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Office of River Protection Mission Completion Strategy

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

P.O. Box 450
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Revision Rev. 0

Office of River Protection Mission Completion Strategy

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OFFICE OF RIVER PROTECTION MISSION COMPLETION STRATEGY

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ABSTRACT

DOE's Office of River Protection (OW) is readying itself to commence construction of a Waste Treatment Plant (WTP) that will start the process of turning Hanford tank waste into glass. The plant is state-of-the *art* and includes reasonable flexibility to improve operations as technology and operational understandings improve. During its 40 year design life the plant has the capability to treat half of the total volume of tank waste and reduce risk to the public by up to ninety percent. Looking beyond initial processing towards the project end state, however, it is apparent that ORP's baseline approach is part of the issue raised by the DOE Secretary when he said that **$300** billion and **75** years is too costly and too long for DOE's environmental cleanups. O W has reviewed its cost and schedule drivers and has started identifying areas where better technologies and risk-based strategies could substantially decrease its life cycle cost and schedule. Specific technologies under consideration will be discussed along with expected return on investment.

O W is totally committed to taking all steps necessary during cleanup to protect human health and the environment and to comply with appropriate regulations and commitments. But, **ORP** is also very conscious of the fact that the history of Hanford production and tank farm operations has resulted in very large tank-to-tank variabilities in the waste constituents. Not all tank wastes demand the same high level of rigor in treatment as provided by the WTP in order to protect people and the environment. Parallel treatment paths, keyed to the hazards and chemical challenges each tank presents, need to be developed. The WTP vitrification capabilities should be deployed for the higher risk wastes that require vitrification. By getting wastes in the proper paths for treatment based upon their chemical characteristics and inherent risks, **ORP** will be able to both accelerate the cleanup schedule and bring its life cycle and annual funding requirements into line. The WTP needs to be managed and its throughput enhanced to vitrify all of the HLW and approximately 50% of the low-level tank waste by about 2030. That represents the lion's share of the current and long-term risk presented by the tanks.

For much of the low activity waste currently in the tanks, parallel treatment technologies are required that protect people and the environment but require less time and less cost than the total vitrification option presents. Any such technologies that ORP deploys must have sound, defensible bases with the prerequisite QA pedigrees. Providing parallel paths for lower risk wastes will allow ORP to avoid the 20 – 30 year treatment schedule that lower risk tanks would otherwise face. Potential parallel paths will be described.

ORP also needs to deploy and test technologies to demonstrate that its tank farms can be successfully closed. Starting such a demonstration during the period while the plant is under construction will allow ORP to start developing critical data that it will need for permanent closures at a later date. It will take many years of testing such demonstration activities and monitoring to develop confidence in tank closure approaches. If ORP starts such an effort, practicing on smaller, more benign tanks, it will reap significant institutional benefits in the near-term and have far better information when it is ready to start to close entire tank farms in the future. Methods being considered for such closure will be described along with institutional issues restraining closure.

OPP manages the largest cleanup project in the nation and the project is going to be used as an example. As such, ORP and the project will undergo a disproportionate share of audits from the IG, GAO, and everyone with an interest due to its size and objectives. Most will appropriately be interested in whether value is being received from public money spent and for signs of confidence that the job will be completed on time and within budget. ORP intends to complete the cleanup of Hanford's tank waste in a cost effective, environmentally protective, and socially responsible manner.

INTRODUCTION

Approximately 53 million gallons of highly radioactive wastes are stored in 177 underground tanks, including 149 older single-shell tanks, at the Hanford Site in Washington State. That waste, which was derived from production of plutonium for the nation's nuclear defense program, has been accumulating since 1944. The waste poses a serious health and safety concern to the public and to the environment. Since most of the single-shell tanks have exceeded their design life, that risk is growing. Sixty-seven of the single-shell tanks are known to have leaked an estimated one million gallons of waste to the surrounding soil.

In 1998, Congress established the Office of River Protection (ORP) to manage the retrieval, treatment, and disposal of the Hanford tank waste, and then to close the tanks in compliance with the Tri-Party Agreement between DOE, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology. This must be done to protect the Columbia River, the surrounding communities, and the economic future of the region.

The plan for the River Protection Project (RPP) to treat the tank waste is divided into two phases with 10 percent of the waste mass containing 25 percent of the radioactivity treated in Phase 1 with the balance of mission to follow. Phased implementation was chosen so that the initial waste treatment would start with robust, demonstrated technology. The phased approach provides flexibility to make changes in the future as new information and technologies emerge.

The current treatment plan is to separate the waste into high-level waste and low-activity waste portions and then to immobilize both portions in glass waste forms for disposal. This plan and the technologies selected meet regulatory requirements, public expectations, and are the best available for immobilizing these wastes. Tests using actual waste and a pilot-scale melter have demonstrated that the technology will meet or exceed requirements. The waste to be treated in Phase 1 has been sampled and analyzed, and meets the WTP feed specifications.

The WTP has the capacity to process the Phase 1 waste by 2018. Requirements to complete the full mission were carefully considered, and provisions for future expansion capacity are provided that would enable completing the mission within the WTP design life. Decisions on future expansion capacity are deferred until there is some Phase 1 operating experience.

The focus of this paper is to outline the strategy ORP is pursuing for completing the RPP in as safe, timely and cost-effective manner as possible.

