DEVELOPMENT OF THE DECONTAMINATION APPROACH FOR THE WEST VALLEY DEMONSTRATION PROJECT DECONTAMINATION PROJECT PLAN

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ABSTRACT

This paper details the development of a decontamination approach for the West Valley Demonstration Project (WVDP), Decontamination Project Plan (Plan).
The WVDP is operated by West Valley Nuclear Services Company (WVNSCO), a subsidiary of Westinghouse Government and Environmental Services, and its parent companies Washington Group International and British Nuclear Fuels Limited (BNFL).

The WVDP is a waste management effort being conducted by the United States Department of Energy (DOE) at the site of the only commercial nuclear fuel reprocessing facility to have operated in the United States. This facility is part of the Western New York Nuclear Service Center (WNYNSC), which is owned by the New York State Energy Research and Development Authority (NYSERDA). As authorized by Congress in 1980 through the West Valley Demonstration Project Act (WVDP Act, Public Law 96-368), the DOE's primary mission at the WVDP is to solidify high-level liquid nuclear waste safely; transport the high-level waste (HLW) to a federal repository; and decontaminate and decommission the facilities and hardware used to solidify the HLW and conduct the WVDP. This includes a provision for the disposal of low-level waste (LLW) and transuranic waste (TRU) produced during processing of the HLW.

Continuation of the effort to reduce the hazard and risk associated with historic operations to the extent needed to ensure the health and safety of the public and the environment will see a change in focus from stabilization of liquid HLW to stabilization of former plutonium and uranium extraction (PUREX) reprocessing plant facilities. This will be achieved through the activities of in-cell component removal and packaging, and preparation for long-term disposal of the long- lived radionuclides. These radionuclides are associated with the former PUREX facility operations, including, and upstream from, facilities utilized in the primary separation and first plutonium / uranium split cycles.

The closure strategy for the WVDP is subject to ongoing evaluation and decision-making involving DOE and NYSERDA. Implementation will be subject to a future Record of Decision (ROD) and an Environmental Impact Statement (EIS).

This work was performed under Contract No. DE-AC24-81NE44139.

INTRODUCTION

In order to prepare the site for implementation of a closure strategy, a decontamination and HLW management project is currently being performed. This paper details the approach taken in performing the decontamination project only, HLW management activities target HLW issues that are beyond the scope of this paper.

The objectives of the decontamination component of the project are:

- packaging high-activity waste (spent nuclear fuel debris) located in the Head End Cells (HEC)
- constructing the Remote-Handled Waste Facility (RHWF) to prepare remote-handled transuranic waste (TRU) or higher activity low-level waste (LLW)
- characterization, packaging, and disposal of decontamination and legacy wastes
- reducing radiological contamination in the Fuel Receiving and Storage (FRS) area.

The decontamination approach is more appropriately described as source-term removal and processing for ultimate long-term disposal, rather than the traditional understanding of removal of contamination from a substrate. This is a broader interpretation of decontamination in that it is not technique specific, i.e., in-situ chemical decontamination. Instead, all aspects of source-term reduction are applied, including remote dismantlement and waste packaging, and the application of improved characterization data in radionuclide source-term modeling.

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Safety First

The single most important aspect of the decontamination project is safety and the protection of the environment, public, and workforce. The Integrated Safety Management System (ISMS) at the WVDP provides the necessary structure to ensure that any work activity that could potentially affect the public, employees, or environment is completed safely and is consistent with DOE Orders and Regulations.

In addition to ISMS, the single most challenging aspect of planning a decontamination project is conformance with the As Low As Reasonably Achievable (ALARA) concept and adherence to the ALARA principles of minimization of exposure pathways, provision of shielding, maintaining distance, radioactive waste reduction, and source-term reduction in order to keep worker doses ALARA.

In context of the Decontamination Project Plan these principles are satisfied by:

- characterization to locate hotspots and targeting these first to reduce general area dose rates
- remote removal of higher dose rate components from cells to reduce general area dose rates for subsequent clean-up efforts
- size reduction and waste packaging of higher activity wastes in a centralized remote-handled waste facility to shield workers from exposure to the radioactive waste
- minimization of secondary waste by application of dry decontamination techniques and localized treatment of liquid secondary waste using modular, liquid waste treatment skids.

Building on Past Success

A number of decontamination projects have been completed or are in progress in the United States and Europe. In the United Kingdom, BNFL plc., has been engaged in the decontamination and decommissioning (D&D) of PUREX facilities at their Sellafield site for the past two decades.

