WEST VALLEY DEMONSTRATION PROJECT
DEACTIVATION OF THE LOW-LEVEL WASTE TREATMENT FACILITY

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INTRODUCTION

As the West Valley Demonstration Project (WVDP) completes the first phase of site cleanup, vitrification of the high-level waste remaining from the commercial fuel reprocessing plant operated from 1967 to 1972 by Nuclear Fuel Services, Inc. (NFS), Project focus has been expanded to Phase II which includes decontamination and deactivation (D&D) of the WVDP facilities. The Low-Level Waste Treatment Facility (LLWTF) was chosen as the first of many site facilities for D&D activities because of its small size and relatively low levels of contamination. These factors were important because the Project had not performed large-scale D&D activities in at least a decade and this facility provided the opportunity to develop D&D methods and skills, and to train new operators. Operations and Maintenance personnel were involved early in the planning phases to take advantage of their diverse skills and experiences, and to ensure safe work practices. This led to the development of the "Deactivation Plan" for the LLWTF, prepared in accordance with DOE/EM-318, "Facility Deactivation Guide: Methods and Practices Handbook." The Deactivation Plan provides the basic methodology and guidance required to place the LLWTF Building in a radiologically and environmentally safe condition.

HISTORY

The original NFS LLWTF processing plant treated radioactive waste waters that contained gross alpha, beta, and gamma activities at a level less than 5.0E-03 μCi/ml. Current operations at the WVDP have continued to use these same facilities. The major components of the LLWTF are: the neutralization pit, the interceptors, four wastewater holding lagoons (NOs. 2 through 5), and the LLWTF Building. Operations within the LLWTF Building included flocculation and clarifying the contaminated water from Lagoon No. 2, with centrifugation to concentrate the bottom sludge. The clarified water stream was filtered through anthracite and then processed through ion-exchange resins primarily to remove strontium and cesium. The water held in Lagoon No. 4 or 5 was then tested and, if satisfactory, discharged to the environment through Lagoon No. 3. The LLWTF Building was used from 1971 through 1998. During 1997, a new water treatment facility (LLW2) was constructed to take advantage of changing purification requirements and improved technology for processing the low-level liquid, and at the same time consolidating new groundwater treatment facilities under the same roof. Concurrently, plans for deactivation of the LLWTF Building were started and by May 1998, clean-out operations were begun.

SUMMARY

The project to deactivate the building portion of the LLWTF was successfully completed in August 1999, leaving the shell of the building in a safe, stable, and mostly passive state. This state minimizes hazards to personnel and the environment. As such, this facility will be convenient to surveil and monitor over a long period of time with minimal costs. In addition, since any radioactive contamination left within the structure has been identified and recorded, the scope of future actions, such as rubblizing the structure, will be easier to evaluate. The project activities started with securing the process systems from other operations of the site and then removing: waste materials, including radioactive resins, from the ion-exchange beds; radioactive anthracite from the filter tank; and sulfuric acid from a storage tank. All nonessential permanent utility feeds to the LLWTF were isolated and disconnected. Temporary services were provided for electricity, air, and water. Communications and site "All Page" services remain fed from the original utility. All reusable equipment was removed. Asbestos-containing insulation, previously identified, was

removed from utility and process piping at locations where piping was to be cut, with the remainder staying with the piping as it was removed. The utility piping, conduits, and equipment were then removed. A majority of the process piping and equipment were acid-flushed to remove built-up scale and residual radioactivity. The piping and equipment were then removed. Finally, the cold side ventilation system was removed and building components to be left intact were surveyed for future reference. Throughout the deactivation activities, all waste generated was segregated by waste stream. Data Quality Objectives (DQOs) and a subsequent Sampling Analysis Plan (SAP) were developed to provide the guidance necessary to perform sampling and analysis of each waste stream for radiological and hazardous characterization. Each waste stream was sampled and analyzed in accordance with WVDP-312, "Sampling and Analysis Plan for Classifying and Characterizing Waste Generated During the Demolition of the 02 Building" as it was generated, and then efficiently packaged for disposal.

PHYSICAL DESCRIPTION

The LLWTF Building is a two-story, steel-framed concrete block structure measuring 27 by 39 feet, with an attached office area and an adjacent 25 by 50-foot bermed concrete slab. The first story of the building contained a sump with submerged water pumps for the incoming water to be processed, a sludge drumming and loadout station, two ion-exchange columns, a process chemistry control area, and an associated instrument control panel. The second floor housed the chemical make-up area, the process chemical area, a centrifuge and monorail-hoist system, a motor control center, a steam boiler, and the ventilation filters and blowers. The outdoor bermed pad contained the waste water flocculator-clarifier, surge tank, anthracite filter, recycle tank, and bulk acid storage tank. All floor drains returned any rain or excess process waters to the feed sump which, in turn, would return its excesses back to the feed water lagoon (Lagoon No. 2).