BACKGROUND

Radioactive waste at the Hanford Site has been generated since the early 1940s in support of national defense activities. Major sources of contamination that require remediation or consideration in making cleanup decisions include tank waste, spent fuel, processing facilities, burial grounds, and liquid disposal sites (cribs, ponds, and ditches). On the Hanford Site 200 Area Central Plateau, waste management activities currently being conducted include waste disposal, waste retrieval demonstrations, and treatment. In addition, planning efforts to establish cleanup priorities and define the extent of cleanup necessary to be protective of human health and the environment. Most waste management facilities are located in either the 200-East or 200-West Area, on the Central Plateau. The 200-East and 200-West Areas are both approximately 3.2 km (2 miles) wide and are approximately 4 km (2.5 miles) apart. The U.S. Department of Energy, Richland Operations Office (DOE RL) is beginning the process of cleaning up contaminated facilities and past practice sites on the 200 Area Plateau. The **U.S.** Department of Energy, Office of River Protection (ORP) is moving forward with retrieval and treatment of the 177 tank waste and associated facilities, evaluating and mitigating the impacts of past tank leaks and spills, and planning for tank farm closure. Both DOE RL and ORP have or plan to dispose of low-level mixed waste on the plateau (ERDF, LLW burial grounds, Immobilized Low Activity Waste (from tank waste treatment)). In addition, a commercial low-level waste disposal facility is located on the plateau.

One hundred forty-nine of the Hanford tanks are older, single-shell tanks (SSTs) that have exceeded their design life by three decades. Sixty-seven have leaked an estimated one million gallons of waste into the soil beneath the tanks. Radionuclides are moving faster and deeper into the ground than was previously predicted, and some have reached the groundwater that flows to the Columbia River seven miles away. Risks to the environment and the people of the Northwest will increase as more radionuclides reach the groundwater. The highly toxic, highly radioactive tank waste presents a threat to human health and the environment, particularly the Columbia River. The preferred permanent solution to this problem is to immobilize the waste so that the hazardous constituents cannot escape to the environment.

The SST system includes 12 individual SST farms that contain 133 large volume tanks (1.9 to 3.8 million L [500,000 to 1 million gal]) and 16 smaller volume tanks (208,000 L [55,000 gal]). The remaining tanks are newer double-shell tanks (DST). The DST system includes 28 large volume (3.8 to 4.5 million L [1 to 1.2 million gal]) tanks. The DSTs are newer generation tanks with secondary containment. Current plans include continued use of the DSTs for storing, managing, and staging waste retrieved from SSTs prior to transfer to the waste treatment plant.

Liquid radioactive and chemical waste from nuclear materials production and research were transferred to Hanford's underground, reinforced-concrete, steel-lined tanks for storage. Large volumes of liquid waste (346 billion gallons) with lower radionuclide concentrations were also discharged to the ground. The SSTs currently contain 125,000,000 L (33,245,000 gal) of radioactive mixed waste and the double-shell tanks (DSTs) currently contain 78,850,000 L (20,833,000 gal) of radioactive mixed waste.

The reprocessing of nearly 107,000 tons of irradiated uranium fuel during that time period resulted in large additions of nonradioactive chemicals to the Hanford HLW for storage in underground tanks: approximately 240,000 tons of chemicals were added to the radioactive wastes by some estimates. The largest portion of these chemicals included primarily nitric acid, sodium hydroxide, and organic solvents used in the removal of fuel cladding, the dissolution of the fuel elements, the separations of unwanted radionuclides from the plutonium and residual uranium, and the neutralization of acidic wastes for corrosion control during storage in carbon steel tanks. Separate from the HLW, these chemicals do not present a particularly difficult challenge to achieve safe treatment and disposal. For example, commercial processes are readily available to convert **all** of these wastes into benign mineral like forms, water, nitrogen and carbon dioxide, if so desired. However, the more common industrial waste management approach for caustic and corrosive chemicals would involve neutralization and solidification with much lower cost treatment approaches.

Tank waste cleanup has been conducted under the ***Hanford Federal Facility Agreement and Consent Order (HFFACO)*** since 1989. The HFFACO (**known** as the Tri-Party Agreement, or TPA) is an agreement between the **U.S.** Environmental Protection Agency, Washington State Department of Ecology, and DOE. The Tri-Party Agreement establishes enforceable requirements and milestones for, among other things, waste cleanup actions. It is a primary driver for the River Protection Project, and any changes to the agreement must go through a public review process and be signed by all the parties.

The RPP life-cycle cost and schedule baseline are driven by a few key requirements and assumptions:

- The schedule for completion of the RPP mission is driven by three key TPA milestone dates: 1) completion of retrieval of all waste from the SSTs by 9/30/2018 (M-45-05), 2) completion of closure of all SSTs by 9/30/2024 (M-45-00), and 3) completion of immobilization of all Hanford tank waste by 12/31/2028 (M-51-00). (ref.: 89-10, Rev. **5**, "Hanford Federal Facility Agreement and Consent Order," December 1998.)

- The total volume of tank waste that is to be retrieved and immobilized is 53 million gallons containing 197 million curies of activity. The baseline assumes that 99% of the tank waste is retrieved and immobilized, consistent with the requirements of TPA Milestone M-45-00.

In the Record of Decision (ROD) for the TWRS EIS, the DOE announced its decision to implement the "Phased Implementation" alternative for retrieval, treatment, and disposal of Hanford tank waste (ref.: DOE-6450-01-P, "Record of Decision for the Tank Waste Remediation System, Hanford Site, Richland, Washington," February 1997). Under this alternative, a demonstration WTP is first constructed and operated to verify that the treatment processes will function effectively (Phase 1), followed by construction and operation of a full-scale WTP (Phase **2).** In both phases, the tank waste is separated into low-activity waste and high-level waste prior to immobilization and disposal (ref.: DOE/EIS-0189, "Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement," August 1996). The baseline assumes that both waste streams in both phases are immobilized in borosilicate glass.

