply to the PUREX plant was isolated back at its branch connection to the 200 East Area header. Additionally, the chances of discovering a break in a timely fashion were considered greater if the isolation valves were outside the facility and/or near a location occupied by personnel.

Normally, all water and steam systems, including facility fire mains, would be isolated and drained during the deactivation process to minimize the potential for leaks and ruptures during the post-deactivation S&M phase and to facilitate future decommissioning efforts. One primary remaining concern would be freeze protection for dead-ended legs and standpipes containing residual water, since deactivated facilities will rarely be heated.

Because of water, steam, fire main, and similar services required at nearby facilities, the associated main's pressure may exist at the deactivated facility's header isolation valve, which may now or in the future leak. At the UO3 plant, a hydrant in the yard needed to be maintained active. Therefore, the water supply line was plugged after it entered the building. The line entered from below grade, up through the floor. The line was plugged by breaking the first flanged joint inside the building, inserting a rubberized, expandable "plug" into the piping to a level below the prevailing frost depth, and filling the line with concrete as a backup barrier to the expandable plug. As a third and final barrier, a solid flange cover was then bolted over the flange opening.

In addition to stopping inflows of fluids at the normal inlet piping to a facility, considerations should be given to disconnecting and plugging/capping normal outlet piping to prevent back flows from physically connected systems which must continue to operate at other facilities.

## EQUIPMENT MOTHBALLING DECISIONS AT HANFORD

At the UO3 plant, none of the equipment, with exception of the elevator, was mothballed. It was determined by the deactivation manager that either none of this equipment would be useful during decommissioning, or that preservation for a yet unknown decommissioning approach was not cost effective.

At the PUREX plant, the only components considered for mothball status were a unique crane, formerly used in the extraction process, and a facility elevator. Eventually, a decision was reached to mothball only the elevator, since a portable crane was foreseen as being sufficient during future decommissioning activities.

Mothballing the elevator at PUREX required the generation of a special work procedure for its deactivation in that status, along with an elevator re-activation procedure for use by the decommissioning contractor, if the contractor decided to use it. The deactivation contractor took the responsibility for developing the re-activation procedure with the insight that all existing operating knowledge and experience was in the deactivation–versus the decommissioning contractor's–organization. Any facility activity involved with the re-activation and/or use of the elevator during the decommissioning phase would be the responsibility of the decommissioning manager.

Since all electrical power was to be removed from the PUREX plant, with the exception of that supplied to a newly installed lighting system for post-deactivation S&M, no provision was made for the performance of any periodic maintenance on the mothballed elevator. However, prior to performing the elevator mothball procedure, the elevator's preventive maintenance procedure was performed and the elevator was operationally tested.

The elevator mothballing procedure at the PUREX plant essentially consisted of positioning the elevator properly and separately releasing the tension caused by the weight of the cab and the counterweight from each end of the elevator cables using hoists, slings, clamps, blocks, and thick wooden beams. The elevator manufacturing company's name and telephone number, along with other pertinent elevator information (e.g., weights of the cab and the counterweight) were provided in the re-activation procedure.

## UTILITY SYSTEMS AT SRS METALLURGICAL LAB

### <u>Background</u>

The 322-M Metallurgical Laboratory is a 12,800 $ft^2$ single story building built in four separate sections on a concrete slab. The first section is the original laboratory built in 1956 which consists of 4,900 $ft^2$. The second section was added in 1961 and consists of 1,900 $ft^2$ of additional lab space. The third section is an entire laboratory wing which was added in 1982 and consists of 4,500 $ft^2$. The fourth section was added in 1986 and consists of 1,500 $ft^2$ of offices and a lunchroom.

The laboratory was removed from service in 1995 and was transitioned to a non-operating, inactive facility. At that time, all building systems were shutdown and cleanup initiatives were undertaken to deactivate the facility based on general knowledge of the hazards in the facility and good environmental stewardship.

**Endpoints**

The following end points relating to utility systems at the SRS Metallurgical Lab were achieved:

*Chilled Water System*

System isolation valves immediately outside the facility (North East corner of original 1956 section, underground) have been shut. Chilled water loads have been drained. Chilled water has not been permanently blanked or disconnected from the facility. However, the Chilled Water System feed and return lines have been blanked for all of M-Area including 322-M.

*Domestic Water System*

System isolation valves immediately outside the facility (North West corner of 1982 addition, below ground) have been shut. Domestic water loads have been drained. Domestic Water has been permanently blanked immediately inside the facility. Isolation of Domestic will be accomplished by a common disconnect for 319-M, 321-M, 322-M and 341-M during FY00.

*Electrical Power*

Electricity is still supplied to 322-M and 340-M via the load centers in Rooms 121 and 147 from the 13.8 KVA substation (352-4M) on the West side of the laboratory. Power has been disconnected from the 13.8KVA substation to 322-M and all equipment in the facility is de-energized.

*HVAC*

There are six HVAC units for the facility; i.e., two for each section. They have been shut down and the Freon**â** purged. All duct penetrations have been sealed.

*Instrument Air System*

Instrument Air is fed to the facility via the Instrument Air Dryer (near frame #2 in the attic) from Plant Air. Instrument Air System isolation valves outside the facility near the steam manifold (North West corner of the 1982 addition) have been shut and the lines have been depressurized.

*Plant Air System*

System isolation valves outside the facility near the steam manifold (North West corners of the 1982 addition) have been shut and plant air loads have been depressurized. Plant Air for M-Area has been permanently shut down.