DEACTIVATION PROJECT ACTIVITIES

The activities within this section were performed to deactivate the LLWTF Building. All deactivation activities were performed in accordance with WVDP-338, "Low-Level Waste Treatment Facility (LLWTF) 02 Building Deactivation Plan." This Deactivation Plan was prepared in accordance with DOE/EM-318, "Facility Deactivation Guide: Methods and Practices Handbook." Deactivation was performed to place the LLWTF Building in a safe state that can be monitored and maintained. In addition, placing the LLWTF in a deactivated state minimizes hazards to personnel and the environment. Deactivation activities consisted of: removing most equipment and miscellaneous items, acid-flushing the process piping and equipment using nitric acid then rinsing the piping with water and removing it, isolating the building's nonessential permanent utilities, and removing miscellaneous materials. In addition, containerized nonhazardous waste generated during deactivation activities was removed from the building. The LLWTF Building will remain in the deactivated state until it is demolished.

REMOVAL OF CONTAMINATED/NONCONTAMINATED MATERIALS

Ion-exchange resins, anthracite filter media, asbestos, and sulfuric acid were removed early in the project in order to ensure a safe environment for further work activities.

Ion-Exchange (IX) Resins

There were two IX columns, constructed of carbon steel with a polymer lining, each measured 4 feet in diameter by 9 feet high, with a capacity for 65 cubic feet of resin. The contents included a lower area filled with several layers of varying sized quartz as a support for the zeolite resin that filled the balance of the columns. Working to a Standard Operating Procedure (SOP), plant operating personnel removed the contents through a side manhole. Since the resins were lumped together, shoveling and scraping were required to remove the upper portions. Finally, the material below the access port was removed with a high efficiency particulate air (HEPA) vacuum filter. The resin and quartz materials were packaged into drums with rigid polyethylene liners, and moved to storage for later disposal.

Anthracite Filter Media

The most challenging of the deactivation operations in this project, removing the media from the anthracite filter, was also the biggest success in planning, execution, and results. The filter, 10 feet in diameter by 24 feet high, consists of three chambers: the water inlet and distribution chamber at the top, the filter media chamber in the middle, and the filtered water collection chamber at the bottom. The granular anthracite media measured two feet deep. There were five major steps to accomplish this job: testing to ensure that all the liquid had been drained from the anthracite, sampling the anthracite media to determine its properties, designing and providing equipment and a procedure for removal of the media, ventilation of the vessel, and finally, access to the filter media and removal of this material. Three accessible ports existed in the filter chamber: a flanged drain connection at the bottom, an upper view port, and the main access panel for loading and unloading the media.

Liquid Test and Media Sample

A flanged connection at the bottom of the filter media chamber was closed with a blind flange. An auxiliary flange equipped with a telltale drain was attached, with the drain line routed to a working pad drain. Upon penetrating the blind flange, no free liquid was found. The drill was removed into pre-placed plastic sleeving and a sample thief, fabricated to fit the same opening, was inserted to retrieve a very small sample of the anthracite. The sample gave evidence of the radiological contamination levels of the filter media. The next samples were obtained from the drums of media as the media was removed from the filter.

Ventilation of the filter chamber above the anthracite bed was achieved by replacing the view port with an adjustable slide gate and duct adaptor, using a custom-made glove bag. Next, a portable ventilation unit (PVU) and the appropriate connecting ductwork were installed.

The filter chamber access hatch was located at the building's second level and was accessible from a working platform. In order to inspect and probe the bulk of the anthracite, the main hatch cover was removed and was replaced with a lighter plexiglass cover. To achieve this safely, a glove bag was designed and secured to the outer area of the filter compartment. This glove bag was large enough to contain the covers, tools, and bagging material, and still left enough room to loosen the fasteners and contain the probes. Once the hatch cover was removed, surveyed, and bagged for disposal, the cover was removed from the glovebag.

The anthracite was observed to be dry on top and caked over with a three-quarter-inch layer of dried and checkered mud. Probing showed this material was not caked throughout the bed and that the bulk of the bed below the crust was wet but did not contain free liquid. The temporary plexiglass cover was installed and the glove-bag was then removed.

Equipment Design and Procedure Demonstration

There were two primary areas of concern: the access and removal of the anthracite/mud mixture from the filter chamber and the packaging of the waste for later disposal. The experiences and creativity of a diverse representation of the on-site resources were pooled to come up with methods to solve these problems. Under the lead of the D&D Projects Group, Radiological Engineering, Radiation Protection Operations, and D&D Operations demonstrated the spirit of Integrated Safety Management Systems (ISMS) by working closely together in designing a functional system. Then other groups, such as

Industrial Health and Safety, and Environmental Affairs, provided input during the review process. It was decided that a vacuum system leading directly to a polyethylene-lined drum and then to a HEPA filter system would be more effective, much cleaner, and safer than a scooping/shoveling approach, and that a mock-up of the system would be necessary because of the nature of the material and the difficulties anticipated in reaching all the areas within the filter chamber through the access opening that measured only 12 x 18 inches. A mock-up of the flanged hatch opening was constructed from plywood, as was an open-top box to hold the simulated mixture. The box was scaled down to represent only a portion of the filter bed and it was moveable so that it could be positioned to test operations at any location within the much larger 10-foot diameter filter.