OFFICE OF RIVER PROTECTION MISSION AND CURRENT STRATEGY

The **ORP** mission is to build and operate a waste treatment complex to complete the remediation of Hanford's highly radioactive tank waste (current and future tank waste and cesium and strontium capsules) in **a** safe, environmentally sound, and cost-effective manner (DOE 2000).

River Protection Project Plan

The plan to treat and immobilize all Hanford tank waste is divided into two phases. A phased implementation was chosen in accordance with the Environmental Impact Statement (EIS) because it meets all regulatory requirements, addresses technical uncertainties, and provides flexibility to accommodate future changes in response to new information and technology development. In Phase 1, 10 percent of the waste by mass and 25 percent by radioactivity will be treated and immobilized. In Phase 2, referred to as the Balance of Mission, the remainder of the waste is treated and immobilized. The plan, as shown in Figure 1, is discussed by phase below.

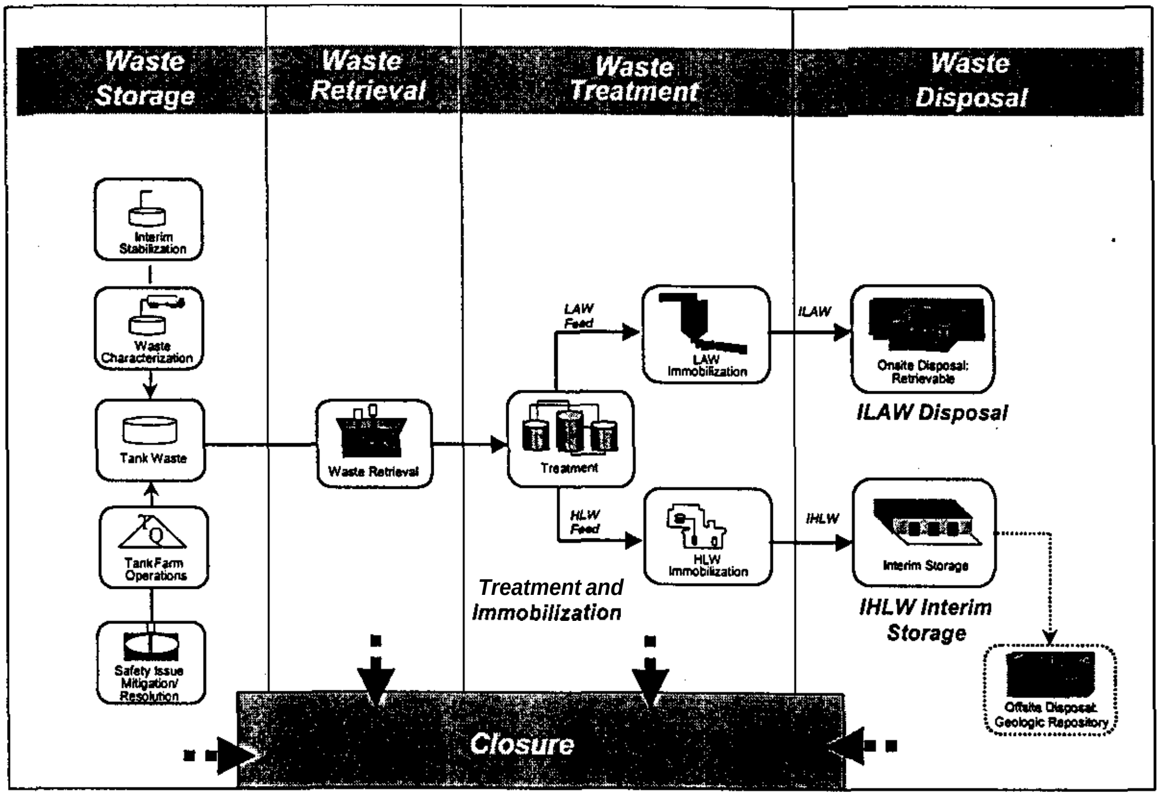

Fig. 1. River Protection Project Flow Diagram

The Office of River Protection is also responsible for disposing of 1,933 highly radioactive cesium and strontium capsules from a previous tank waste treatment process. The method for disposing of these capsules has not yet been determined. Some may be used as radiation sources in other programs. However, for planning purposes it is assumed that during the later stages of the project the cesium and strontium will be blended in with the other high-level tank waste, vitrified, and stored until it can be shipped to the off-site federal geologic repository for disposal.

Phase 1 Plan

Waste Storage. The tank waste will be safely stored in the 177 underground tanks until it is retrieved for treatment and disposal. Tank waste safety issues will be resolved, waste will be characterized, the single-shell tanks will be interim-stabilized, and some water will be evaporated to reduce the waste volume. Surveillance, and maintenance of the waste and tanks also will be conducted.

Waste Retrieval. Waste will be retrieved from both single-shell and double-shell tanks, staged in double-shell tanks, and then fed to the WTP. Waste retrieval systems (pipelines, pumps, etc.) will be installed.

Waste Treatment. The WTP will include processes to separate the waste into LAW and HLW portions and to vitrify both portions. The waste from the tanks will be separated into soluble and insoluble portions. Key radionuclides will be removed from the soluble waste so it can be classified as LAW and immobilized (vitrified) for on-site, near-surface disposal. The removed radionuclides will be added to the HLW insoluble portion and vitrified for disposal in an off-site federal geologic repository when it is available.