*Sanitary Drainage System*

Sanitary drain lines in the building have not been isolated. However, the six-inch cast iron line from 322-M has been plugged in the Sanitary Sewer manhole just of West of 321-M.

*Steam System*

Steam has been disconnected from the facility at the North West and North East corners of the facility at the steam manifolds.

## Gloveboxes, Hot Cells, and Hoods

Gloveboxes that have been used for handling of plutonium, uranium, or other alpha emitting material should be cleaned to some acceptable level. After cleaning is complete, the gloveboxes should be isolated to prevent the spread of radioactive material outside of their boundaries. It is particularly important to remove or fix plutonium contamination because of its tendency to disperse and become an airborne hazard. A description of the specification for glovebox isolation at the Hanford PUREX plant (link below) provides an example of a comprehensive specification. (See also **Glovebox Endpoint Criteria for Criticality Prevention**.)

**Glovebox Isolation – Hanford PUREX**

**Glovebox Radiological Control – Hanford PUREX**

**Hot Cell Isolation – SRS Metallurgical Lab**

**Laboratory Hood Isolation – SRS Metallurgical Lab**

## GLOVEBOX ISOLATION – HANFORD PUREX

*This has been adapted from material by A. Westra of the PUREX Staff. The description is extensive. However, because it is somewhat unique in nature, there is much value in the detail that has been retained.*

### Process, Utility, and Instrument Air Line Penetrations

The line penetrations through the glovebox wall are stainless steel pipe seal welded to the glovebox wall. Most are 1/2" or 3/4" pipe and have a tubing fitting to pipe weld connection inside the glovebox within a few inches of the glovebox wall.

Each process, utility, and instrument air line entering a glovebox will be disconnected at the first threaded or flanged connection inside the glovebox and blanked with a stainless steel tubing plug, threaded cap, pancake blank, or blind flange.

### Electrical Power

Bulkhead electrical fittings were used for electrical penetrations through the glovebox walls. Prior to deactivating a glovebox, electrical power will be isolated from all equipment inside the gloveboxes by unplugging all electrical leads at the bulkhead connector on the outside of the glovebox wall. The bulkhead connectors will then be sealed with RTV silicone sealant since they are not airtight when unplugged. This also prevents reconnection of the electrical leads to the bulkhead fittings. The electrical leads inside of the glovebox will be cut at the bulkhead connectors and bagged out as waste. The $HNO^3$ atmosphere corrodes the connectors inside the glovebox so that they generally cannot be taken apart.

### Fire Suppression Nozzles and Temperature Detectors

The ports for fire suppression nozzles consist of 3/4" NPT pipe couplings welded into the glovebox wall. The ports for temperature detectors are similar except a 3/4" NPT half coupling is used.

After the Halon fire system is deactivated, the Halon lines will be blanked in the sample gallery near the Halon bottles.

The temperature detectors will be left in place since the detector elements are threaded into the half couplings and the parts that are exposed to the glovebox atmosphere are corrosion resistant and air tight.

### Gage Fittings and Dewpoint Measuring Ports

Pressure gage fittings are made of a 1/4" NPT half coupling welded into the glovebox wall. The dewpoint measuring ports for the dry gloveboxes were made by welding a 3/4" NPT half coupling into the glovebox wall.

The pressure sensing lines will be left as is. They will be available for monitoring negative pressure in the gloveboxes during post-deactivation S&M.

### Glovebox Exhaust Ventilation System

The gloveboxes are vented to the main exhaust system stack through a system of HEPA filters, dampers, and ducting. There are two types of exhaust filters on various gloveboxes which are push-through filters and bagout type HEPA filters.

The main glovebox exhaust duct will be blanked in the room containing the gloveboxes, which will then be individually and locally vented to the air tunnel through the vessel vent piping. The first stage of vessel vent filters inside one of the gloveboxes will be removed to allow the wet gloveboxes to vent to the vessel vent piping. The dry gloveboxes will be vented through a new duct installed from the another glovebox to the vessel vent piping.

The sliding door between the bagging glovebox and the can conveyor to the secondary canning glovebox will be sealed shut to prevent contamination spread into the clean secondary canning glovebox.

**Exhaust Ducting Ports and Push-through Filters**

The glovebox ventilation air is exhausted either through push-through HEPA filter housings that are bolted to the glovebox wall and sealed with O-rings, or through ports made of 4" or 6" diameter fittings welded around a hole in the glovebox wall. The covers on the push-through filter housings are bolted to the housing and sealed with O-rings. Neoprene gaskets attached to the outside of the filter elements provide a seal between the filter element and the inside of the filter housing.

The isolation dampers for the push through filters will be closed, the filters will be pushed into the gloveboxes with spacers, and then bagged out as waste. The bagout HEPA filters will be removed with the bag stubs left in place. The filter housing door will be replaced and latched.

**Inlet Filter Ports**

Ventilation air entered the gloveboxes through inlet filters located at the bottom of the gloveboxes. The inlet filter ports for most of the gloveboxes are made of a section of 4" Schedule 40 304L stainless steel pipe welded into a hole cut into the bottom of the glovebox. A fitting is welded to the section of pipe protruding out of the glovebox. This fitting uses an O-ring and retainer coupling to attach a damper and filter to the inlet port.

The inlet filter ports for the N6 glovebox are the same as above except they are installed in the side of the glovebox.

The two inlet filter ports for the calciner glovebox are made of 6" pipe welded into holes cut into the end of the glovebox.