A mixture was developed for trial operations simulating the mixed media found in the filter. Unused replacement anthracite available in the Warehouse, bentonite clay available from the Utility Room water purification system, soil from the site, and water that was mixed and dried, produced a very representative material. This mixture was placed into the mock-up box.

The vacuum system was powered by a RadVac™ air-motor driven vacuum unit with a separate HEPA filter. The hoses selected for vacuuming the anthracite simulant were two-inch diameter, wire-reinforced vacuum suction hoses. The suctioning end was attached to one of several poles or sectioned handles, with several arrangements eventually selected to reach different locations within the filter media chamber. The waste receiver was an open-top, 55-gallon drum with a rigid open top polyethylene liner. A filling lid was procured from the RadVac™ system manufacturer and modified by West Valley Nuclear Services Company (WVNS) to deliver the anthracite vertically into the top of the polyethylene-lined drum. The lid was originally designed to seal against the metal drum, but was modified to also seal against the rigid polyethylene liner to avoid a loss of vacuum, eliminate the spread of contaminated anthracite outside the poly liner, and provide physical support to the liner while it was under vacuum. This design effectively dropped the solids into the drum.

Operation of the mock-up system proved invaluable in providing data for the design of the tooling, in establishing the amount of operating room needed, and determining the radiological controls that would be necessary, not only when things were running well, but more importantly when problems such as plugged hoses and equipment failures occurred. The mock-up operation also established that it was necessary to interrupt filling, lift the lid to check the level, and determine when rotation of the fill lid was necessary to ensure even distribution of filter media in the polyethylene liner. A radiation monitor remote sensor was suspended adjacent to the filling lid so that if the radiation field were higher than expected when the poly liner was being filled, the operator would be provided with an immediate warning.

Hot System Construction and Operation

Drum filling operations, radiological containment, and the handling of drums were major concerns. An aisle area on the first floor of the LLWTF with a roll-up door and an access apron from the adjacent roadway was selected. A containment tent was designed to house: empty drums for filling, some filled drums, a knockout drum in the vacuum system, a roller conveyer weight scale, and working spaces for the operator and a radiation protection technician when needed. The vacuum knockout drum was connected to a RadVac™ with an internal HEPA filter. The tent was connected to a smaller RadVac™, also with an internal HEPA filter, to ensure positive air flow into the containment tent. Both of the RadVacs™ were placed outside the tent to reduce the noise level for the operator and to facilitate maintenance should it be necessary. The drums were placed on a roller conveyor that led out through the tent door to the entrance apron where a pallet was placed for later transportation of the drums. Square steel support plates were placed under the drums to facilitate easy and safe rolling on the conveyor. At the filling point, a weight scale was modified with a conveyor section, allowing control of the amount of anthracite added to each drum. As the filling and sequencing of the drums out of the tent proceeded, an empty drum would be placed on the weight scale at the head of the conveyor to accept the filling lid thereby eliminating the need for a separate resting stand or support for the somewhat contaminated lid. Dry-run, or "mock-up" operations resulted in some minor improvements and demonstrated the system to be workable.

The end of the hose for removing the anthracite from the filter was fit with an adaptor to provide both an attachment point for the handle and to provide a scraping nozzle for loosening and directing the congealed material. The design of these components of the removal system was tested and refined in the mock-up of the system. On the second level, herculite was laid on the deck at the access hatch as spill prevention. The plexiglass cover was removed and the hoses strung to the drum filling area. Care was taken to ensure that the hoses had a continuous downward slope to facilitate the flow of the solids. The vacuum nozzle and the vacuum hose were equipped with threaded stud and nutted sectioned handles. Attachment of the hose to the handle varied with the location of the work.

Operations were very successful, with only a few problems that were readily overcome. Hose plugging was common, but generally was overcome by very aggressively shaking or tapping on the hose. On two occasions the plugging could not be overcome and the hoses were simply replaced. In the drum filling area, two of the rigid polyethylene liners partially collapsed from the vacuum. No spillage or damage occurred. When operations were completed, the vacuuming system was used to transfer the material from these damaged drums to two new drums. When finished, 23 drums, totaling approximately 170 cubic feet, were filled and the filter was empty.