The vitrified LAW will be poured into cylindrical stainless steel containers 2.3 meters in height and 1.22 meters in diameter. The vitrified HLW will be poured into canisters 4.5 meters in length and 0.61 meters in diameter.

The planned nominal WTP capacity during Phase 1 will be 30 metric tons of glass per day (MTG/day) of ILAW, 1.5 MTG/day of IHLW. The WTP also will have expansion capability, that will permit doubling its capacity by adding a separate, parallel LAW vitrification facility and a second HLW melter (Figure 2). The HLW vitrification system will be sized such that the capacity can be increased to 6 MTG/day through enhancements to the melters. The WTP is being designed for a 40-year life.

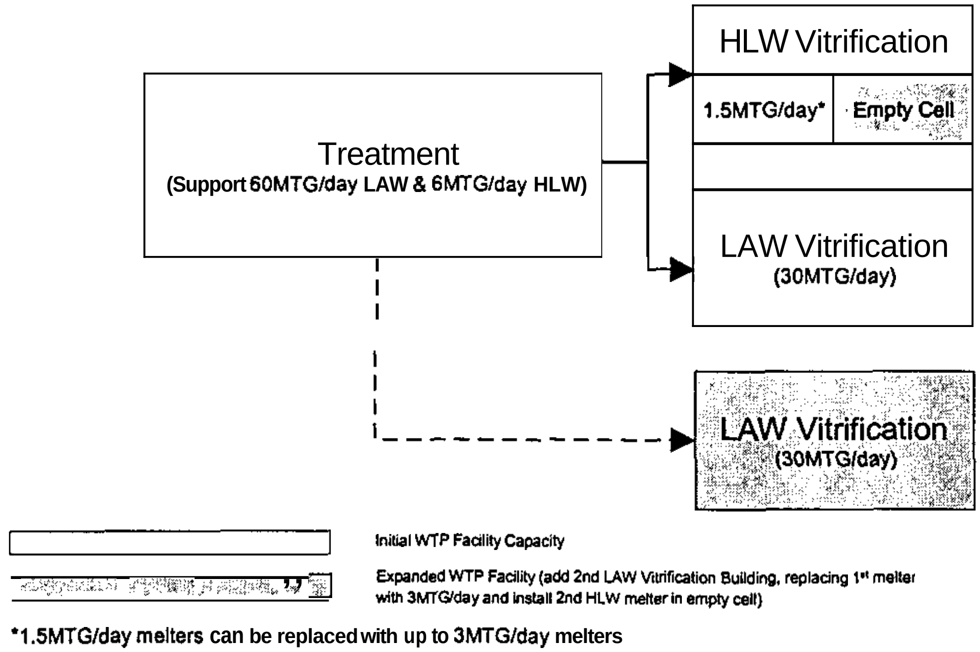

Fig 2. WTP Facility Expansion for Balance of Mission

As discussed earlier, the Balance of Mission options rely heavily on the initial capacity and expansion capability of the WTP.

Waste Disposal. The ILAW will be disposed of in new below-ground facilities in Hanford's 200 East Area. The facilities will resemble Hanford's mixed low-level waste burial trenches with intrusion-prevention barriers placed on top of the filled trenches.

The two unused cells in Hanford's Canister Storage Building will be outfitted for interim storage of the IHLW canisters produced during Phase 1. The IHLW will be shipped to an off-site federal geologic repository once it is ready to start accepting this waste from Hanford.

The Phase 1 technical approach is proven and robust. Waste retrieval and transfer operations are currently performed with proven technology. The WTP technology is mature and all operations have been demonstrated on actual waste, from several different tanks.

Balance of Mission Plan

The current River Protection Project plan for the Balance of Mission is to continue the Phase 1 activities with expanded WTP capacities. The existing RPP baseline plan is based on privatized waste retrieval, treatment, and immobilization services for Phase **2,** which resulted from an earlier contracting strategy. The Balance of Mission plan is now being re-examined to reflect government-owned treatment and immobilization facilities, and non-privatized contracts for waste retrieval, as well as a renewed emphasis on reducing overall life cycle cost. Several factors will influence how the Balance of\ Mission is planned and conducted. Among these are:

- The double-shell tank capacity available to receive and stage single-shell tank waste for the WTP
- The rate at which waste can be retrieved from the single-shell tanks
- Advancements in technology development
- WTP performance
- Tank closure requirements

Additional knowledge and experience will be gained in Phase 1 before decisions are made on how to proceed with the Balance of Mission during the WTP hot commissioning time frame. The decisions could range from continuing to operate the WTP as configured to increasing its capacity or adopting another approach. Ways in which the WTP capacity could be increased include attaining better operating efficiencies, exercising the built-in expansion capability (i.e., adding melters and enlarging other processes), implementing improved technologies as they mature, and building additional processing facilities.

DOE recognizes its responsibility to reduce risk, decrease cost, and accelerate completion of the cleanup mission. DOE is actively identifying and evaluating options to improve the current plan. Options being investigated include:

- Increasing WTP throughput by addressing rate-limiting steps and increasing operating efficiency
- Increasing waste loading in the immobilized waste products
- Inserting new or improved technology
- Implementing the expansion features being designed into the Phase 1 WTP
- Extending the useful life of the WTP
- Constructing additional waste treatment facilities.