The inlet filter port for the maintenance glovebox has a 150# slip-on flange welded on the end of the port protruding out of the glovebox instead of an Aeroquip fitting used on the others.

The inlet filters will be removed and blanks installed on the duct.

**Gloveports and Bagports**

The gloveports are 8" in diameter and most of the bagports are 12" in diameter. There are some 3" bagports for bagging out sample bottles.

The gloveports and bagports will be sealed by taping pie pan shaped covers over stubby bags, and then using Canusawrap heat shrink material to further seal the pie pans covers to the gloveports.

Canusawrap is a heat-shrinkable wraparound material which consists of an irradiation resistant cross-linked polyolefin backing pre-coated with a layer of anti-corrosion adhesive sealant. When the Canusawrap is heated, the adhesive is transformed into an amorphous, low viscosity liquid. As the sleeve shrinks, it forces the molten adhesive into all surface irregularities as the sleeve conforms to the joint contours. On cooling, the adhesive reverts to its strong elastomeric state to form a tough permanent bond to the entire surface of the joint. Canusawrap is a made by CANUSA, a division of Shaw Pipe, Inc.

**Criticality Drains**

The wet gloveboxes are equipped with a system of primary and secondary criticality drains to prevent solution buildup in the bottom of the gloveboxes.

Solution draining to the floor of the of the wet gloveboxes will either overflow to an adjacent glovebox or through a criticality drain. Four of the gloveboxes are butted up against each other with only low curbs between adjacent gloveboxes so solution will overflow from glovebox to glovebox instead of building up.

The primary criticality drains connect to a common drain line that passes through the canyon wall into L Cell. The criticality drains consist of 2" diameter drain lines with liquid traps to prevent air flow through the lines. The entrances to these criticality drains are covered with screens to prevent plugging of the drain line.

The primary criticality drains will be plugged to prevent air flow from the canyon back into the gloveboxes, which will be more negative than the canyon since the gloveboxes will be vented directly to the air tunnel. These will be sealed by removing the screen covering the inlet to the drain and installing an expansion plug.

The secondary criticality drains between adjacent gloveboxes consist of 2" square tubing. It was installed to prevent solution buildup in the event that a primary criticality drain became plugged. The secondary criticality drains will be left open to allow air movement between the gloveboxes.

## Shaft Seals

The calciners and blender rotation stand were powered by motors located outside the glovebox. The shafts connecting the motors to the rotating equipment inside the gloveboxes are sealed with TFE packing and Buna N O-rings where the shafts pass through the glovebox wall.

The shafts will be left in place and further sealed with RTV silicone sealant, or removed and replaced with a cover plate.

## Sphincter Seals

Sphincter seals were installed in the gloveboxes for transferring sample bottles and product cans into the gloveboxes. The sphincter seals for product cans have threaded stainless steel covers.

A product can will be left in each product can sphincter seal and then the cover will be installed after a bead of RTV silicone sealant has been laid on the threads inside the sphincter seal. A cover of Lexan or stainless steel will be made for each sample bottle sphincter seal. The covers will be attached with screws or an adhesive.

## Vacuum Cleaning System Outlet and Return Lines

A vacuum cleaning system was installed in the Loadout glovebox to reduce dusting and clean up powder spills in the N4 and Loadout gloveboxes. The vacuum line leaves the west end of the Loadout glovebox through a 1" OD tubing spool piece welded into the glovebox wall. A Tri Clamp fitting ferrule is butt welded to both ends of the tubing spool piece. After leaving the glovebox, the vacuum line passes through two HEPA filters and a blower before it returns to the glovebox through a transition piece welded to an oblong slot cut into the upper west end of the glovebox. The return line has a check valve installed in a 1" standard flanged connection located several feet away from the glovebox.

The vacuum system line leaving the glovebox will be blanked or plugged at the first fitting outside the glovebox downstream from the HEPA filters. This will prevent migration of contamination into the clean piping downstream from the filters. The return line will be blanked at the first flange outside the glovebox where a check valve is presently located.

## Dry Air Diffuser Supply Lines

Dry air was supplied to diffusers in the N4 glovebox through two lines which enter the east end of the glovebox. Similarly, dry air was supplied to diffusers in the Loadout glovebox through two lines that enter the west end of the glovebox. The dry air penetrations consist of 2" Sch. 40 pipe spool pieces for the N4 glovebox and 2" OD x 0.095 wall tubing for the Loadout glovebox. All four of the spool pieces are welded to the glovebox wall. Aeroquip Corp. pipe flanges are butt welded to both ends of the spool pieces. Diffuser pipes are connected to the flanges inside the glovebox and the dry air supply line is connected to the flanges outside the glovebox. The piping connections are made with Aeroquip Corp. couplings. The isolation valves for all four dry air lines are located approximately 12 in from the glovebox. The isolation valves for the N4 glovebox are ball valves while the valves for loadout glovebox are gate valves.

The dry air lines to the loadout glovebox will be blanked at the flanges nearest to the glovebox wall either inside or outside the gloveboxes. The dry air lines to the N4 glove box will be isolated by installing isolation locks on the ball valves just outside the glovebox.

## Surge Relief Device

The N4 glovebox is equipped with a surge relief device to prevent pressurizing the glovebox. The surge relief device is filled with Dow Corning 200 fluid and is connected to the dry air supply line to the east end of the N4 glovebox. A HEPA filter is installed on the other side of the surge relief device. The port where the surge relief device originally connected directly to the glovebox has been blanked.