Process Piping and Equipment Scale - Acid Flushing

Years of processing water had resulted in accumulations of hardness scale (calcium, magnesium, and other salts) and other absorbed radioactive and chemical impurities in the process piping and equipment. Testing of samples indicated that this piping, if disposed of "as is," would result in the generation of Class "B" wastes. At the present time, only Class "A" waste can be shipped off site for waste disposal. Therefore, it was decided to reduce the radioactive contamination levels inside the piping prior to removal, so that the waste generated would be Class "A" waste versus Class "B" waste. In addition, the current cost for disposal of Class "A" waste is $ 13.60/ cubic foot, while the current cost for disposal of Class "B" waste is $ 325.00/ cubic foot. Reduction of the class of waste generated from "B" to "A" results in cost savings of $ 311.00 per cubic foot. Acid flushing of the piping was considered the most direct and efficient method of ensuring Class "A" waste.

Nitric acid ($HN0_3$) is a strong acid and is ideally suited to removing the type of calcium carbonate material that had built-up inside the stainless steel process piping. Nitric acid had been used with success for years at the LLWTF to remove localized buildups in line segments or equipment. Frequently this was done when maintenance was required. Nitrites generated as a result of nitric acid use caused concern over the site's State Pollutant Discharge Elimination System (SPDES) limitations. Other strong acids that were available for use, namely hydrochloric acid (HCl) and sulfuric acid (H_2SO_4), were considered but determined to be poor choices. Hydrochloric acid dissolves stainless steel into its constituents, including chromium which on its own presents a specific site SPDES release problem. Sulfuric acid, on the other hand, produces calcium sulfate as a reaction product that has a very low solubility and would act to slow the removal process by shielding the unreacted scale. This by-product would also require handling either a slurry or a very dilute solution, creating additional handling and disposal problems. Weaker acids such as acetic acid were tested in the laboratory and found to work much more slowly than strong acids. In the end, nitric acid was chosen as the acid to use to flush the LLWTF process lines. Again, laboratory tests indicated that a 4 to 5% concentration would be both effective and manageable.

Three distinct flow loops were selected for flushing to cover all the process piping: Loop 1 - feed lines, Loop 2 - IX columns and associated piping, and Loop 3 - anthracite filter system. In each case, piping existed to utilize an existing system pump. A surge tank was added to provide a convenient test spot to monitor the progress of the reaction and to allow the release of the by-product carbon dioxide gas. Estimates of the total acid required were prepared, but only a portion of this quantity was added at one time, minimizing the possibility of having to dispose of excess acid. As an initial test of the work instructions, the process piping was flushed with soft water using the acid flush work order. This test operation: provided a basis for checking the accuracy of the work instructions, increased operator familiarity with the process, checked for leakage, and checked the flow loops for full coverage. Comments and observations were then incorporated into the final acid flush work order. The work was performed in January 1999, which for disposal purposes, took advantage of favorable lagoon chemistry and flow rates. Before discharge, the waste acid solution was neutralized with sodium hydroxide pellets. Approximately 4,500 gal. of neutralized flush solution was sampled and tested for gross α, gross β, pH, and total chrome. The results of the sampling were: gross $\alpha = 3.64e^{-7}$mCi/ml, gross $\beta = 2.91e^{-4}$mCi/ml, pH = 7.58, and total chrome = 0.487 mg/ml.

The old interceptor tank, part of the site interceptor system, was used as a holding container for the neutralized flush solution. Working to an established SOP, the contents of this interceptor tank were later transferred intermittently into the new Low-Level Waste Treatment System (LLW2) at controlled rates within the limitations of the SPDES permit.

Several sections and dead legs of piping could not be effectively flushed and therefore both the flushed and unflushed process pipes were identified by color coding so that they could be treated properly and handled safely when removed.

Removing scale from the clarifier was handled as a separate project; filling the unit with softwater, slowly adding nitric acid, and operating the rake and agitator systems. Several pipe openings near the top were closed off, while the bottom outlet was modified to handle the final discharge, which had some expected undissolved solids. Estimates of the amount of scale, combined with the very large volume of approximately 17,000 gallons of water, resulted in an estimated final acid strength of about 1 percent, lower than that used for the piping. Again, the graded approach was used when adding the acid in several portions, which also allowed control of the by-product carbon dioxide gas and minor amounts of foam. At the end, a small amount of excess acid was neutralized with sodium hydroxide before pumping the neutralized solution to the old interceptor tank for intermittent transfer to the LLW2 treatment system.

Asbestos Abatement

Asbestos Containing Materials (ACM) were found primarily in the piping insulation. Approximately 350 linear feet of piping with ACM insulation existed in the facility, consisting of the exterior process and wet utility lines and the interior steam lines. The removal was done in four stages. First, since the lines with ACM insulation had previously been identified by the site's New York State Department of Labor (NYSDOL)-certified asbestos project designer, no individual testing was required. All field work was done by NYSDOL-certified asbestos handlers and supervisors. When the lines were drained, the ACM insulation was boldly color coded for their entire pipe line length. Second, all pipe lines with ACM insulation were double-wrapped with plastic, and cut lines were marked at approximately six-foot intervals for convenient packaging into "Industrial Packages" as defined in 49 CFR § 173.403 (i.e., S-70 container). Third, the ACM insulation was removed from the cut points using glove bags. Fourth, and finally, the piping was cut at the uninsulated points with the bulk of the insulation remaining in place. These segments of pipe were then packaged for disposal.

