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CLEANUP OF THE COLUMBIA RIVER CORRIDOR: ACCELERATING VISIBLE PROGRESS ALONG THE HANFORD REACH

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ABSTRACT

With the high cost of today's U.S. Department of Energy (DOE) environmental cleanup work, it is crucial to produce measurable accomplishments at DOE projects, along with a high return on investment through cost savings initiatives and/or mortgage reductions. The consistent demonstration of continuous progress is often critical to sustaining the annual funding needed for cost-efficient management of DOE's larger cleanup programs.

While there has been significant recent progress in the environmental cleanup of the Hanford Site, current funding scenarios do not support any highly visible accomplishments for completion in the near future. However, with a reasonable amount of redirected or supplemental funding over the next few years, and by focusing cleanup activities along the Columbia River Corridor, an opportunity exists to accelerate the cleanup of the Hanford Site and to demonstrate several near-term, highly visible, and measurable accomplishments. A modest level of annual funding will show an attractive return-on-investment through cost savings and mortgage reduction, and will demonstrate important cleanup progress along the Hanford Reach, which is an environmentally sensitive segment of this vital regional waterway that borders on the Hanford Site in southeastern Washington State.

INTRODUCTION

The Hanford Site was established in 1943 as the Hanford Engineer Works, by the Manhattan Engineering District of the U.S. Army Corps of Engineers. It was the world's first plutonium production facility. The 1,450-km^2 (560-mi^2) site was located in southeastern Washington State (Fig. 1) because it was remote from any major populated areas, it had ample electrical power from the Grand Coulee Dam, it offered convenient access to railroads and highways, and there was an abundant water supply in the Columbia River to cool the reactors. (1)

For more than 40 years, Hanford's primary mission involved the production of nuclear materials for national defense. In the late 1980s, the primary mission at the Hanford Site was focused on the cleanup of the nuclear defense production legacy, which included the following:

- 1,400 identified waste sites
- 2,100 metric tons (2,315 tons) of deteriorating nuclear fuel
- 177 underground tanks containing over 245 million L (65 million gal) of high-level waste
- 11.7 metric tons (12.9 tons) of plutonium
- 260 km^2 (100 mi^2) of contaminated groundwater (over 3.8 trillion L [1 trillion gal])

- 3.8 million m^3 (5 million yd^3) of contaminated soil
- 5 chemical processing "canyon" facilities
- 9 retired plutonium production reactors.

Site operations over the years, and current cleanup activities addressing these legacy issues, are conducted in numerically designated areas at the Hanford Site. The 100 Area was used for plutonium production; the 200 Area was used for chemical processing, plutonium finishing, and waste management and disposal activities; the 300 Area supported reactor fuel manufacturing and laboratory facilities; and the 1100 Area provided administrative support facilities. The 400 Area houses the Fast Flux Test Facility, which was built as part of DOE's liquid metal fast breeder reactor program. The Fast Flux Test Facility was shut down in 1993, but remains in standby, awaiting the results of an Environmental Impact Study that is evaluating the viability of the restart of the reactor for civilian missions.