The line connecting the surge relief device to the dry air line will be blanked. Then the HEPA filter will be removed and the surge relief device drained.

## Process Vacuum Line

The process vacuum line leaves the top of the N2B glovebox and passes through the ceiling to the filters and vacuum pump in the Sample Gallery. The vent line from the vacuum system goes back down to N Cell and ties into the vessel vent line between the second stage filters and the blowers.

The process vacuum line inside the N2B glovebox will be blanked at the flange closest to the glovebox wall. The vent line from the vacuum pump will be blanked at the flange where it ties into the vessel vent line.

**DOP Test Ports**

DOP test ports for filters inside the gloveboxes are similar to instrument lines and will plugged inside the gloveboxes. DOP test ports on external filters normally have piping plugs installed in them. These plugs will be left in place.

## GLOVEBOX RADIOLOGICAL CONTROL – HANFORD PUREX

*This has been adapted from material by A. Westra of the PUREX Staff.*

As part of the PUREX Transition project, residual plutonium was removed from the N Cell gloveboxes to reduce the potential for a criticality, to reduce the potential for contamination spread before and during decommissioning activities, and to minimize the overall radiation dose rates to personnel during both deactivation and decommissioning. The following criteria were used to determine when the residual plutonium inventory in a glovebox had been reduced enough with respect to Radiological Control so that no further equipment removal or decontamination was required:

- The inside surfaces of the gloveboxes and any equipment that had not been removed were wiped down with damp rags to remove loose plutonium.
- After the inside surfaces of the gloveboxes were wiped down, the residual plutonium contamination inside the gloveboxes was fixed with non-strippable paint.
- The gloveports, bagout ports, bulkhead electrical fittings, inlet filters, and other penetrations into the glovebox were sealed to prevent contamination spread when the ventilation was reduced to a minimum.

## HOT CELL ISOLATION – SRS METALLURGICAL LAB

**End Point**

The end point is the sealing of openings in the Room 125 Hot Cell. The objective of the end point is the protection of workers by isolating contaminated surfaces.

**Facility**

The facility is the 322-M Metallurgical Laboratory at the Savannah River Site. The laboratory has been deactivated and made passively safe, requiring minimal surveillance and no scheduled maintenance.

**End Point Implementation**

The Hot Cell in Room 125 is equipped with a manipulator and glovebox access. The Hot Cell is an inactive High Contamination Area with contamination levels of 1000 dpm/100 $cm^2$ alpha and 20 mrad/100 $cm^2$ beta-gamma. This level of radioactivity could result in a contact extremity dose rate of 1155 mrem/hr at 5 cm, and a skin dose rate of 69 mrem/hr at 30 cm. Cell contents such as broken saw blades. Plastic and paper trash, pieces of bar stock, hand tools, and fines from the top of the cell table were removed to the extent practical without a major D&D effort. The cell cask and vacuum cleaner were left in place with their lids removed to facilitate future visual surveillance. The inner cell door, the ventilation duct, the manipulator penetrations, the glovebox access, and all interior seams were permanently sealed. The exterior cell door was tack welded shut. The Hot Cell is marked as containing internal/fixed contamination.

**Closure Documentation**

Work packages were prepared to implement the end point. Verification of attainment was through review of the completed work packages.

## LABORATORY HOOD ISOLATION – SRS METALLURGICAL LAB

**End Point**

The end point is the isolation and fixing of contamination in the laboratory hoods of the Metallurgical Laboratory. The objective of the end point is the protection of workers by isolating contaminated surfaces.

**Facility**

The facility is the 322-M Metallurgical Laboratory at the Savannah River Site. The laboratory has been deactivated and made passively safe, requiring minimal surveillance and no scheduled maintenance.

### End Point Implementation

There are 23 laboratory hoods in the 322-M Metallurgical Laboratory. Radiological surveys determined that 12 of the hoods had contamination levels originally from 400 to 200,000 dpm/100 $cm^2$ alpha and 10,000 to 1,500,000 dpm/100 $cm^2$ beta-gamma. Most of the transferable contamination in these hoods was removed, the internal surfaces double-painted, and the inside posted as having internal/fixed contamination. These hoods were then closed, sealed, and posted on the outside for known internal contamination.

The remaining hoods with a radiological history were sealed and posted on the outside as having internal contamination as a conservative measure in the event that with the passage of time, contamination in the hood ducting might migrate down into the hood. The sealing of all laboratory hoods makes the migration of hood residual contamination out of the facility and into the environment a remote possibility.

Excluding the hoods in the hot cell room, hoods with flexible hoses for ducting have been disconnected from the Process Exhaust System and the ends of the ducts sealed with tape and/or plastic bags and tape. Hoods with metal ducting have been isolated by closing their dampers. For long term care, the ends of the metal exhaust ducts have been taped with a robust metal tape to ensure sealing of contamination in those ducts.

### Closure Documentation

Work packages were prepared to implement the end point. Verification of attainment was through review of the completed work packages.

## Worker Support and Protection during Post-Deactivation S&M

This section addresses deactivation work which is conducted for the purpose of facilitating post-deactivation surveillance and maintenance. The actual conduct of post-deactivation S&M is beyond the scope of this handbook.

A variety of industrial hazards may be left in the facility. They should be described for the protection of future decommissioning workers. Safety information may be required where there are hazards or special considerations for re-entry of areas. Exit paths in complex facilities may also be called for.