Sulfuric Acid

Concentrated sulfuric acid was, and still is, used to adjust treated water pH as needed. The storage tank for this acid had a capacity of 3,000 gallons. However, due to working off the inventory in anticipation of the shutdown of the old system, less than 100 gallons of acid remained. The acid was tested to ensure its quality and then transferred to the storage tank at the new LLW2 treatment system. The tank was then washed until the discharge pH was neutral, with no chemical neutralization required, and then removed.

Isolation of Building

One system at a time, process lines and nonessential utility services to and from the building were identified, isolated, and terminated by severing the lines. Then replacement utilities consisting of electric, soft water, and utility air were provided in a manner that would make them easily identified and disconnected as needed at some future date. This approach was taken because over the years of operations, plans for expansion, shutdown, and restart for vitrification, many changes had taken place and historic records were not always kept up to date. Where any question existed, the approach was conservative.

Process Piping Termination

Only three process lines were involved: the feed of contaminated water from and an interconnected overflow return to feed Lagoon No. 2, and the discharge of purified water. In constructing the new LLW2 treatment system, a new feed line was required because of the facility locations, starting from the existing lagoon pumping station. When the transition was made from the old system to the new, the piping was changed at the pumps. Due to space consideration, a portion of the old feed line was removed in the pump house and capped. The balance of the old line ran underground through contaminated soil and was left in place. The overflow/return line from the old building feed sump was left in place because as decontamination activities proceeded, it was convenient to return some of the contaminated liquids to Lagoon No. 2. The new LLW2 treatment system was built with an entirely new overflow/return line so that no transition was necessary. Finally, the purified water discharge line, which led to two parallel hold-and-test lagoons (NOs. 4 & 5), was cut at a point near the lagoons where the new system discharge line was run. The old line was disconnected in an existing valve pit after it exited the LLWTF Building.

Utilities Termination and Replacement

The utilities servicing the building included potable water, soft water, steam, condensate return, utility air, and natural gas. Each service was walked down by the Plant Operations staff. As part of these walk-downs, each service was traced out into the surrounding yard areas. This was an area of major concern because many unrecorded changes had occurred in this area. Carefully following established lock-out / tag-out (LOTO) and line breaking procedures, nonessential services were valved out, lines vented, lines capped, lines to be removed were color coded, and continuity of services to the other operating areas assured.

Remaining utilities included only soft water, natural gas, and utility air. Where the softwater and utility air entered the LLWTF Building, they were set up as hose stations. Hoses were then strung to points of service as needed. In the absence of potable water, self-contained portable safety-shower / eye-wash stations were placed as needed. New telephone and emergency communications "All-Page" lines were installed and clearly marked to distinguish them from the old systems.

Services to the hold-and-test lagoons (NOs. 4 & 5) include soft water and utility air, and had previously been supplied from the LLWTF Building. In constructing the new LLW2 system, these services were also switched to be supplied from the new facility.

Electrical power for lighting and operation of essential equipment was required. A power distribution trailer was designed to provide "plug-in" service for 480V, 240V, 120V power, with the thought that this distribution center could be relocated to a new area as needed after the current service was completed. The distribution trailer fed essential equipment/components via separate circuits. Circuit breakers in the trailer control panel provided essential component isolation when needed. The Motor Control Center (MCC) serving the LLWTF Building was located on the second floor, so the power trailer was placed there. The power supply cables that had fed the MCC were discontinued and redirected as the feed to the distribution trailer. All required temporary services inside the building were provided via temporary cables, with all 480V service cords clearly labeled. Temporary light stringers were also installed and could easily be moved when necessary. Temporary heat was provided as needed by construction-type electrical heaters. Permanent electrical conduits within the LLWTF Building process areas were abandoned for demolition with three exceptions: 480V power that fed the MCC was redirected to the trailer, power to the 2nd floor hoist and beam heaters, and the conduits and distribution center in the LLWTF office. After the 480V power was redirected to the trailer, the MCC internal hardware and main distribution panel was removed by qualified maintenance electricians, confirming electrical power isolation. Thereafter, all conduits, fixtures, motors, controls, and equipment hardware were safe for removal.

Equipment and Piping - Dismantling and Removal

Once the process lines had been flushed, all the terminations of nonessential services and process connections had been completed, and electrical power had been isolated, removal of the piping and equipment became a straightforward operation. All previously painted and steam and condensate piping were considered suspect contaminated and, therefore, packaged as radioactive waste. All other piping, fittings, conduits, components, supports, etc. that were not painted, were surveyed for radiological contamination and, if appropriate, were free-released. To make efficient use of scaffolding set-up and relocation, it was then practical to remove items area by area, rather than moving along each piping run independently. All items were size- reduced to fit efficiently into the black disposal boxes.