The international experience and the maturity of the technology applied in decontamination projects analogous to that at the WVDP has allowed WVNSCO the opportunity to apply the lessons learned from these projects in developing the decontamination approach for the Plan. This experience has been integrated with the engineering capability of Washington Group International, the waste management and D&D capability of the BNFL Group of companies, and the Westinghouse operational experience at the WVDP, to develop an innovative decontamination approach for the Plan.

Three Integrated Projects

The decontamination Plan is comprised of three integrated projects:

- remote handling, size reduction, and packaging of wastes
- waste management and characterization
- liquid waste management.

The activities required to achieve the specified decontamination will generate numerous radioactive solid waste streams and liquid effluents. The solid waste products of the decontamination program are typically a range of stabilized, solid wastes including:

- wastes that conform to 10 CFR 61 LLW waste classifications and appropriate disposal site waste acceptance criteria (WAC)
- contact-handled transuranic waste (CH-TRU)
- remote-handled transuranic waste (RH-TRU)
- waste incidental to reprocessing (WIR)
- potentially there may be a low volume of mixed low-level waste (MLLW).

The MLLW is typically attributable to historic use and application of Resource Conservation and Recovery Act (RCRA) hazardous materials in and around the contaminated facilities.

The waste management strategy in support of PUREX plant decontamination is required to be flexible and responsive to the changing legislative and regulatory policy as applied to the management of radioactive waste. This is manifest in the selection and operation of multiple technologies and processes for treating, handling, and storing radioactive waste.

The technologies that can be applied to decontamination projects saw a rapid increase in number and complexity during the 1980s and 1990s. Today, as a result of the extensive experience of D&D projects, lessons learned, and initiatives such as the DOE's Large-Scale Demonstration and Deployment Projects (LSDDPs), it is possible to place a value on the numerous technologies. The Decontamination Project Plan seeks to deploy the most cost-effective solutions to its technology needs. The following sections on characterization and liquid waste treatment detail some of the technologies used in benchmarking exercises to determine cost-optimal solutions.

REMOTE HANDLING, SIZE REDUCTION, AND PACKAGING OF WASTES

Traditionally PUREX plant Head End and Primary Separation areas have required the design and deployment of highly articulate remote manipulators and tooling to perform decontamination and size reduction for waste packaging of the in-cell plant components. Each individual cell requires its own remotely operated tooling and waste path, which is costly in both capital and schedule since each cell requires its own design, commissioning, and deployment phase.

To address these issues, the Decontamination Project Plan has introduced an innovative approach based upon the construction of a Remote-Handled Waste Facility (RHWF) that will perform the complex tasks of component size reduction, characterization, and waste packaging for disposal of PUREX facility component wastes requiring remote handling. In taking this approach it has been possible to dramatically reduce the complexity of the decontamination tasks performed in the Main Plant facilities as these are now limited to the removal of large components which will become the feed stream for the RHWF.

In developing the single, centralized RHWF approach it is possible to perform the Head End and Primary Separation in-cell size reduction and source-term removal projects using refurbished in-cell manipulators, existing waste paths, and modified operating procedures. This represents a considerable saving over the individually designed remote systems developed for the early PUREX decontamination projects. An additional saving is accomplished by having one centralized location, the RHWF, to perform the complex radiometric characterization of the waste streams to meet disposal site waste acceptance criteria and transport regulations.

The centralized remote-handling waste facility approach affords an additional strategic advantage in that waste streams packaged for disposal are done against a presumed criteria; in the absence of a disposal site approved for final acceptance of commercial higher activity waste streams. Clearly it would be impractical to return these packaged wastes to the originating cell for additional treatment should future prescriptive waste acceptance criteria require a reconfiguration of the existing packaged waste. However, returning the waste to the centralized facility for subsequent processing and repackaging is a relatively simple task.
It remains to be proven, but is offered for consideration, that operation of a centralized RHWF may demonstrate a reduction in disposal costs of TRU and Class B and Class C LLW associated with decontamination of PUREX facilities. This potential cost reduction compared to the traditional in-situ decontamination and waste packaging approach will be a result of the increased packaging efficiency, both bulk and radionuclide, achievable in the RHWF.

Key to the success of the decontamination project and the operation of the RHWF is characterization and waste management. In recognition of this, a commitment to investment in technology for performance of these tasks and learning from past experience of similar efforts is applied during the decontamination effort.