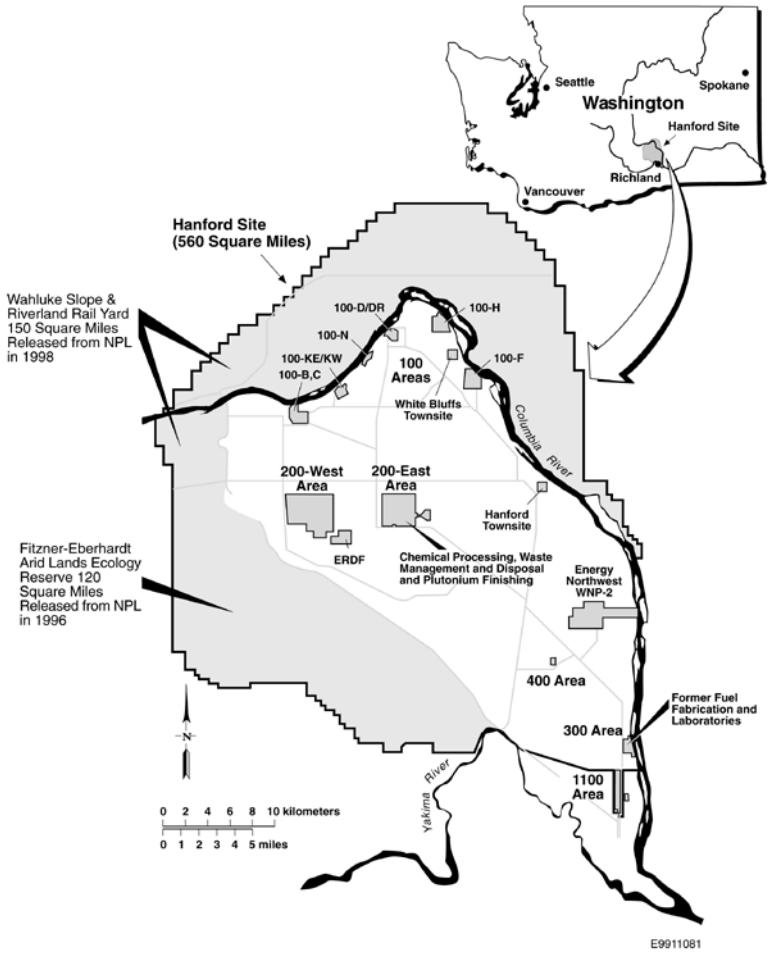

Fig. 1. The U.S. Department of Energy Hanford Site – Cleanup of the Nuclear Defense Production Legacy.

REGULATORY DRIVERS FOR HANFORD SITE CLEANUP

There are two primary regulatory drivers for cleanup of the Hanford Site:

- The U.S. Environmental Protection Agency's (EPA's) Superfund *National Priorities List* (NPL)
- The *Hanford Federal Facility Agreement and Consent Order* (*Tri-Party Agreement)*.

On November 3, 1989, the Hanford Site was officially placed on the EPA's NPL. The four Hanford Areas (100, 200, 300, and 1100) were designated as aggregate areas for the Hanford Site's NPL listing, with a total of 78 operable units. An operable unit is a geographic area where similar wastes from past operating practices were deposited. Additional past-practice units from other areas have also been assigned to operable units within one of the four aggregate areas, for the purpose of investigation and subsequent action. (2,3)

Since EPA's 1989 listing action, significant progress has been made in deleting portions of the Hanford Site from the NPL. For example, the 1100 Area Superfund Site, and two operable units in the 100 Area Superfund Site, have been cleaned up and deleted from the NPL by the EPA. The 310-km^2 (120-mi^2) 1100 Area Superfund Site, which included the Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve on the western portion of the site, was deleted from the NPL in 1996. The two operable units in the 100 Area Superfund Site, the Riverland Rail Yard (100-IU-1) and the Wahluke Slope (100-IU-3) (approximately 388 km^2 [150 mi^2]), were also deleted from the NPL in 1998. (4,5) To date, nearly one-half of the Hanford Site has been deleted from the NPL.

The *Tri-Party Agreement* was implemented in May 1989 by the DOE, the EPA, and the Washington State Department of Ecology. The milestones in the *Tri-Party Agreement* are used to develop lifecycle long-range plans for Hanford Site cleanup. The long-range plans integrate the technical scope, cost estimates, and detailed schedules with a prioritization logic to identify the funding levels necessary to complete the cleanup milestones in the *Tri-Party Agreement*.

DESIRED OUTCOMES AND RECENT ACCOMPLISHMENTS

The DOE Richland Operations Office is focusing the cleanup of the Hanford Site on two major outcomes:

- Transitioning the Central Plateau for long-term waste management
- Restoring the Columbia River Corridor.