The centrifuge assembly weighed approximately 1,740 lb. and the safe working load of the existing lift beam mounted above the centrifuge was 700 lb. It was agreed that the most practical thing to do would be to disassemble the centrifuge into smaller components weighing no more than 700 lb. each. Even though the centrifuge had been operated only one time, it was flushed to remove internally contaminated deposits. Acid flushing was not practical, so a water flush, with the centrifuge operating, was performed to remove the contaminated debris in the machine and chute. The flush water was directed down the discharge chute to an area floor drain below that, in turn, flowed to the building sump. The centrifuge was disassembled and the components bagged or wrapped to prevent the spread of contamination. These components were then placed into a black box and blocked with wood to prevent movement. The centrifuge discharge chute was known to be radiologically contaminated. However, due to its shape, normal fixatives could not be applied. The chute was then filled with foam to fix the contamination and then cut into pieces for packaging.

Two ventilation systems serviced the building, one called the cold side and one called the hot side. The cold side system served the general area of the building where little contamination was present and was carefully dismantled and disposed of as radioactive waste. The hot side system served the centrifuge sludge drumming, load-out, and associated areas where higher levels of contamination were present. It has been left with the building shell for possible future use.

Large pieces of equipment have been left in place, with plans to remove them when the final disposition of the building has been determined. These include the IX columns, anthracite filter, clarifier, and the recycle and surge tanks.

WASTE STREAM SAMPLING AND ANALYSIS

Purpose

This section summarizes the sampling protocol, analytical requirements and evaluations, and characterization processes associated with the LLWTF Building Deactivation Project. Waste materials generated during the deactivation activities require the following:

- Characterization to determine the radioactive waste classification in accordance with 10 CFR §61.55.
- Characterization to determine the Resource Conservation and Recovery Act (RCRA) hazardous characterization in accordance with 40 CFR §264.24/6 NYCRR §371.2.
- Evaluation to assess whether the waste material's radionuclide concentrations and chemical constituent concentrations meet the waste acceptance criteria (WAC) of the designated waste disposal facility.
- Classification in accordance with the U.S. Department of Transportation requirements.
- Cost Benefit Analysis (CBA) required in accordance with DOE Decommissioning Handbook, EM 0142P, to determine which, if any, waste materials are candidates for decontamination and subsequent volume reduction of the radioactive waste materials.

Data Quality Objectives (DQOs) Process

Pursuant to the requirements of WV-902, "Planning for Data Collection Activities," a Planning Team was formed to determine if DQOs and a subsequent Sampling Analysis Plan (SAP) would be required. The Planning Team consisted of personnel from Radiological Engineering (RE), Radioactive Waste Services (RWS), Waste Management Operations (WMO), Environmental Affairs (EA), Quality Engineering (QE), Decommissioning Planning (DP), and Dames & Moore (D&M). The determination made by the Planning Team was that DQOs and a SAP would be required for the LLWTF Building Deactivation Project, and that the CBA phase and characterization phase would each require separate DQOs.

DQOs for CBA Phase

The purpose of the CBA was to determine the cost effectiveness of radiological decontamination of all or portions of the 02 Building so that the resultant material could be released as industrial waste material. This radiological decontamination process, if performed, would serve to volumetrically reduce the radioactive waste material that would be generated as a result of the decommissioning project. The analytical scope of the CBA DQO was limited to gross α, gross β, and a gamma isotopic scan as identified in WVDP-312, "Sampling and Analysis Plan for Classifying and Characterizing Waste Generated During the Demolition of the 02 Building."

DQOs for Characterization Phase

This phase of the DQO process established the criteria to determine the required samples and analytical parameters for the waste materials that will be generated in the event the CBA evaluation has determined that radiological decontamination of the 02 Building is not cost effective. In addition, the DQO defined the sampling and analytical criteria used for those materials known to be of a nature where radiological decontamination was not practical. The scope of the characterization DQO included full radiological analysis and was incorporated into the project SAP (WVDP-312).

Cost Benefit Analysis (CBA) Sampling and Analysis Process

The sampling and analytical requirements detailed in the sampling work document were based on the DQO, which was attached to the work document to ensure accuracy. The steps required to complete the work document and associated off-site shipment of the samples were:

- Prepare and issue the Work Order (WO) for CBA sampling.
- Perform CBA sampling in accordance with DQO requirements.

- Send the CBA samples to an off-site laboratory for analytical requirements of the DQOs which include gross α, gross β, and gamma isotopic. The off-site laboratory performs the analysis and transmits the analytical results to the A&PC Laboratory at the WVDP.
- The A&PC Laboratory validates the analytical data.
- The validated results are forwarded through the cognizant engineer to the Decommissioning Planning Group for input into the CBA. The cognizant engineer also forwards the validated analytical report to the statistical evaluator to determine if additional samples are required for the characterization of the waste materials to be generated.