Systems and equipment may be abandoned, preserved, or remain operational. Active locks and tags in place in facilities turned over for long term S&M must be recorded for the turnover information package. Consideration should be given to permanently disabling systems and circuits that will never be used again. The change in organizations, if not contractors, along with new, possibly less experienced personnel, can be an administrative burden with the potential for unnecessary personnel hazards (e. g., electrical shock).

This will be a problem for facilities which have not been systematically deactivated and where tags put in place decades before have no record. There is a reluctance to remove them, and a lack of knowledge of why they were put in place or how to readily eliminate their need. For systems and equipment that are not disabled and for which a tagging system is needed after deactivation, a system in accordance with current OSHA standards should be put in place. Information about the reason for tags and locks should be more detailed than for normal operation because it may be years before there is a need to understand why they are in place. Tags made of material more lasting than paper should be used.

**Identification of Hazards to S&M Personnel**

**Signs and Barriers for Worker Protection**

**Lighting to Facilitate Post-Deactivation S&M**

**SRS Metallurgical Lab Endpoints to Facilitate Post-Deactivation S&M**

**Hazards Removal from SRS Metallurgical Lab**

**Worker Protection Features of Hanford 105-C Reactor SSE**

## IDENTIFICATION OF HAZARDS TO S&M PERSONNEL

Deactivation activities will seldom remove all hazards from a facility. Examples of hazards that remained in and around the UO3 plant at Hanford at the time of an end point assessment (conducted by an Industrial Safety Engineer) were:

1) Chemical residues inside systems
2) Confined, unventilated spaces
3) Radiation and contamination hazards
4) Combustible materials (e.g., electrical wiring insulation)
5) Unguarded/unblocked ladders and open-sided platform hazards
6) Personnel trip and "head-knocker" hazards; unlighted stairwells
7) Vehicle hazards inside fenced area (e.g., abandoned steam/sewer/propane gas lines)
8) Oil residues inside transformers
9) Loose or ill-fitting gratings and floor openings
10) Asbestos in piping, equipment and building insulation
11) De-energized lighting equipment ballasts
12) Unmarked facility escape lanes and sealed (to minimize contamination migration) egress doorways

The official "Hazard Assessment at Deactivation" Report was made a part of the turnover records for the decommissioning contractor. Additionally, reports of potential chemical residues in piping and equipment, with appropriate Material Safety Data Sheets (MSDS), and a confined spaces listing with potential hazards identified, were part of the official turnover records for the deactivated facility. Also, detailed radiation and contamination surveys were made and turned over to the decommissioning contractor.

## SIGNS AND BARRIERS FOR WORKER PROTECTION

Many of the physical hazards which existed in the UO3 plant (see **Identification of Hazards to S&M Personnel**) were resolved by installing physical barriers (e.g., chains) and/or warning signs for protection of personnel during post-deactivation S&M. New signs adopted as part of the Hazard Communication System for the facility included:

- "WARNING: No Unauthorized Access:" installed on the locked gates in the physical security fence erected around the facility and on former access doors to the facility.
- "Equipment Abandoned in Place:" placed on such equipment only after all applicable end points pertaining to that equipment had been achieved.
- "DANGER – Out of Service:" chained to ladders for platforms (formerly) alongside tanks that had been removed (i.e., open-sided platforms), and similar such hazards, along with the above "WARNING" sign.
- "CAUTION – Acid. Be Careful:" placed near piping, valves, and sumps which formerly contained acid, but in which some residual acid might be trapped after being drained.

No special materials were used for signs. They are expected to last at least 5 to 10 years. During post-deactivation quarterly inspections, it is expected that damaged or severely degraded signs will be replaced.

An issue raised during the deactivation of PUREX concerned the disposition of the current permanently installed/posted warning, caution, and information signs in the plant. One proposal under consideration is to spray paint a distinctive color "streak" across all signs that are no longer relevant or applicable, versus expending a considerable effort to physically remove the signs. That convention would also become part of the Hazard Identification System turned over to the decommissioning contractor.

PUREX is using a "Deactivated Facility" sign at the entrance to small outbuildings.

## LIGHTING TO FACILITATE POST-DEACTIVATION S&M

Post-deactivation S&M will require lighting. Options vary from leaving part of the installed system operable to total dependence on portable lights. (Also see **Electrical Systems**.)

Facilities often have small exterior buildings for a variety of reasons. Uses include services, ventilation systems, monitoring instruments, and staging areas. Often these building will be sealed with post-deactivation S&M conducted from the outside so as to avoid having to open and enter contaminated areas.

