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Prepared for the U.S. Department of Energy
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Hanford Site River Corridor Cleanup

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ABSTRACT

In 2005, the U.S. Department of Energy (DOE) launched the third generation of closure contracts, including the River Corridor Closure (RCC) Contract at Hanford. Over the past decade, significant progress has been made on cleaning up the river shore that borders Hanford. However, the most important cleanup challenges lie ahead. In March 2005, DOE awarded the Hanford River Corridor Closure Contract to Washington Closure Hanford (WCH), a limited liability company owned by Washington Group International, Bechtel National and CH2M HILL. It is a single-purpose company whose goal is to safely and efficiently accelerate cleanup in the 544 km^2 Hanford river corridor and reduce or eliminate future obligations to DOE for maintaining long-term stewardship over the site. The RCC Contract is a cost-plus-incentive-fee closure contract, which incentivizes the contractor to reduce cost and accelerate the schedule. At $1.9 billion and seven years, WCH has accelerated cleaning up Hanford's river corridor significantly compared to the $3.2 billion and 10 years originally estimated by the U.S. Army Corps of Engineers.

Predictable funding is one of the key features of the new contract, with funding set by contract at $183 million in fiscal year (FY) 2006 and peaking at $387 million in FY2012. Another feature of the contract allows for Washington Closure to perform up to 40 percent of the value of the contract and subcontract the balance. One of the major challenges in the next few years will be to identify and qualify sufficient subcontractors to meet the goal.

INTRODUCTION

The Hanford Site was established in 1943 to produce plutonium as part of the Manhattan Project. During the initial 22-month construction phase, the U.S. Army Corps of Engineers and its construction contractor, E. I. Du Pont de Nemours and Co., built reactor fuel manufacturing plants, physical and life sciences research facilities, three nuclear reactors, two spent fuel separations plants, dozens of waste storage tanks, warehouse, office space, living quarters, electrical substations and the infrastructure necessary to support it.

The Hanford Site was selected for three important reasons: 1) it was isolated, 2) Grand Coulee Dam had just been completed and was capable of supplying vast amounts of electricity, and 3) the Columbia River, which passed through the site, was able to supply the large amounts of water needed to cool the reactors.

The graphite-moderated reactors had a once-through cooling system using filtered Columbia River water at a rate of 102 m^3/minute in the first three reactors – B, D and F reactors. Through process efficiencies and the construction of additional reactors, cooling water requirements jumped to 1,893 m^3/minute by the late 1950s when all eight of the once-through reactors were operating [1]. The water was transferred from the reactors to retention basins through reactor effluent piping before being emptied back into the Columbia River.

Over time, cooling water containing activation products and fission products from fuel failures ended up contaminating the soil as it leaked from the effluent piping and retention basins. The resulting contaminated soil makes up a sizeable percentage of the estimated 9.1 million metric tons of contaminated material in Hanford's River Corridor. The remaining contaminated material generally comes from burial ground and waste site remediation and facility demolition.