All of these options use the Phase 1 WTP, which has an operating design life of 40 years. Proposed expansions to the WTP at the end of Phase 1, which would nominally double the capacity, were illustrated earlier in Figure 2.

The potential impact of all the options being considered is illustrated in Figure 3, which shows the range of possibilities for completing the waste treatment and immobilization mission within the operating life of the WTP. Figure 3 illustrates how much of the waste could be processed over time depending on the capacity and efficiency of the WTP. The upper dotted line represents current cleanup requirements. With an assumed Phase 1 operating efficiency of 48 percent, increased to 60 percent for the balance of the mission to reflect operating experience (a combination of greater throughput and reduced downtime), the amount of waste processed over time is shown by the lower line in Figure 3.

Expanding the WTP to double the capacity would treat 100 percent of the retrieved waste within its design life. The upper line in Figure 3 illustrates what could be accomplished by quadrupling overall plant capacity, which would require, without efficiency or technology improvements, building additional treatment and vitrification facilities beyond those indicated in Figure 3.

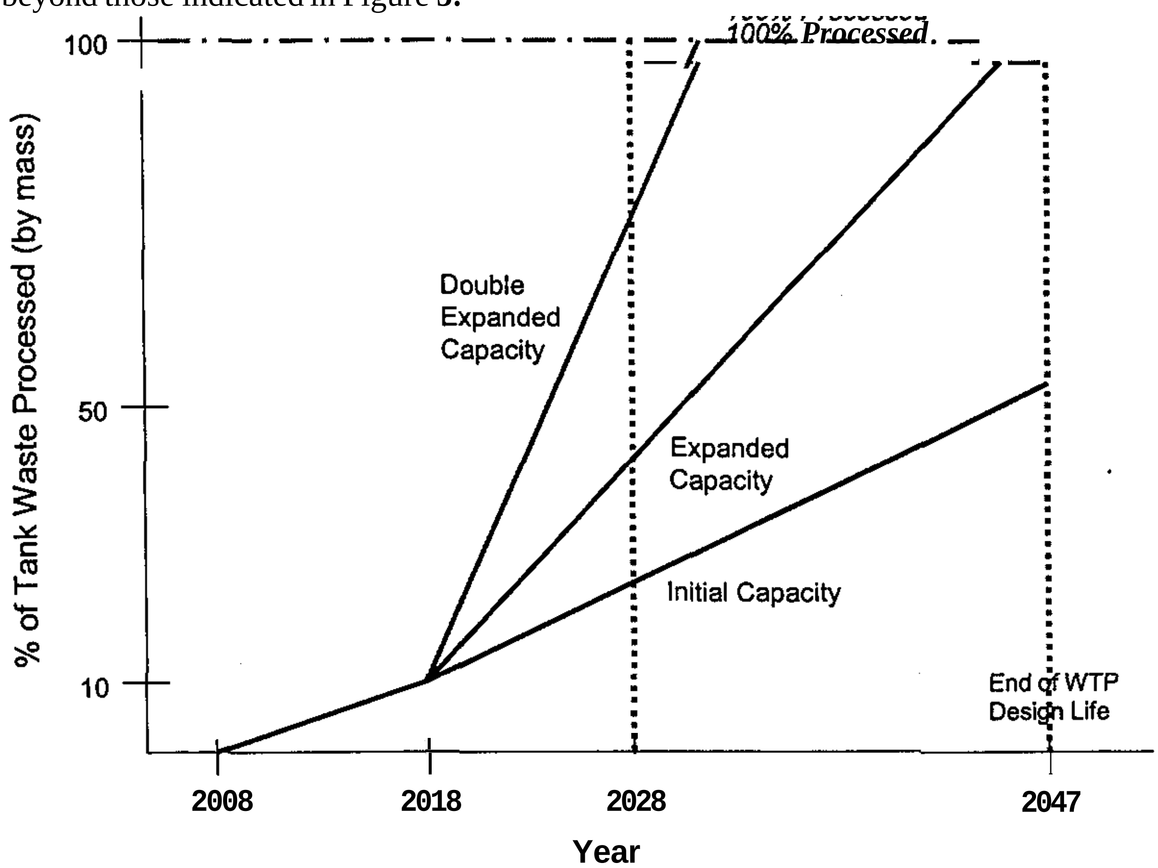

Fig. 3. Tank Waste Processing for Different **WTP** Capacities

The WTP capacity needed and/or the time to complete waste processing would be significantly altered if a risk-based approach to waste retrieval reduces the amount of waste that has to be removed from the tanks and processed. Moreover, the time needed to complete waste processing could be reduced if process/plant efficiencies **or** new technologies could be incorporated into the WTP.

The DOE has successfully demonstrated the technologies required to *carry* out Phase 1 processing and will be making parallel investments to take advantage of emerging technologies that could be incorporated into the WTP during this phase. The Office of River Protection is working jointly with the DOE Environmental Management Office of Science and Technology in a sustained effort to accelerate progress and reduce technical risk. Areas being addressed include not only vitrification and melter technology but advanced separations processes and methods for treating the River Protection Project cesium and strontium capsules. In particular, separations research could result in a reduction in the amount of waste requiring processing by the WTP, which could in effect increase the processing rates shown in Figure **3.**

Issues with the Current Balance of Mission Plan

It is generally recognized that the current RPP Baseline is neither technically nor programmatically achievable. Decommissioning the multi-billion dollar initial WTP after only 10 years or less of operation (about 2018) and replacing it with another multi-billion dollar WTP that will operate only 10-15 years to complete immobilization of all tank waste by **2028** is not fundable. Retrieving the tank waste from all 149 SSTs by 2018 (99% of all tank waste) is not technically practical. Furthermore, major strategic changes in the technical and programmatic direction of the RPP, including changing the contracting strategy for the WTP from a privatization contract **to** a standard M&O contract and disposing of ILAW in trenches rather than concrete vaults, has significantly altered the life-cycle cost profile for the project.