CHARACTERIZATION AND WASTE MANAGEMENT

The challenge in managing the safe, cost-efficient disposal of the waste streams generated in the execution of decontamination projects is the ability to characterize the radiological source-term these wastes represent in their current configuration in the former reprocessing plant facilities, systems, and vessels.

Providing a technique for the accurate assay of higher activity wastes presents a major challenge. Gamma measurements alone are of limited applicability for the measurement of historic waste for the following reasons:

- the short half-lives of many of the gamma emitters
- interference effects from the intense gamma rays from fission and activation products

- absorption of gamma rays in bulk materials (particularly severe for scrap metals)
- prolonged contact with water (during wet storage) leads to selective leaching of fission products, which adversely affects the ability to use isotopic ratio fingerprints.

Computer-controlled passive and active neutron techniques are better suited to the measurement of these wastes. However, there are a number of problem areas in the adaptation of these techniques to the higher activity wastes to be removed from decommissioned PUREX facilities.

These computer-controlled instruments must perform reliable on-line measurements within challenging plant environments. Shielding, handling, and containment are necessary due to high dose rates and loose contamination.

Characterization of nuclear facilities is a complex task and the complexity increases with the period of dormancy from the time operations ceased. In the case of an irradiated fuel reprocessing plant, this period of dormancy and the wide distribution of the radionuclide source-term can greatly increase the complexity of the characterization task.

The wide distribution of the radionuclide source-term takes place during the partitioning of process streams. Specifically, in the case of non-operational nuclear plants that have been in a care and maintenance period, the distribution has an even greater variability because of the post operational clean-out activities performed at the end of operations. These post operational clean-out activities have the effect of redistributing the partitioned process streams throughout entire cells and in some instances entire stages of the PUREX process.

The distribution of a non-homogeneous radionuclide source-term has the effect of challenging the validity of using process knowledge alone for generic modeling the source-term against single, point dose rate measurements and intrusive grab samples. Therefore, it becomes necessary to gather an increased number of intrusive samples under a Data Quality Objective approach and employ specific radiometric assay instrumentation and models that are constructed to be representative of cell-specific radionuclide distribution ratios. Numerous intrusive sampling campaigns are expensive and challenge ALARA budgets for the decontamination project.

There are varying degrees of rigor that can be applied to facility characterization depending upon the selected waste removal strategy. It is possible in some instances to apply a source-term based upon a worst-case nuclide identification derived from the single most radiologically challenging feed stream that entered the plant during operations. In taking this approach waste streams can be characterized based upon the gamma dose rates and all other radionuclides inferred from the worst-case nuclide identification and quantification. This type of approach may introduce considerable conservatism and result in an overestimation of the source-term, thereby resulting in a higher waste classification than is necessary

The following section applies the BNFL experience and capability in radiometric physics. This is provided for establishing a baseline set of technologies that can be applied as a benchmark for technology selection in support of characterization programs:

- High and Low Resolution Gamma Spectroscopy (HGRS and LGRS) modular gamma scanners − offer a rapid, accurate assay of waste drums, isotopic identification, near real-time assay, measures packages of multiple dimensions, and a unique LLW measurement technique.
- Drum and crate monitors - segregation of TRU and LLW at the 10nCi/g boundary, unique imaging passive active neutron assay system and handles packages of multiple dimensions.
- TRU piece monitors − installed plutonium piece monitor, highly accurate monitoring of waste items prior to packaging, maximizes drum loading, confirms criticality limits, reduces waste costs, and offers a rapid assay time.
- TRU drum and crate monitors − high-performance plutonium monitor, rapid accurate assay of waste containers for plutonium content and isotopic composition, enables selection of cost- effective disposal option,

enables compliance with criticality, transport, and disposal regulations / criteria.

- Alpha pipe and large item monitor − provides accurate, automated measurement of internal / external alpha contamination, classification at the LLW unrestricted release boundary.
- Conveyor-based monitors − provides a conveyorized survey monitor for accurate measurement of soil, rubble, metals and general process wastes; alpha, beta, and gamma options, and is rapid and proven for high-volume throughput.
- DrumScan − a tomographic gamma scanner that provides accurate measurement of plutonium and uranium content in waste to comply with waste disposal and materials accountancy regulations. Offers an assay of traditionally difficult waste streams such as inhomogeneous packaged waste.
- Hulls monitor − provides a complete radiological inventory of fuel cladding and debris after the dissolution cycle. It is automated, accurate, and is a sensitive assay of residual fuel.
- Gamma imaging − the remote real-time identification and mapping of hot spots in equipment, vessels, and cells. Offers reduced operator dose uptake, provides dose rate overlay on real-time video images, and, in addition the equipment is transportable.
- In situ assay of TRU process equipment - provides 3D location and quantification of plutonium inventory, confirms compliance with criticality and safety requirements, and is transportable.
- TRU portable package monitors – measures TRU packages at their point of origin, provide a go / no go indication for criticality control, and estimates total plutonium mass for efficient packaging into larger containers.