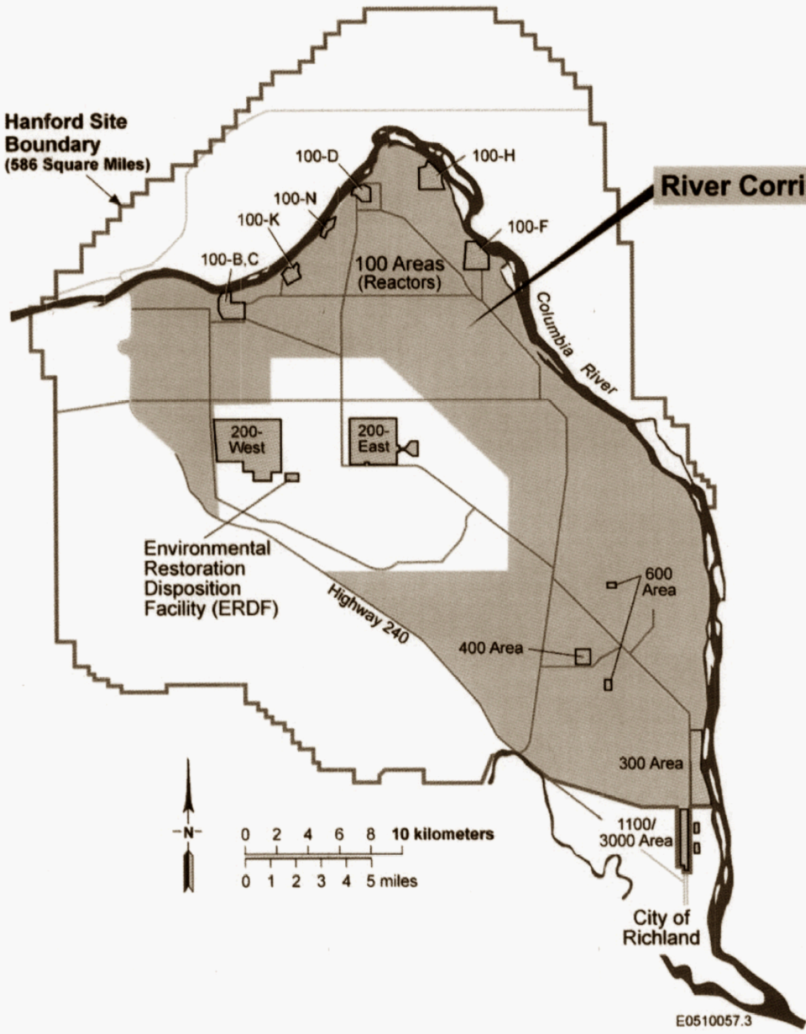
Cleanup at Hanford began in earnest in 1989 with the end of the site's plutonium production mission and the closing of N Reactor, the last of Hanford's nine reactors to be shut down. Although some contaminated facilities and sites had been cleaned up before that date, as well as after, full-scale cleanup didn't begin until DOE established the Environmental Restoration Contract in 1994. That was replaced in late 2005 with the first Hanford closure contract, the River Corridor Closure Contract.

ENVIRONMENTAL RESTORATION CONTRACT

Before awarding the RCC Contract, significant progress had been made by the previous contractor, Bechtel Hanford, on the Environmental Restoration Project. Four of the former plutonium production reactors had been placed in interim safe storage – C, D, DR and F; numerous facilities had been demolished; a number of wastes sites had been remediated; and more than six million tons of contaminated materials had been removed from near the Columbia River and disposed at the Environmental Restoration Disposal Facility (ERDF).

RIVER CORRIDOR CLOSURE CONTRACT

In 2005, the DOE launched the third generation of closure contracts, including the RCC Contract at Hanford [2, 3]. The Hanford RCC Contract was awarded in March 2005 to WCH, a limited liability company owned by Washington Group International, Bechtel National and CH2M HILL. It is a single-purpose company whose goal is to safely and efficiently accelerate cleanup in the 544 km^2 Hanford river corridor and reduce or eliminate future obligations to DOE for maintaining long-term stewardship over the site. The RCC Contract is a cost-plus-incentive-fee closure contract. For every dollar saved over the target cost, DOE keeps 80 cents and WCH will earn 20 cents. At $1.9 billion and seven years, WCH has accelerated cleaning up Hanford's river corridor significantly compared to the $3.2 billion and 10 years originally estimated by the U.S. Army Corps of Engineers.



Scope Includes:

- Demolition of 510 facilities
- Remediation of two high-risk burial grounds known to contain transuranic waste
- Remediation and closure of 486 waste sites
- Place four reactors into safe storage condition
- Disposal operations (treatment, transporation, disposal of 4 million tons of waste)

Fig. 1. Hanford Site with River Corridor footprint and contract scope

Contract Scope

WCH's approach to managing the closure project is to get in, get it done safely and expeditiously, deliver the promised environmental results and close the site. To do that, the company initially adopted several existing systems and work processes to maintain continuity of the existing work and customized other practices to support acceleration. A key feature of this effort is to work with regulators in a collaborative method to streamline the regulatory approval process and avoid cleanup delays. Potential hazards at each facility and site will be thoroughly evaluated, and include employee involvement to eliminate barriers to safe and efficient cleanup. Demolition of facilities is prioritized based on the hazards they present to workers, the public and the environment.

In all, 510 facilities will be decommissioned or demolished and 486 waste sites will be cleaned up or closed. Specific challenges include remediating burial grounds at the former plutonium-production reactor sites. What was placed in the burial grounds was either poorly documented or not documented at all, or documentation was lost over the years, making it difficult to design cleanup plans without significant site testing and analysis. Records and other data are complete enough at the 618-10 and 618-11 burial grounds for WCH staff to know that many questions need to be answered before meaningful site design work can begin. The 618-11 burial ground for example will require extensive engineering evaluation before cleanup can begin due, in part, to a source of tritium in the groundwater. A major concern at the site is adequately protecting workers and the environment, not to mention protecting workers at the nearby commercial nuclear power plant, while cleanup is underway.