Cost Benefit Analysis (CBA) Evaluation

Performance of the CBA evaluation is the responsibility of the Decommissioning Planning Group. Once this evaluation has been completed, it will be forwarded to the D&D Projects manager for implementation.

Characterization Sampling Plan Phase I

The first sampling campaign involved the steps required for characterization of the structural steel, concrete, and miscellaneous hardware to be generated. A preliminary CBA had determined that radiological decontamination would not be cost effective. A compositing scheme was developed for the paint and cement samples already collected and present at the vendor's laboratory. These composite results will be utilized for the cement, structural steel, and miscellaneous hardware waste streams' characterizations, and the determination of related scaling factors. Compilation samples of paint and cement were correlated to the cement waste stream, while paint-only samples were used to correlate to the structural steel and miscellaneous hardware waste streams. Three samples and one duplicate were analyzed for each of the two composite types. Characterization samples were analyzed for "Total Rad Analysis," which consists of:

- 10 CFR §61.55 Table 1 Radionuclides.
- 10 CFR §61.55 Table 2 Radionuclides.
- Isotopic uranium (U) analysis.
- Isotopic plutonium (Pu) analysis.

Characterization Sampling Plan Phase II

The second sampling campaign involved sampling and analysis of waste materials that were generated regardless of the radiological decontamination of the 02 Building. This waste material includes process piping, anthracite, drumming station equipment, roofing material, a HEPA filter, and roughing filter material. In addition to the radiological analysis identified in Section 6.5 above, analyses for selected chemical constituents were completed for the roofing material and anthracite waste material. The sampling protocol for each waste stream was unique and is discussed below.

Anthracite

Samples were required for both radiochemical and chemical constituent analysis. A very significant concern was to determine when material to be sent for off-site analysis became a sample, as the chemical constituent analysis required mercury metal analysis which has a 28-day holding time.
Composite sampling was originally determined to be the method for both radiochemical and chemical sampling. Prior to initiation of sampling activities, the question was raised concerning the composite samples for the chemical constituent analysis. It was felt that due to the length of time required to collect the composite sample (i.e., collected from each interim storage drum as generated) the 28-day holding time for metal mercury analysis would be exceeded. A second position was that the composite sample did not become a sample until the material that was to be analyzed was collected from the composite container. The composite sample did not exist from the time the first material was placed into the composite container. It was decided that the laboratory that was to perform the chemical constituent analysis would

be contacted to address this concern and that their opinion would be considered in development of the sample plan. In consultation with the laboratory, it was decided to utilize grab sampling for the collection of chemical constituent samples.

Radiochemical Sampling and Analysis

Four composite samples were collected (three and a duplicate) for "Total Rad Analysis." There is a six-month holding time for radionuclide analysis, so there was not a concern of sample collection time versus start of analysis. The samples were sent to the off-site laboratory to perform Total Rad Analysis.

Chemical Sampling and Analysis

As stated previously, the off-site laboratory that was to perform the analysis was contacted for their input on when a sample becomes a sample. The laboratory stated that in their opinion the composite sample is created when the first material that makes up the sample is placed into the compositing container, not when the sample material is removed from the compositing container.

At this time it was decided to utilize grab samples rather than composite samples for the chemical constituent analysis. It was felt that the 28-day holding time would be exceeded by attempting to collect composite samples. Therefore, four grab samples (three and a duplicate) were collected for chemical constituent analysis. The chemical constituent analysis consisted of Toxicity Characteristic Leaching Procedure (TCLP) metals.

Process Piping

Samples were initially required for both radiochemical and chemical constituent analysis. There were areas of concern that were discovered during the initial preparation of the work order to perform sampling.

The first concern identified was that the proposed sampling protocol for chemical constituent analysis was outside the guidelines of Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Toxicity Characteristic Leaching Procedure (Method 1311) for sample collection to perform TCLP analysis. The proposed particle size of the sample was well beyond the recommended particle size identified in Method 1311. In addition, the laboratory that was to perform the radiochemical analysis was unwilling to attempt analysis on the samples that WVNS proposed to send, due to the size of the samples (six- inch length pipe). This laboratory did not feel confident that they could correlate the analytical results to a specific concentration for the radionuclides that would be identified. Furthermore, the majority of the process piping had been acid flushed (> 95%) and this was not considered in the original SAP. Numerous discussions took place between WVNS personnel and off-site laboratory personnel to alleviate the concerns and provide alternatives that would satisfy the requirements of the SAP, WVDP-312. The resultant sampling protocols are discussed in their respective sections below.

Radiochemical Sampling and Analysis

In communications with Analytical & Process Chemistry (A&PC) and the off-site laboratory, a decision was reached on the sample size. It was decided to use coupon samples ranging in size from 4 to 12 grams for the analysis. Four composite samples of coupons were collected from both the acid-flushed piping and the unflushed piping. The unflushed process piping waste stream would be grouped with the drumming station equipment waste stream for characterization and scaling factor determination. The samples were sent to the off-site laboratory to perform Total Rad Analysis in accordance with WVDP-312.