The current RPP baseline cost profile for the entire mission is shown in Figure 4. There are two areas highlighted in that figure where ORP is focusing on cost and schedule reductions. The first is the peak around 2010 where the Phase 2 WTP is to be built according to the baseline. In that same time period, retrieval costs are high in order to provide feed to the Phase 2 plant, and possibly the Phase 1 WTP, if the decision is made to extend its use. The second target for savings is in the tail of the cost profile, where potentially billions of dollars could be saved by completing the mission earlier.

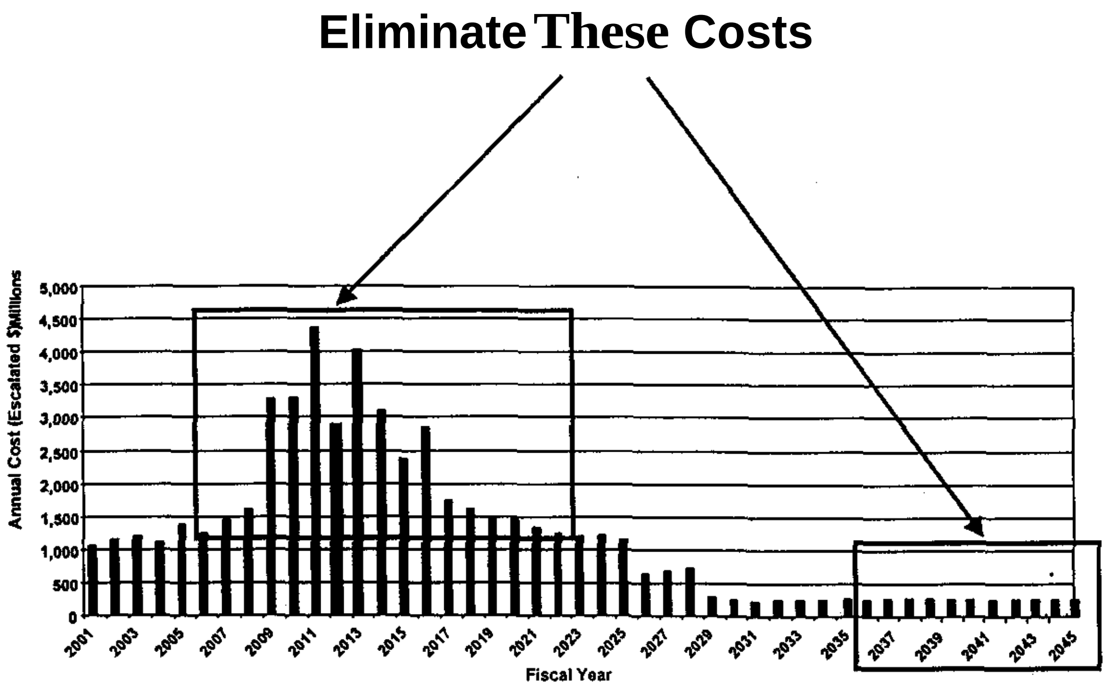

Fig. 4. River Protection Project Life Cycle Cost Profile

ORP is confident that it has a sound technical foundation and plan for its Phase 1 waste treatment facilities. Work to date indicates that those facilities will perform at levels exceeding current requirements and that they will be capable of treating the bulk of the tank waste. The waste vitrification facilities are the cornerstone of ORP's three-pronged Hanford tank farm clean up strategy. The other prongs of the strategy are equally important to providing cost effective completion of the O W mission. These elements include

- Identifying proven methods to treat waste that does not need to be vitrified to protect human health in a manner that reduces cost and accelerates mission completion.
- Reducing risk and completing cleanup by accelerating retrieval of high-risk waste from SSTs while proceeding with closure of tanks that pose nominal risks and do not require retrieval and treatment.

Each prong of this strategy will be discussed below.

CONSIDERATION OF IMPROVED TECHNOLOGIES FOR WTP OPTIMIZATION

The first prong of the strategy is to "supercharge" the WTP to enable the maximum productivity. As can be seen from the preceding figures, a 4X waste processing capability is needed to treat all of the tank waste by the Tri-Party Agreement milestone of 2028, as well as a tremendous effort to retrieve all of the waste at the same time in order to provide feed for the WTP. On the other hand, the cost profile in Figure 4, which would require several billion dollars per year in the peak years, virtually precludes the ability to fund and build a 4X plant available for service in 2018. The challenge is to increase the effective processing rate for the original plant, without the capital investment for a second, larger plant.

As can be seen in Figure 2, over the 40-year lifetime of the Phase 1 WTP, that facility can treat approximately 50% of the total tank waste at its original rated LAW processing capacity of 30 MTG/day. Recent pilot tests, however, have shown an ability to achieve 45 MT/day. This should enable the WTP to process nearly all of the LAW during the life of the plant.

On the HLW side, ORP is now considering expanding the HLW capacity to 4X in the Phase 1 WTP, scheduled for hot start in 2007. That would allow virtually all of the HLW separated from the tank waste to be treated by 2028, provided the feed can be supplied.