There is a comprehensive set of radiometric assay equipment and techniques available to D&D projects, as evidenced by the preceding narrative. The availability of this equipment and capability assists in achieving optimal cost-efficiency in the removal, packaging, and disposal of waste generated during decontamination projects.

LIQUID WASTE MANAGEMENT

A final component of a decontamination approach addresses liquid secondary waste. Historically this has been a challenge to successfully performing D&D projects and, with continuing reductions in effluent discharge authorizations, will continue to be so.

The Plan has and will continue to be based upon minimization of water usage, with reliance upon dry decontamination techniques. Such a strategy cannot completely eliminate the use of water and, consequently, ways to optimize the cost-efficiency of liquid waste treatment are required.

The relationship between selection of decontamination technology, the degree of decontamination achievable, and the performance characteristics of the downstream effluent treatment plants is one of the key success criterion of an effective decontamination program.

In the past, the selection of decontamination techniques has been limited by the influent acceptance criteria of fixed, high-cost, effluent treatment plants. Avoidance of this issue can be achieved by modularization of effluent treatment processes. Modularization allows further enhancement in the flexibility of clean-up programs by responding to changes in source-term characterization, waste routing strategy, and disposal site waste acceptance criteria.

This flexibility is achieved through selection of chemistries specifically developed for treatment of the variable decontamination effluents without the need to perform engineering modifications to the treatment plants. This flexibility can only be achieved through limiting the use of water to that which can be processed in skid-mounted modular plants.

The liquid effluent streams generated during decontamination activities exhibit considerable variability in both composition and rate of generation. In order to respond to this variability a treatment approach based upon an

integration of commercially available effluent treatment technology modules has been developed.
The design of effluent treatment systems requires an understanding of the site discharge limits for decontaminated effluents. Typically that understanding includes the following elements:

- maximum permissible radioactivity concentration in the effluent
- flow rate of the effluent and total volume actual, monthly, and/or yearly radioactivity discharge, both for total activity and for individual or grouped radionuclides
- chemical composition of the effluent (pH, biological oxygen demand, chemical oxygen demand, suspended solids, temperature, toxicity, etc.)
- origination of waste stream
- chemical reagents added during treatment
- efficiency of solid/liquid separation.

In addition to the process flexibility, the modular approach offers the ability to readily relocate the modules in response to changes in strategy and schedule. Modifying the sequence of use of the various effluent treatment process modules, in response to changes in influent contamination characteristics, offers considerable benefits to a flexible and responsive decontamination approach.

This flexibility can be incorporated into a decontamination plan within the context of an integrated modular approach to effluent treatment. This means provision of a single effluent processing strategy comprised of individual technology modules that are operated in multiple combinations.

This approach provides a broad base effluent treatment capability that is responsive to an influent with diverse pollutant characteristics, yet has very high specificity designed into each individual effluent treatment technology module.

A typical modular system will consist of six key technologies, each with a specific function. These are:

- separation by hydrocyclone
- ultrafiltration
- ion-exchange
- evaporation
- reverse osmosis
- wet oxidation.

Hydrocyclones

This type of system is ideally suited for applications where large volumes of low-level contaminated water are associated with highly radioactive particulate debris. In such cases it is advantageous to remove the solid, highly radioactive component prior to decontamination of the remaining low levels of soluble contamination. This achieves efficiency in cost of disposal of secondary waste and ALARA.

A typical example of this approach is in the treatment of Spent Fuel Pool water and sludge. Systems such as this can be deployed and operated remotely underwater. This type of system was pioneered by the Westinghouse / BNFL subsidiary company, PCI, for removal of debris generated from size reduction of reactor internals Greater than Class C waste.