Another challenge involves cocooning of the N, KE and KW reactors. Cocooning involves removing all reactor building structures down to the 3-to-4-foot-thick concrete walls surrounding the reactor core, sealing all openings and placing a new roof on the remaining structure. ISS work at the KE and KW reactors will begin once removal of fuel fragments and sludge from the fuel-storage basins is completed by another Hanford contractor. As the most recent and only closed-loop reactor constructed at Hanford, N Reactor presents its own challenges. N Reactor, the nation's only dual-purpose reactor – producing steam to generate electricity and plutonium for defense purposes – was shut down in 1989. The radioactive material in N Reactor has not had as much time to decay as the material in the eight single-pass reactors, most of which were decommissioned in the late 1960s and early 1970s. N Reactor is also much different in design than the eight single-pass reactors.

Another major challenge will be the deactivation, decommissioning, decontamination and demolition (D4) of about 300 buildings in the Hanford 300 Area. Only one mile north of the city of Richland, the 300 Area was the site's primary area for manufacturing reactor fuel and doing laboratory research and development. Complicating the cleanup task is the fact that many of the facilities are contaminated with radioactive materials, asbestos and beryllium. In addition, nine of the major laboratory facilities are still being used by the U.S. Department of Energy's Pacific Northwest National Laboratory to support major science, energy and homeland security initiatives important to the U.S. government. Those facilities must be replaced before they can be turned over to WCH to D4.

D4 (Deactivation, Decommissioning, Decontamination and Demolition) Closure – There are about 510 facilities to be demolished in the 100, 300 and 400 areas of the Hanford Site. The project critical path schedule runs through demolition of the 220 facilities in the 300 Area. This area contains some of the most challenging facilities, including the 324, 325, 326 327 and 329 buildings. These buildings contain significant inventories of fission products as well as lower levels of actinides. These facilities contain hot cells, nuclear fuel examination facilities and, in some cases, have structural walls that are 1-1.5 m thick. Work is just now beginning on the deactivation and decontamination of the 324 and 327 buildings.

Specialized engineering and demolition techniques will be required to complete the removal of these hot cell facilities. The current plan calls for filling the cells with a grout material and then using a diamond-wire saw to cut the grout-filled cells into large chunks for removal and subsequent burial at the Hanford Environmental Restoration Disposal Facility.

Fig. 2. Eliminating the spread of contamination during facility demolition

There are 14 facilities in the 300 Area that are currently occupied and operated by the Pacific Northwest National Laboratory (PNNL). These facilities are scheduled to be released to WCH by DOE in 2009. In order for this to occur, replacement facilities need to be in place. Work has begun on these facility replacement activities.

In addition to the buildings in the 300 Area, there are more than 200 structures in N, K East and K West areas that will need to be demolished. Most of these structures were built to support the plutonium production mission assigned to the three reactors that reside in those areas. The facilities in the 100 areas range from industrial buildings, such as maintenance shops, to highly contaminated structures, such as spent fuel basins, that support reactor operations.

The fuel storage basins associated with the K East and K West reactors still contain material left behind from the reactor operation and fuel storage missions. The materials include miscellaneous debris, fuel storage racks and radioactive sludge. The basins are scheduled to be cleaned, demolished and turned over to WCH by 2007.

The 400 Area contains 44 industrial-type facilities used to support Fast Flux Test Facility operations.

Reactor Interim Safe Storage (ISS) Closure – Hanford is home to nine former plutonium production reactors – B, C, D, DR, F, H, KE, KW and N reactors. The Interim Safe Storage process, commonly referred to as cocooning, involves demolishing the reactor building down to the 1.5-m-thick concrete shield walls surrounding the reactor core. All openings in the building are sealed with concrete or steel plates except for one door, which is welded shut after remote heat and moisture sensors are installed in the building. The final step is to place a new, galvanized aluminum roof on the facility. Then, once every five years, workers will unseal the door and enter the facility to conduct a detailed inspection of the interior and make any necessary repairs.

The reactors will remain in this state for up to 75 years, allowing DOE and the regulators time to determine alternate disposal methods for the radioactive reactor cores in each reactor.