In addition, insertion of new technologies will be key to increasing the capacity of the Phase 1 WTP to perform at capacities approaching 4X. ORP is working with EM-50 and private industry to explore some of these technologies:

- Technologies for removing or reducing waste-loading-limiting constituents (e.g. Na, S04, Nitrate) before feed to the LAW vitrification.
- Improved melters with better capacity, operating lifetimes, and TOE.
- Technologies for pretreating waste to enhance throughput (e.g. steam reforming to provide *dry* feed to the LAW melter with S04 and other elements removed)

PARALLEL PROCESSING PATHS TO ACCELERATE ORP TANK WASTE CLEANUP

Processes have also been proposed, and in many cases demonstrated, for removing large fractions of the nonradioactive chemical species from the HLW so they could be treated and disposed by accepted commercial practices. In some cases, technology has been demonstrated in laboratory tests to be capable of separating a highly purified stream of a chemical product with no detectable trace radioactivity. In theory, this purified waste product could be recycled for other industrial applications if regulatory approval were granted. The main reason these processes were not chosen or implemented at Hanford is that they were not well enough developed or demonstrated for these types of applications at the time the current baseline was proposed. In other cases, the engineering analysis that was done to compare the various options didn't show sufficient financial incentive for implementing alternatives to the baseline plans in light of the greater uncertainty, the remaining technical challenges, or the unclear regulatory pathway for acceptance.

Some of the tanks contain waste that may already be suitable for application of alternative waste treatment approaches without extensive processing through the WTP. While these same tanks are not likely to pose a significant radiological health risk because of their already low levels of radioactivity, the hazardous chemical constituents may still present a significant long term risk. This would be in addition to the short term risk associated with a steadily increasing potential for a breach in tank integrity the longer these tanks remain in service.

For instance, ORP believes a case can be made for treating as many as 17of the Hanford tanks, containing approximately 1.7M gal of waste, as non-HLW based on the waste source definition for HLW. Six of these tanks appear to contain waste that is less than Class C LLW and the other 11 could be classified as TRU. These particular tanks offer the advantage as candidates for early volume-reduction demonstrations that the waste form acceptance criteria for disposal of the immobilized waste does not demand they be vitrified. **Also,** the need for radionuclide separations before treatment would be unconstrained by several of the factors that drive the decisions on treating HLW.

The degree to which separations processes remove radionuclides from the waste will dictate the requirements on the integrity of the waste form that is produced through different immobilization processes. **A** high degree of separations is generally associated with an increasingly complex and costly separations process and an increasingly simple and inexpensive immobilization process. In addition to radionuclide separations, the nitrate/nitrite and certain RCRA metals that are present in the wastes will dictate the required waste form quality or the use of immobilization processes that destroy and/or tightly bind the hazardous constituents.

The alternate treatment options of greatest interest to ORP include those that actually result in a substantial reduction in the amount of waste stored in DSTs without reliance on simply concentrating the waste, more efficient space management, or more efficient waste processing through the WTP. These options generally covered the selective partitioning of non-radioactive fractions from the radioactive waste fraction as a third waste stream using existing facilities and field deployable low volume capacity processing units. Some of the processes and technologies being reviewed are:

- Ramon-Rad Separations
    - **IX** Resin Systems
    - Solvent Extraction
    - Fractional Crystallization
    - Salt Splitting Membrane
- Nitrate Destruction
    - Fluid Bed Calciner adn Steam Reformer
    - Rotary Calciner
    - Molten Alkali Reactor
    - Electrochemical
- Secondary Waste Immobilization

- o GeoMelt
- o Plasma Enhanced Melter
- o Grout
- o NAC Process
- o Sulfur Polymer Cements
- o Phosphate Ceramic Matrix
- o Sol Gel Glasses
- o Stir Melt

At this point, ORP has not completed cost and processing capacity analyses for these alternatives, but believes they may be substantial. Moreover, the processing alternatives can benefit the RFP by decreasing pressure on DST space needs, and can be demonstrated even before the Phase 1 WTP comes on line.

TANK CLOSURE DEMONSTRATIONS TO REDUCE RISK TO THE PUBLIC AND ACCELERATE PROGRESS

Following completion of waste retrieval activities, the tanks will be transitioned to . closure. Under Tri-Party Agreement milestone M-45-06, ***"Closure of all single-shell tankfarms in accordance with approved closure/post closure plans"*** is to occur by 9/30/24. Although SST farm closure occurs toward the end of the ORP mission, near-term decisions for elements of the River Protection Project are inter-related with future closure decisions.

Early demonstration of single-shell tank closure would provide a basis for development of reasonable criteria for closing all tanks and real near term progress and risk reduction as tanks and tank farms are closed. The current plan would result in the closure of the first tank in 2014. Clearly there is a need to do better and it is plausible to begin closing tanks in the next few years. Closing tanks will have the benefits of:

- Reducing risk to workers, the public and the environment from aging tanks with low volume of waste
- Achieving near term operations and long term retrieval life cycle cost savings
- Engaging regulators and stakeholders in open discussion of issues critical to the completion of the mission
- Collecting and analyzing data and completing demonstration of technologies needed for closure of the remaining tanks.

Some of the single-shell tanks may not require any waste retrieval prior to closure. Other tanks may be suitable for closure following application of inexpensive retrieval methods.