Additional features of this system are the use of backwashable filters for removal of fine particulate in the hydrocyclone overflow. The filters are capable of removing all particulate down to 2.5 micron. The 2.5-micron backwashable filters are able to remove the fine particulate that passes into the overflow of the hydrocyclone. Following filtration, the liquid effluent is routed to ion-exchange columns provided within pressure vessels (PV) that are used to remove dissolved radionuclides.

Waste removed by the hydrocyclone separator is considerably more radioactive than the other waste forms; therefore, it is de-watered and packaged underwater in a High Integrity Container (HIC). The ion-exchange media (resin) is packaged in a polyethylene HIC fitted with sludge internals. The filter waste is packaged in similar filter overpacks.

This type of system allows decontamination liquid effluents to be processed remotely to remove the high-dose particulate debris and package them for direct disposal in appropriate containers. Considerable savings in the ALARA budget can be achieved by adopting this approach and, in addition, the radiation tolerance design specification for downstream effluent treatment plants can be relaxed. Examples of the high-dose particulate debris encountered in PUREX decontamination projects are:

- spent fuel and cladding fragments / debris
- activated fuel assembly components
- debris from size reduction of fuel handling and primary separation process equipment
- insoluble residual fines from reprocessing operations.

Following mechanical separation, the soluble / dissolved contaminants must then be removed from solution. For relatively pure waste streams with little total dissolved solids, ion-exchange is the next step. Many of the PUREX decontamination liquid effluents contain dissolved solids that would preferentially be taken up by the ion-exchange media, leaving the radionuclides in solution. For these waste streams, ultrafiltration will be the next processing step, which has the capability for chemical and mechanical separation of contaminants.

Ultrafiltration

Ultrafiltration modules are used in shielded enclosures for de-watering radioactive sludge. Typically they are employed in concert with flocculation and co-precipitation systems. Flocculation is a well-known technique where waste streams containing dissolved heavy metals, notably iron, are chemically adjusted to cause the dissolved species to precipitate. The precipitated body of a ferric floc has a very high surface area with a high adsorption capacity that exhibits an affinity for other less concentrated dissolved species which become co-precipitated with the ferric floc. Other chemical additions can be performed using millimolar concentrations of ion-selective adsorbers such as hexacyanoferrates to sequester highly soluble species such as cesium.

The separation of ferric flocs is a challenge for conventional filtration technology and much success has been achieved through the application of cross-flow ultrafiltration technology. The system described above is generic, but typical of many such systems now in operation.

The Enhanced Actinide Removal Plant (EARP) at BNFL's Sellafield, UK, reprocessing plant is one such system. EARP processes operational wastes to remove actinides and cesium from effluent prior to discharge. Following concentration in the EARP process, the sludge is routed for remote encapsulation in cement for subsequent long-term geologic disposal. The plant has been in successful full-scale operation since the 1980s and numerous skid-mounted variants, based on crossflow ultrafiltration, are now available from vendors in the US.

An operational flexibility of ultrafiltration is the ability to introduce low concentrations of highly specific ion-exchange media used to sequester individual radionuclides. These ion-exchange materials are then entrained in the body of the ferric floc and removed by the filtration process. This allows the treatment module to respond to changes in influent speciation without the need for mechanical modification of the process.

The addition of ion-exchange media into effluent streams being concentrated by ultrafiltration is an effective method for removing gross levels of soluble species such as cesium. However, it is not sufficiently effective to meet discharge levels for the Plan. To achieve this final polishing, ion-exchange is required.

Ion exchange

Of all the effluent treatment technologies, ion-exchange exhibits the greatest specificity and consequently is relatively intolerant to changes in the composition of the influent. The highly selective nature of modern ion-exchange media allows very high volumes of liquid waste to be decontaminated with minimal secondary waste generated. As for ultrafiltration, the specificity of an ion-exchange effluent treatment module can be changed in response to changes in influent speciation simply by changing out the media, without the need for an engineering modification.

Ion exchange is in widespread use on large-scale effluent treatment systems; in particular for removal of cesium and strontium. An example of this is the BNFL, Sellafield, Site Ion-Exchange Plant (SIXEP) plant, which is employed in the treatment of spent fuel pool cooling water prior to discharge.