Four reactors were cocooned under the Environmental Restoration Contract. WCH completed H Reactor in October 2005, and KE, KW and N reactors are scheduled to by completed no later than 2012. B Reactor may be released to WCH at a later date, pending a DOE decision on a permanent museum/interpretive center concept.

Field Remediation Closure – The goal of the Field Remediation Closure Project is to complete remediation of liquid and solid waste sites, as well as burial grounds. The RCC work scope identifies 486 waste sites for remediation. Also included in the contract is remediation of the 618-10 and 618-11 burial grounds. Both burial grounds will be released by DOE for remediation following DOE's approval of WCH's *600 Area Remediation Design Solution*.

Field Remediation deals with three types of sites: liquid and solid waste sites, as well as burial grounds. The largest volume of contaminated waste in the River Corridor comes from liquid waste sites. The liquid waste sites primarily comprise the area surrounding the plutonium production reactors' effluent piping systems, which released reactor cooling water contaminated with activation products as well as fission products from fuel breaches. The N Reactor was the only one of Hanford's nine production reactors which had a closed loop cooling system. The other reactors drew in river water which ran directly through the core, was expelled through effluent piping, held in retention basis for short periods of time and then returned to the river.

With the liquid waste sites, remediation workers knew what they were dealing with – piping of a certain width, diameter and length, detailed blueprints of retention basins, weir boxes and outfall structures. The only unknown was how far they would need to chase a contaminated plume. The solid waste sites and burial grounds are a far different story. Here, radioactive and hazardous material was buried with little or no documentation. In one case, a burial ground thought to contain mostly construction debris, ended up yielding 768 drums with depleted uranium shavings in oil or drums of uranium oxide. Other burial grounds thought to contain worn out reactor parts have been found to contain spent reactor fuel, sizeable quantities of mercury and contaminated fork lifts.

Fig. 3. Excavation of contaminated material from waste sites and burial grounds near the Columbia River

The most problematic remediation exists at the 618-10 and 618-11 burial grounds. The burial grounds were used in the 1950s and 1960s. One is more than 2.0 hectares in size, the other more than 3.2 hectares. The 618-11 burial ground is adjacent to the employee parking lot for a commercial nuclear power plant. Highly radioactive wastes from research operations were disposed in trenches, vertical pipe storage units and caissons. DOE will release these two sites to WCH for remediation once the remediation design plan is approved.

Waste Operations – The Waste Operations group is responsible for the safe transport, treatment and disposal of all contaminated materials generated through field remediation and demolition activities for the RCC Project and other Hanford contractors.

A key feature of Waste Operations is the ERDF, a CERCLA-authorized, RCRA-compliant, engineered landfill. With initial construction in 1996, the facility was designed to be expanded as needed. Since then, it has been expanded twice and currently has an operational capacity of 7.26 million metric tons. So far, more than 5.4 million metric tons of contaminated materials have been disposed at ERDF. The amount represents about 60 percent of the 9.1 metric tons of contaminated materials estimated to be located near the Columbia River. WCH expects to expand ERDF capacity to 12.7 million metric tons within the life of the contract.

A fleet of 18 trucks ship an average of 200 containers, or 3629 metric tons, per day, of contaminated soil and debris, to ERDF. The disposal facility has been operated for nine consecutive years without a lost-time accident. ERDF transportation drivers have logged more than 16 million km with only one at-fault accident – far surpassing national transportation statistics for safe operation.

WCH's current priorities for Waste Operations are to procure major subcontracts for waste transport and ERDF operations, develop alternate transport systems for 300 Area wastes, and develop safe and efficient disposal methods for beryllium-contaminated wastes.

End State and Final Closure – The purpose of the End State and Final Closure (ESFC) Project is to ensure WCH has met the appropriate regulatory requirements in River Corridor cleanup to ensure DOE can "close" specific areas or sites and transfer them to long-term stewardship. DOE defines River Corridor closure as "...completion of all activities required to: deactivate, decontaminate, decommission, and demolish excess facilities; place former production reactors in an interim safe and stable condition; remediate waste sites and burial grounds; meet regulatory requirements; and transition to long-term stewardship."