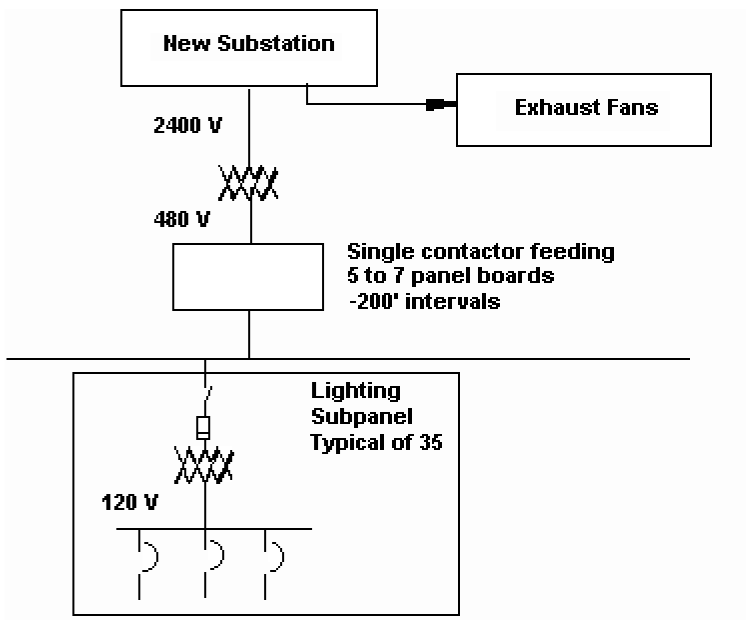
Out-buildings present many of the same challenges to post-deactivation S&M and decommissioning planners as do major deactivated facilities. While the number of systems in out-buildings can be expected to be smaller, similar draining, flushing, cleaning, and housekeeping considerations for facilitating post-deactivation S&M apply. Serviceable portable equipment and consumables should be removed. The amount and location of any remaining hazardous substances/dangerous wastes should be documented. Once the buildings have been isolated and sealed, the principal concerns would be bird and animal intrusion and migration of contamination.

Viewing the interior through a window in the access door may be sufficient in many cases to conduct a periodic surveillance of a sealed out-building. Securing interior doors in the open position would facilitate interior viewing through a window. If small animal intrusion and contamination migration are not major concerns, the solid door with window might be replaced with a small-mesh, steel grating-type door. Surveillance personnel may require a strong beam lamp, since electrical lighting will probably not be provided to the building. Since the out-building is sealed, no building entry would normally be planned, unless post-deactivation S&M activity identified a problem which required immediate correction.

The PUREX canyon facility is very large and includes many electrical systems and a complex distribution. For post-deactivation S&M, a minimal number of circuits is required for:

- Ventilation exhaust fans - the largest load - will be running continuously.
- Monitoring systems (radiation, air flow, etc.) - continuous.
- Lighting - will only be turned on prior to entry.

It was decided to install a separate substation external to the facility. (See discussion of the PUREX example under **Electrical Systems**.) The exhaust ventilation fans being outside of the canyon building made this an easy technical choice. For lighting, a set of subpanels is to be installed with separate feeders from outside the facility as indicated in this sketch.




A single switch outside of the facility will turn on all lights prior to the quarterly post-deactivation S&M entry.

This installation will take place while other deactivation work is in progress, thus not impacting the deactivation critical path schedule. Thus, in addition to the direct cost being much less than reconfiguring the existing system, substantial potential indirect costs associated with schedule impact can be avoided.

**SRS METALLURGICAL LAB ENDPOINTS TO FACILITATE POST-DEACTIVATION S&M**

**Background**

The 322-M Metallurgical Laboratory is a 12,800 ft$^2$ single story building built in four separate sections on a concrete slab. The first section is the original laboratory built in 1956 which consists of 4,900 ft$^2$. The second section was added in 1961 and consists of 1,900 ft$^2$ of additional lab space. The third section is an entire laboratory wing which was added in 1982 and consists of 4,500 ft$^2$. The fourth section was added in 1986 and consists of 1,500 ft$^2$ of offices and a lunchroom.

The laboratory was removed from service in 1995 and was transitioned to a non-operating, inactive facility. At that time, all building systems were shutdown and cleanup initiatives were undertaken to deactivate the facility based on general knowledge of the hazards in the facility and good environmental stewardship. A Deactivation Project Plan was developed and issued in September 1998.

Implementation of the Project Plan has placed the 322-M facility into a passively safe and stable configuration with minimal surveillance and no scheduled maintenance requirements for an extended period of time. Any equipment remaining in the facility with no identified requirements or plans to remove was retired in place without being decontaminated. The facility was locked and de-energized completely, including the shutdown of all ventilation. All utilities were isolated from the facility at its boundary. All loose transferable radioactive contamination in the facility, including material in hold-up, was isolated or fixed in place. All possible pathways for the migration of contamination out of the facility into the environment were sealed.

**End Points**

The following end points were achieved to facilitate S&M:

- Suspended ceiling tiles (which had deteriorated from mold growth and moisture after shutdown of the facility HVAC) were removed from all rooms as well as insulation above the suspended ceilings to provide visual access to the roof for S&M.
- Doors were removed or blocked open leading into all rooms except at RBA boundaries.
- Post de-activation contamination was labeled and mapped.
- RBA conditions were videotaped.
- A long term S&M Plan and Deactivation Project Completion Report were developed and issued.

## HAZARDS REMOVAL FROM SRS METALLURGICAL LAB

**Background**

The 322-M Metallurgical Laboratory is a 12,800 $ft^2$ single story building built in four separate sections on a concrete slab. The first section is the original laboratory built in 1956 which consists of 4,900 $ft^2$. The second section was added in 1961 and consists of 1,900 $ft^2$ of additional lab space. The third section is an entire laboratory wing which was added in 1982 and consists of 4,500 $ft^2$. The fourth section was added in 1986 and consists of 1,500 $ft^2$ of offices and a lunchroom.

The laboratory was removed from service in 1995 and was transitioned to a non-operating, inactive facility. At that time, all building systems were shutdown and cleanup initiatives were undertaken to deactivate the facility based on general knowledge of the hazards in the facility and good environmental stewardship.

**Identification and Status of Hazards**

The following materials have either been removed or assessed as not representing a hazard to S&M workers.

*Hazardous Energy*

Electrical power, chilled water, process water, domestic water, steam supply and plant air (100 psi) are isolated exterior to the facility.