Chemical Sampling and Analysis

Waste Management Services of WVNS determined that sampling this process piping waste stream for hazardous waste characterization would not be required. The 02 Building was not utilized as a wastewater treatment facility so there was no reason to suspect the presence of RCRA chemical constituents. Therefore, further analysis for TCLP Volatile Organic Analysis (VOA), Semi-VOAs, Pesticides, and Herbicides was not needed. In addition, the results of the anthracite filter media analysis were utilized to confirm that metals were not present in this waste stream. Similarly, sampling for chemical analysis of the miscellaneous hardware and drumming station waste streams was not necessary.

Roofing Material

Samples were required for both radiochemical and chemical constituent analysis. There were no areas of concern identified with sampling this waste stream. The sampling protocols are discussed in their respective sections below.

Radiochemical Sampling and Analysis

Three composite samples and a duplicate composite sample were collected. The samples were sent to an off-site laboratory to perform Total Rad Analysis.

Chemical Sampling and Analysis

One composite sample and a duplicate composite sample were collected. The samples were sent to an off-site laboratory to perform TCLP-VOA, Semi-VOA, Pesticides, Herbicides, TCLP Metals, and copper and zinc analysis.

HEPA Filter and Roughing Filter Material

Samples were required only for radiochemical analysis. There were no areas of concern identified with sampling this waste stream. Three composite samples and a duplicate composite sample will be collected prior to demolition of the 02 Building. The samples will be sent to an off-site laboratory to perform Total Rad Analysis.

CONCLUSION

Deactivation of the LLWTF Building has been successfully completed by placing the building into a safe, stable, and passive state that can be monitored over a long period of time with minimal cost. The layers of protection that have been afforded as a result of deactivation are elimination of hazards, effective facility containment, and facility monitoring and control. All deactivation activities identified in WVDP-338, "Low-Level Waste Treatment Facility (LLWTF) 02 Building Deactivation Plan" have been completed.

In addition, sampling and analysis has been completed for both the Cost Benefit Analysis and Characterization phases of WVDP-312, "Sampling and Analysis Plan for Classifying and Characterizing Waste Generated During Demolition of the 02 Building." All waste streams identified within WVDP-312 have been characterized except as noted. The Cost Benefit Analysis has been performed that gives the basis for radiological decontamination of waste streams or disposal as radioactive waste of those same waste streams. The Cost Benefit Analysis is contained in a separate document.

Overall, the deactivation of the LLWTF Building was a huge success that incorporated Integrated Safety Management System criteria throughout the project. Lessons Learned are identified in Section 8.

LESSONS LEARNED

In the development and execution of this project, two issues highlighted the fact that deactivation operations are different from normal operations, maintenance, or construction. These covered knowledge of the facility and hazards related to the inexperience of personnel.

Knowledge of the Facility

Since the facilities were old and because of ownership changes, records were not always complete or up to date. Extra time was needed at all phases of the project, from determination of configurations and sources of utilities, to establishing procedures for first cleaning and then removing equipment. The knowledge of people who knew the history was a valuable asset.

Line Breaking

Lock-out/tag-out (LOTO) and line-breaking take on new meanings when doing a deactivation project. As stated earlier, no work was done inside the building until all lines leading into and out of the building had been identified and isolated. Thereafter, LOTO was not required on individual subsystems. However, stored energy was still present in some lines that could not be drained conveniently. Again, extra time and attention were required. The cognizant engineer, field supervisors, and mainly the operators who may not have had much previous experience in the operation of the old systems, each had to be very thorough in determining each step. With patience and planning, we completed the work without injury.

GLOSSARY

Acronym	Meaning
ACM	Asbestos Containing Materials
CBA	Cost Benefit Analysis
D&D	Decontamination & Decommissioning
D&M	Dames and Moore
DP	Decommissioning Planning
DQOs	Data Quality Objectives
EA	Environmental Affairs
HEPA	High-Effeciency Particulate Air Filter
ISMS	Integrated Safety Management System
IX	Ion-Exchange
LLW2	New Low-Level Waste Treatment Facility
LLWTF	Low-Level Waste Treatment Facility
LOTO	Lock-Out/Tag Out
MCC	Motor Control Center
NFS	Nuclear Fuel Services, Inc.
NYSDOL	New York State Department of Labor
PVU	Portable Ventilation Unit
QE	Quality Engineering
RCRA	Resource Conservation and Recovery Act
RE	Radiological Engineering Services
RWS	Radiological Waste Services
SAP	Sampling Analysis Plan
SOP	Standard Operating Procedure
SPDES	State Pollutant Discharge Elimination System
TCLP	Toxicity Characteristic Leaching Procedure

VOA	Volatile Organic Analysis
WAC	Waste Acceptance Criteria
WMO	Waste Management Operations
WO	Work Order
WVDP	West Valley Demonstration Project
WVNS	West Valley Nuclear Services Co.