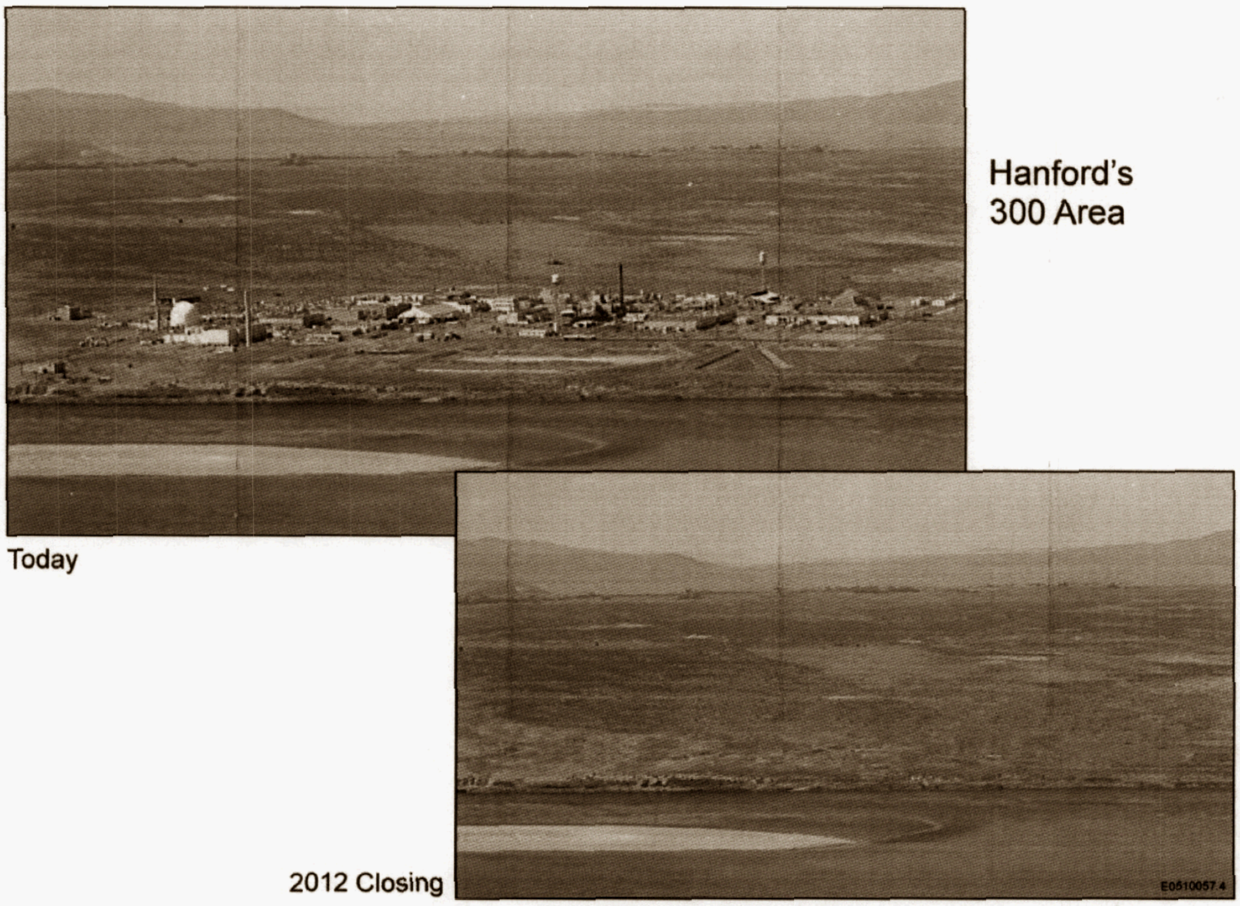


Fig. 4. The Hanford Site 300 Area – today and when cleaned up

The End State and Final Closure Project follows the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) process and uses the outputs from the other Washington Closure field projects and functional organizations, culminating in a "Finding of Suitability to Transfer" to long-term stewardship.

The work scope includes developing an end state strategy, preparing an integrated river corridor work plan for a CERCLA baseline risk assessment, preparing a baseline risk assessment, conducting orphan site evaluations, conducting surface soil surveys, preparing remedial action reports, preparing a remedial investigation report and a proposed plan for river corridor source areas, conducting independent closure reviews, and preparing draft and final long-term stewardship plans. The ESFC Project uses the Voluntary Protection Program and Integrated Environment, Safety, Health Management System to achieve project objectives.