The application of ion exchange to decontamination of liquid effluents is a mature and robust technology as typified by the Westinghouse Electric Company (WEC) / BNFL subsidiary company, PN Services. PN Services has demonstrated the effectiveness of this technology in cleaning up numerous spent fuel pools, as well as Boiling Water Reactor (BWR) and Pressurized Water Reactor (PWR) decontamination effluents, for numerous nuclear power generating utilities in the U.S. and worldwide. In many cases reactor internal surfaces were decontaminated from several hundred R/hr down to the mR/hr range, with all the removed radioactivity being contained on ion-exchange resins for subsequent disposal as class C LLW

Typically the equipment is remotely controlled due to the very high levels of radiation and can be designed to operate underwater, thereby greatly reducing area dose rates.

Evaporation

Evaporation is routinely used at the WVDP for the concentration of lower activity aqueous waste streams. This has the effect of achieving excellent decontamination of the evaporated product, allowing the bulk of the aqueous feed to be discharged. The concentrate fraction of the waste stream from the evaporator is suitable for feeding to subsequent treatment by either direct immobilization for disposal or additional processing by ion-exchange, co-precipitation, or membrane separation techniques. The disadvantages of evaporation as a treatment technique are the need for additional treatment of the concentrate, high operating costs, and corrosion of evaporation equipment. However, for low ionic strength aqueous waste streams with diverse pollutant characteristics, it is a high throughput, reliable treatment technology.

Reverse Osmosis and Wet Oxidation

Reverse osmosis (RO) is perhaps the least robust of the effluent treatment technologies because of problems with fouling of the separation membranes. It is highly efficient in the concentration of low ionic-strength waste streams containing low contamination. Typically, laundry effluent falls into this category.

Laundry water contains complexing agents in the detergents that prevent ion-exchange being used as a treatment technology because the contaminants are more tightly held by the complexing agent and are not readily ionizable for exchange. (They can be exchanged as the charged complex, but that requires the use of expensive backwashable media.) Therefore, concentration by RO is preferable to ion-exchange for these types of waste streams because the bulk of the contamination, including the complexing agents, are retained in the concentrated RO product, the reject, for subsequent immobilization and disposal.

In some circumstances the presence of complexing agents such as ethylenediaminetetraacetic acid (EDTA) and citrates (widely used during the clean-up of the Main Process Building in the 1970s) make it possible for contaminants to pass through virtually all the known treatment technologies as complexed species. The concentrations involved are in the ppm range but can still be sufficient to exceed the discharge limits.

Destruction of organic complexes in waste water is most appropriately addressed for WVDP effluents through the application of wet oxidation and, more specifically, photocatalytic destruction. This process requires a relatively pure influent. Therefore extensive pre-treatment is required to ensure the influent has low turbidity and is low in dissolved heavy metals.

Deployment of Innovative Technology in Effluent Treatment Processes

Modularization of effluent treatment technologies allows for the integration of innovative technology within a proven processing regime where the innovative technology can be demonstrated to exhibit efficiencies over the existing baseline.

Integration of innovative technology is performed only when such technology has been demonstrated to be an improvement over the existing baseline. Examples of the source of innovative technologies are the U.S. Department of Energy, Large Scale Demonstration and Deployment Projects (LSDDPs), Westinghouse, BNFL plc., and Washington Group International project involvement at the Hanford, Rocky Flats, Oak Ridge, Idaho, and Savannah River clean-up projects and BNFL plc's European D&D projects.

CONCLUSIONS

The WVDP decontamination Plan has produced a robust and flexible, cost-effective solution for the one of the most radiologically challenging projects encountered in the nuclear fuel cycle D&D arena.

Flexibility in a decontamination plan can be maximized through selection of a modular approach in the design of decontamination projects and waste-routing strategies.

Facility characterization is an essential component of a decontamination project and related waste-routing strategy. Mapping the decontamination waste streams to disposal site waste acceptance criteria and maintaining flexibility in the processing regime to meet them allows for cost-effective mitigation of legislative or regulatory changes in disposal and / or transportation criteria.

Characterization of redundant facilities specified in the Plan is being performed through a collation of historical process knowledge, intrusive sampling and laboratory assay data, and deployment of modern radiometric assay and imaging equipment. In taking this approach, WVNSCO is able to maximize the cost efficiency of the waste handling, size reduction, packaging, and disposal activities that will be performed in its Remote-Handled Waste Facility (RHWF). This also permits optimization of the degree of decontamination required to meet the facility end state that will be prescribed in a future Record of Decision (ROD) and Environmental Impact Statement detailing facility closure strategy.

Cost efficiency of decontamination specified in the Plan for redundant PUREX plant and facilities is being maximized through application of an integrated set of proven technologies into a robust and flexible decontamination approach.