*Asbestos*

Transite paneling was used for exterior sheathing on the original section of 322-M Metallurgical Laboratory and the 1961 addition. Duct and pipe insulation in the facility has been inspected for asbestos and has been properly labeled. There is no identified friable asbestos in 322-M. Potential sources of asbestos containing material (ACM) in 322-M include:

- Floor tile
- Steam line insulation
- Mastics
- Equipment gaskets
- Water heater insulation
- Some installed piping

Final waste characterization during the decommissioning phase will identify whether any of these materials are ACM.

*Fluorescent Light Bulbs*

No fluorescent light bulbs remain installed in 322-M.

*Polychlorinated Byphenols (PCB)*

All known sources of PCB (transformers, lube oil, fluorescent light ballasts) have been removed from 322-M. PCBs may still be present in residual oil films on equipment and in the paint applied to equipment or components prior to 1982.

*Lead*

Lead patches were used to seal some openings in the Transite paneling and lead-headed screws were used to fasten the Transite to the steel beams. The word "LEAD" has been painted on the patches. In addition, poured lead was used in the Sanitary Sewer line joints and lead is contained in the paint applied to the process areas.

*Batteries*

Nickel-Cadmium (Ni-Cd) and lead-acid batteries were removed during de-inventory.

*Mercury Vapor Light Bulbs*

No mercury vapor light bulbs remain installed in 322-M.

*Freon*

Freon was purged from all major HVAC equipment and collected for recycling. No Freon exists in refrigeration equipment in 322-M.

*Tritium*

There are no process sources of tritium remaining in the facility. All exits signs containing tritium sources have been removed.

*Americium*

All smoke detectors with americium sources were removed and disposed.

*Other Hazardous Materials*

The only other known hazardous materials used in 322-M were laboratory chemicals that were removed from the facility during de-inventory.

## WORKER PROTECTION FEATURES OF HANFORD 105-C REACTOR SSE

### Background

A safe storage enclosure (SSE) has been installed over the deactivated Hanford 105-C reactor. The SSE is designed to provide safe storage for the reactor until its decommissioning and one-piece removal. The scope of the project included removal of the fuel storage basin, the fuel examination facility, ancillary support buildings, and all portions of the building structure outside the shield walls that surround the reactor. Steel walls and roof were built up over the reactor using the existing shield walls as the "new" outside walls. The SSE provides a weather-protected containment for the reactor. The reactor block is located near the center of the enclosure. The reactor consists of a graphite block enclosed in a cast iron thermal shield, a biological shield consisting of alternating layers of masonite and steel on the sides, and a seven-foot thick concrete shield on top. The entire block rests on a massive concrete foundation. The block is 46 by 46 by 40 feet deep.

### Worker Protection Features

The SSE, including the roof, has been designed for a 50-year life. Normal S&M inspections are planned at a frequency of once every five years. The following are features which enhance the protection of workers performing S&M activities.

- A new lighting system has been installed for S&M inspections. For further details, see **Electrical Systems**.
- Although normal ventilation is passive, provisions have been made to force-ventilate the SSE in the event that work more intensive than routine S&M inspections is required. See **Ventilation** for further details.
- Intrusion by small animals and insects is prevented by sealing all openings, including sub-surface tunnels and pipes. Only one access door is provided and it is welded closed. Opening of the door requires grinding or cutting retaining mechanisms.
- Barriers and postings are used to prevent unwarranted access to hazardous areas and to inform personnel of conditions that exist at the SSE.

- Maps and routes for S&M inspections have been defined and documented.
- Liquid pipe checks have been performed at low points to ensure no liquids remain. Contaminated piping systems have been sealed. Floor drains have been sealed.
- S&M entries are controlled by Radiological Work Permits.
- All accessible asbestos was removed. It is not expected that asbestos will be encountered during S&M.
- All known hazardous materials (e.g., mercury, PCBs, lubrication oils) that were used during reactor operation have been removed. None are expected to be encountered during surveillance activities.
- Accessible loose contamination within the shield walls was either removed or fixed to the greatest extent possible.

## Disposal, Reclamation, or Sale of Commodities

Some commodities, even though contaminated, may be of use elsewhere in the government or may be sold on the commercial market. Decisions to pursue this must be cost beneficial. Reuse of contaminated chemicals requires a production operation which can use the material and for which the contamination does not create an operational or disposal burden. The potential for waste minimization as well as cost reduction are strong incentives for pursuing such alternatives.

A large amount and variety of non-radioactively contaminated chemicals were left when the PUREX plant went on standby in 1990. Hanford developed a process to sell usable chemicals to the commercial market to avoid having to dispose of them. More than two and one-half million pounds of chemicals have been sold.

**Disposal of Contaminated Solvent**

**Disposal of Contaminated Nitric Acid**

### DISPOSAL OF CONTAMINATED SOLVENT

Reuse of contaminated chemicals requires a production operation which can use the material and for which the contamination does not create an operational or disposal burden. The potential for waste minimization as well as cost reduction are strong incentives for pursuing such alternatives.

There were approximately 20,000 gallons of contaminated kerosene-like solvent left in the Hanford PUREX plant for which several disposal alternatives were evaluated. The selected option, considered to be the best in terms of safety and cost-effectiveness, was to send the solvent to a licensed, commercial incineration facility in Tennessee. This facility generates electricity from the destruction of the solvent.