The 200 Area of the Hanford Site is designated as the Central Plateau. The Central Plateau is the location of 177 high-level waste underground storage tanks, the Plutonium Finishing Plant complex (now shut down), and a number of deactivated chemical processing canyon facilities. The Central Plateau is also used for the storage of transuranic (TRU) waste, and for operation of low-level and mixed radioactive waste disposal facilities. The Central Plateau will be the future site of a vitrification plant for processing the high-level waste that is currently in underground storage tanks.

To date, there have been a number of accomplishments in the Central Plateau that demonstrate significant progress in Hanford's cleanup. These include the following:

- The deactivation of the Plutonium Uranium Extraction and B Plant chemical processing plants, ahead of schedule.
- The construction of a 2.1-million m^3 (2.8-million yd^3) capacity Environmental Restoration Disposal Facility (ERDF), for the safe disposal of low-level and mixed radioactive waste from Hanford's cleanup activities.
- The retrieval of drums of TRU waste from Hanford Site trenches, which was initiated more than one year ahead of the *Tri-Party Agreement* milestone. This began a long-term effort to process, treat, and transport TRU waste from the Hanford Site for final disposal at the Waste Isolation Pilot Plant, which is located outside of Carlsbad, New Mexico.

The Columbia River Corridor is that portion of the Hanford Site adjacent to the southern shoreline of the Columbia River, beginning at the Vernita Bridge and progressing downstream approximately 67.6 km (42 mi), past the Hanford 100 Areas to the Hanford 300 Area, which is north of the City of Richland. This stretch of the Columbia River is designated as the Hanford Reach, and this is the last free-flowing, non-tidal segment of the Columbia River in the United States. (6,7)

The Hanford 100 Areas, which are adjacent to the river, include six sites where nine shutdown plutonium production reactors and their support facilities are located: 100-B/C, 100-KE/KW, 100-N, 100-D/DR, 100-H, and 100-F. Each of these reactor areas contains large quantities of contaminated soils in former liquid waste disposal cribs and waste burial grounds. Two large fuel storage basins at 100-KE/KW contain 2,100 metric tons (2,315 tons) of deteriorating spent nuclear fuel. The historic remains of the White Bluffs and Hanford Townsites are also included in the 100 Areas. The 300 Area contains shutdown fuel fabrication and support facilities, along with shutdown and operating laboratory facilities.

As in the Central Plateau, there have been a number of recent and highly visible accomplishments in Hanford cleanup along the Columbia River Corridor. These include the following:

- The deactivation of the world's only dual-purpose reactor (special nuclear material and steam for electricity): the 860 MWe N Reactor.
- The removal of more than 1.8 metric tons (2.0 tons) of contaminated soil from along the Columbia River shoreline for disposal in the ERDF.
- The completion of interim safe storage (ISS) for the C Reactor. The "coccooning" of the C Reactor reduced the original footprint of the reactor building by more than 80%, and minimized the need for surveillance and maintenance for up to 75 years. The C Reactor is the first of eight Hanford Site retired plutonium production reactors that will be placed in ISS. The B Reactor, which was Hanford's first reactor to produce plutonium, went into operation in June 1943. It has been placed on the National Historic Register and is scheduled to become a museum.

Unfortunately, current cleanup plans do not identify any near-term, highly visible accomplishments for completion in either the Central Plateau or the Columbia River Corridor. The shipment of TRU waste to the Waste Isolation Pilot Plant will begin in 2000, and shipments are scheduled to continue over the next few decades. The first waste to be processed by the tank waste vitrification plant is scheduled for 2007, and the deactivation of the Plutonium Finishing Plant complex is not scheduled for completion until 2016. The next reactor for ISS, F Reactor, is not scheduled to be completed until 2003, with the DR Reactor in 2005, the D Reactor in 2007, and the H Reactor in 2009. The removal of the spent nuclear fuel from the KE and KW basins is not scheduled to be completed until 2003, and remediation of contaminated soils in the 100-F Area waste sites and burial grounds will be completed in 2009.