By approaching tank closure using early demonstration activities, ORP would be able to make progress prior to final clean up decisions. The closure demonstrations would achieve "interim closure", which is defined as the closure of the tank, soils and ancillary equipment either following waste retrieval or without waste retrieval when the waste left in place will not result in risks to human health. Depending on the contents, the following activities will be completed pending final closure:

- Manipulation of the waste to minimize waste migration

- Application of fill material to provide structural stability
- Application of infiltration and intrusion controls.

ORP intends to pursue whether the near term demonstration actions will be acceptable for final closure decisions.

The closure demonstration must have a sound basis that includes engineering, regulatory (including risk management), and management aspects. None of the Hanford tanks currently meet the regulatory requirements for closure that would permit the reuse or unrestricted use of the tanks or tank farms or that would satisfy the waste volumes specified as an interim retrieval goal under the Tri-Party Agreement. Therefore, DOE will need to demonstrate that when the tank(s) are closed (under DOE Order 435.1 and the Hazardous Waste Management Act), waste remaining in the tanks (and in surrounding soils and ancillary equipment) will not pose an unacceptable risk to human health. This risk-based approach is an accepted regulatory pathway to closure and would result in a LLW disposal facility under DOE Orders and a RCRA Part B landfill under the Washington State Hazardous Waste Management Act.

ORP envisions completing closure demonstration(s) on one or more single shell tanks as soon as possible. Preliminary planning indicates that an aggressive schedule could result in the closure of the first single shell tank as early as 2003-04 with a reasonable degree of confidence.

PATH FORWARD

ORP continues to make good progress on improving its capability to treat the Hanford tank waste. Design of the waste vitrification facilities **is** proceeding well and construction will begin within the next year, on contract schedule. Progress is also being made in reducing risk to the worker and the environment from the waste currently stored in the tank farms. Removal of liquids from single-shell tanks **(SSTs)** is on schedule and **ORP** will begin removing solids (salt cake) from a tank (241-U-107) in 2002.

There is a sound technical foundation for the Phase 1 waste vitrification facilities. These initial facilities will be capable of treating (vitrifying) the bulk of Hanford tank waste and are the cornerstone of the **ORP** clean-up strategy. It is recognized that the near-term work is vital, and that there exists an equally strong and defensible plan for completing the **ORP** mission.

ORP is pursuing a three-pronged approach for moving the mission forward. First, **ORP** will continue to work aggressively to complete the waste vitrification facilities. **ORP** plans to provide the most capable and robust facilities to maximize the amount of waste treated by these initial facilities by 2028 (our regulatory commitment for completion of waste treatment).

Second, and in parallel with completing the waste vitrification facilities, ORP is examining how best to treat the waste not processed by the initial facilities (the current plan calls for vitrifying 99% of the tank waste). Waste in the Hanford tank farms varies greatly in character. That is, the waste in some tanks is much more hazardous/dangerous than in other tanks. The most hazardous/dangerous waste will be the first waste turned into glass by the initial facilities. More complete characterization will reveal more about the character of the waste in each tank, and it can be determined whether vitrification is required to protect worker health and the environment, and comply with regulations. Vitrification is a robust treatment process that produces a very high quality waste form; however, it also requires costly facilities. There may be other technologies capable of treating some of the less hazardous/dangerous waste, thereby, producing immobilized waste that meets requirements for protection of health and the environment, but at a lower cost. Such alternatives might include existing technologies like cement waste forms, glass-like products from "steam reforming," and immobilization with polymers. Also, in place treatment might be considered for some tanks (e.g., in-situ vitrification). If alternative technologies can treat waste sufficiently to protect the health and environment, and do so at reduced cost, then the use of such alternatives could reduce the cost and schedule for overall waste treatment. If, as alternative treatment technologies are considered which do not provide confidence that they can successfully treat waste to an extent that protects worker health and the environment, then vitrification is still available to complete the job. Reducing costs and accelerating the program are the best ways to assure ORP is positioned for long-term success, and ORP is pursuing the obligation to evaluate potential alternatives. There needs to be open discussion and evaluation of alternatives now so there is a clear path to move aggressively to complete the Hanford tank waste cleanup.

The final piece of the ORP strategy is to continue to move forward with actions to reduce risk in the tank farms and complete cleanup. At this time, there is some space available in the **28** newer double-shell tanks (DSTs). These tanks comply with regulations for storing waste and are actively in use. Where space permits, waste from SSTs can be removed and transferred to DSTs for safe storage prior to treatment. Removal of liquids is currently underway and removal of solids from SSTs will begin in early **2002.** Waste removal from SSTs is important because it places the waste in tanks that are not likely to leak to the environment and because once empty, workers will not have to perform surveillances and maintain the old SSTs. This reduction of risk to workers and the environment is an important element of the ORP strategy. In addition to tanks where waste is retrieved, a number of SSTs currently have very little waste. Where the quantity and character of waste in an SST allows, it should be possible to proceed to close that SST. Before ORP can begin to close an SST, however, there must be confidence that any residual waste in the tank is small enough as not to pose a significant threat to human health and the environment. ORP is prepared to remove residual waste as needed prior to closure. For some tanks, however, waste heels and residuals may be closed in place.

The goal of these efforts is to keep ORP on a success path for completing cleanup of Hanford tank waste. With the aggressive path forward to provide vitrification facilities with enhanced capabilities, there must be parallel work on a credible plan for completing waste treatment and accelerating risk reduction. In its planning, ORP is treating two principles as paramount; 1) all actions are focused on protecting worker health and the environment and complying with laws and regulations, and **2)** open discussion, involvement, and cooperation of regulators and stakeholders is fundamental to **any** future decision making.