### DISPOSAL OF CONTAMINATED NITRIC ACID

**Disposal Choices**

When PUREX was ordered shut down in December 1992, a result was the placing in storage of approximately 200,000 gallons of concentrated nitric acid containing uranium at an average concentration of 11 grams per liter. The enrichment level of the uranium in the acid (0.92% U-235) is slightly above the level of naturally occurring uranium (0.71% U-235). The acid contains no appreciable plutonium (less than 1/2 gram of Pu total). The material could not be left in storage during the post-deactivation S&M period.

The original plan for the acid (and the uranium in it) was to be treat it as a waste and transfer it to the Hanford Tank Farms for subsequent vitrification. The processing method for the 10 molar nitric acid was to sugar denitrate the material to approximately 1 molar acid in the PUREX canyon.

However, the project team identified an alternative which would allow the acid to be reused instead of disposed as waste. There was no use for the surplus acid identified within the DOE complex, so private sector interest was solicited. This ultimately resulted in the transfer the acid from Hanford, Washington to British Nuclear Fuels Limited at Sellafield, England.

***Environmental Impact***

The concept of shipping the acid to England for use in a process similar to PUREX was first addressed under the National Environmental Policy Act (NEPA) as a Categorical Exclusion or (CX). After additional consideration, DOE determined that an Environmental Assessment would be prepared to evaluate potential environmental impacts.

The Environmental Assessment analyzed the transfer and concluded that it would minimize waste and waste generation both at Hanford and on a global scale. The scope of the Environmental Assessment included removal, land and ocean transport, and ultimate disposition of the shipping casks.

Preparation, review and approval of the Environmental Assessment took many months. An Ad Hoc review committee, consisting of representatives from three local interest groups, DOE and Westinghouse, was formed to facilitate document preparation and review. Subsequently, the draft document was sent to more than 200 individuals, states, Indian Nations, interest groups and affected public for public comment. Public meetings were held on the east coast at the three proposed shipping ports; Portsmouth, Virginia, Baltimore, Maryland and Newark, New Jersey. During the public comment period more than 50 inquiries for information, clarification or comment were addressed.

A Finding of No Significant Impact or (FONSI) was approved by the Hanford Site Manager in May 1995. Shortly there after the first nitric acid shipments to England were made.

In October 1994, Secretary O'Leary signed a memorandum authorizing consideration of shipment of 183,000 gallons of nitric acid containing slightly enriched uranium from the PUREX plant to the British Nuclear Fuels Limited Magnox Fuel Reprocessing plant at Sellafield, England.

**Shipping the Acid**

The shipping containers utilized to transport the nitric acid from the Hanford site to England were designed and fabricated to the Department of Transportation specifications, the International Atomic Energy Agency (IAEA) requirements, the International Maritime Dangerous Goods (IMDG) requirements, and the "Recommendations on the Transport of Dangerous Goods," prepared by the United Nations Committee of Experts. The containers were designed for radioactivity and corrosion from the acid. Shipments were designated Radioactive Material, Low Specific Activity per the Department of Transportation regulations.

The shipping container had a maximum gross weight limit of 52,900 pounds. This limit accounts for the container's tare weight and the weight of the contents. The tank was sized to accept 3,725 gallons of acid to meet both weight and filling limits. Pre-job safety meetings were held prior to loading the containers with acid. Containers were top loaded using a dip-leg and external pump.

A total of 16 shipping containers was utilized to optimize the shipping schedule in-conjunction with BNFL's processing capacity. Containers were shipped two per week and it took 56 days to make a round trip from Hanford to Sellafield, England and back to Hanford. Containers of acid were dispatched from Hanford Site four hours apart, bound for one of the three possible East Coast shipping ports.

A safety meeting was held with the drivers prior to the shipments leaving the Hanford site. Prior to leaving the Hanford site the tractor, chassis and shipping container were inspected to defect free criteria per the North American Enhanced Container Vehicle Safety Alliance (CVSA) Specifications and Requirements. This inspection was not required for this type of radioactive shipment. However, these inspections were performed as a means to gather transportation data for statistical purposes. The containers were also inspected by the State Police upon arrival in Virginia. Each state, as they deemed necessary, could inspect the shipments as they entered their borders.

Additionally, although not required by Department of Transportation regulation or requirements, each shipment was tracked via TRANSCOM (a satellite tracking system) throughout the continental United State. During the shipping campaign, bi-weekly conference calls were conducted with officials of the states along all transportation corridors.

Each week the two containers were loaded onto a ship bound for England. The containers were off-loaded at Felixstowe, England and placed on rail cars and sent to Sellafield. The contents of the containers were off-loaded and utilized in BNFL's B205 Magnox Fuel Reprocessing facility at Sellafield.

**Bottom Line**

Although the campaign for transfer to England was arduous, abandoning the treatment option and pursuing reuse of the material was well worth doing. Along with other related changes to the project, it shortened the duration of the deactivation project by 10 months, resulting in cost avoidance of $37 million.

[1]"jumpers" refers to removable sections of piping that connect process equipment and were used to configure systems for various process operations.
[2]Since this work was done, DOE Order 5480.7A, Fire Protection, was canceled by DOE Order 440.1, Worker Protection Management for DOE Federal and Contractor Employees, effective 9/30/95, and by the DOE Order 420.1, Facility Safety. The

DOE Fire Hazards Analysis policy is now included in an Implementation Guide for Use with DOE Orders 420.1 and 440.1, "Fire Safety Program" which is currently in distribution (10/95).
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