River Corridor Closure Contract Terms

The River Corridor Closure Contract is a cost-plus, incentive fee contract for the closure of 544 km^2 of the 1,517 km^2 Hanford Site. The contract terms provide incentives to the contractor to complete the project on or ahead of schedule and below the target cost. The schedule incentives are graduated from zero to $40 million based on the degree of acceleration. The $40 million maximum can be earned by completing the project by March 2012. The cost incentive structure is based on an 80/20 split. Washington Closure proposed to complete the project for a target cost of $1.79 billion. For each dollar below the proposed target cost, the government keeps 80 cents and Washington Closure earns 20 cents in fee. The fee is capped at 13.5 percent of the target cost. Washington Closure proposed to complete the project by September 2012 for $1.79 billion, which provides for earning a $30 million schedule bonus. Completing the project by September 2012 and for $1.79 billion is a significant cost and schedule improvement as compared to the independent government estimate. Washington Closure believes it will be successful by applying experienced personnel and lessons-learned from other closure projects at Rocky Flats, Mound, Weldon Springs and Savannah River.

A major feature of the contract is its subcontracting requirements. The RCC Contract offers significant opportunities for subcontracting. WCH can self-perform up to 40 percent of the value of the contract and must subcontract the balance. Thirty percent of the total value of the contract must be performed by small businesses [3]. WCH has implemented an aggressive strategy to meet its subcontracting goals. The company held a procurement seminar the first month of its contract and will hold similar events throughout the life of the contract. Potential subcontracts should register on the WCH procurement web page at www.washingtonclosure.com. The procurement page also lists upcoming procurements, as well as specific technology needs and requirements for the project.

PROJECT RISKS

There are several significant challenges and risks associated with closing the Hanford River Corridor: 1) removal of the 618-10 and 618-11 burial grounds; 2) demolishing the large hot-cell facilities in the 300 Area; 3) meeting cost and schedule targets if the K Area fuel storage basins and PNNL-occupied facilities in the 300 Area are not vacated and released on schedule; and 4) cleaning up to standards that may change.

Technical Risks

Remediation of the 618-10 and 618-11 burial grounds poses significant risks from potential high dose rates and contamination levels. In addition, the limited information available on burial ground waste indicates that some of the materials could be considered transuranic waste. Risk mitigation strategies are being developed as part of the engineering process, now underway, used to prepare for burial ground material removal.

Demolition of the 324, 325, 327 and 329 hot cell facilities in the 300 Area has not been attempted on this scale. The high dose rates, contamination levels inside the hot cells, and the heavy concrete walls preclude traditional approaches to decontamination and demolition. Risk mitigation plans are being developed for waste and facility removal. Current plans call for the use of diamond wire saws to cut the hot cells into monolithic pieces for eventual removal and burial in the Hanford Site Environmental Restoration Disposal Facility.

Institutional Risks

The most likely institutional risks to project schedule and costs are the delayed release of facilities in the 300 Area and 100 K Area to Washington Closure. PNNL's ability to vacate 300 Area facilities and still support their research mission is predicated on the construction of replacement facilities. The replacement facilities are needed by mid-2009 to support the schedule for D4. Having the new facilities available is dependent on obtaining DOE and other funding in time to get the design and construction completed to support the schedule.

In fact, U.S. Rep. Doc Hastings of Washington state announced on December 20, 2005, that DOE had extended the laboratory construction schedule by 15 months to ensure replacement facilities can be completed before 300 Area buildings must be vacated and demolished under the River Corridor Closure Project[4]. The extension was from September 30, 2009, to December 31, 2010.

Several of the PNNL facilities in the 300 Area are on the Washington Closure critical path for completing D4 activities in 300 Area. Washington Closure, PNNL and DOE are working closely to determine what impact the 15-month construction extension will have on the RCC Project cost and schedule.

The potential late release of the 100 K spent fuel storage basins and ancillary facilities from Project Hanford Management Contractor (PHMC). A delay in the release of the fuel storage basins was recently announced by the PHMC and DOE, which could potentially impact the schedule for placing the 100 K East and K West reactor buildings in interim safe storage[5]. It is not yet clear if the delay will result in an overall delay in the schedule for completing the RCC scope.

The 300 Area is being cleaned up to an industrial reuse standard. Some stakeholders are calling for the standard to be changed to the more-conservative residential or recreational levels. There is a risk that cost increases and schedule delays will be necessary to accommodate the potential changes.

SUMMARY

The RCC Contract represents the third generation of closure contracts in the DOE-EM complex, with Rocky Flats being the first and Mound and Fernald being the second. DOE and WCH are dedicating significant project experience, talent and corporate commitment to ensure the project is completed safely, on time and within the cost estimate. The expectations are that by building on the first and second generation closure experience, the project objectives can be achieved.

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