THE COLUMBIA RIVER CORRIDOR – OPPORTUNITIES TO ACCELERATE HANFORD CLEANUP

While current Hanford Site cleanup plans do not identify any projects with the potential for immediate, highly visible accomplishment, the Columbia River Corridor offers a number of opportunities to accelerate the cleanup of the Hanford Site, to demonstrate near-term, highly visible, measurable accomplishments, and to show a high return on investment through cost savings and mortgage reduction.

There are several regulatory, stakeholder, political, and programmatic reasons to focus on the Columbia River Corridor to accelerate cleanup of the Hanford Site. In 1994, the three participating government agencies in the *Tri-Party Agreement* -- the DOE, the EPA, and the Washington State Department of Ecology -- acknowledged that one of the strongest messages voiced by the public during the previous several years was to focus cleanup efforts along the Columbia River. In response to this public desire to direct cleanup along the Columbia River, the three parties entered into an *Agreement in Principle* on July 18, 1994, for negotiations on matters relating to "refocusing activities" for the environmental restoration of Hanford Site. (8)

The *Agreement in Principle* cited an existing September 30, 1993, *Agreement in Principle* that stated the following:

> "The parties agree that cleanup should proceed on a geographic basis to help ensure coordination of Decommissioning and Decontamination (D&D) and RCRA and CERCLA past practice cleanup actions. The parties further agree that it is appropriate to refocus environmental restoration activities to achieve:
>
> 1. Earlier initiation and completion of remedial actions, and
> 2. Accelerated remediation of sites along the Columbia River and adjacent to the City of Richland."

Also cited in the *Agreement in Principle* was a January 25, 1994, Cost and Management Efficiency Initiative agreed to by the parties:

> "Refocus Environmental Restoration – The parties agree that it is appropriate to refocus the environmental restoration program to achieve earlier remediation and to focus on remediation of sites along the Columbia River."

A WORK SCOPE TO ACCELERATE CLEANUP AND DEMONSTRATE CONTINUED PROGRESS IN PROTECTING THE COLUMBIA RIVER

In 1999, the Richland Environmental Restoration (ER) Project undertook an initiative to focus on completing cleanup work in targeted geographic areas along the Columbia River, and to accelerate the availability of land along the Hanford Reach for alternative use. The objective of the initiative was to develop a phased work scope with early, measurable, and highly visible accomplishments that would demonstrate progress in protecting the Columbia River, while maintaining minimum safe operations and mitigating urgent and high risks at the Hanford Site.

For the purpose of the initiative, the Columbia River Corridor (Fig. 2) was defined as that portion of the Hanford Site adjacent to the southern shoreline of the Columbia River, beginning at the Vernita Bridge at river mile (RM) 388 (distance from the Pacific Ocean) and progressing downstream 67.6 km (42 mi) to RM 346 at the north end of the Hanford 300 Area. The inland boundary of the Columbia River Corridor begins at the north end of the 300 Area (adjacent to RM 346) and follows the river side of Route 4S from the 300 Area northwest to the Wye Barricade. The boundary then follows the river side of Routes 2S and 2N north by northwest to Route 1; follows the river side of Route 1 west toward the100-B/C Area to the western boundary line of Township 13North, Range 26 East, Willamette Meridian; then directly south along the western boundary line parallel to Route 6 to intersect with Route 11A; and then west on Route 11A to the intersection of Route 11A and Washington State Routes (SR) 240/24. The western boundary of the corridor begins at the intersection of SR 240/24 and 11A and follows SR 24 north to the Vernita Bridge. The areas to the west of the defined Columbia River Corridor, between SR 240/24 and the western boundary of the Hanford Site, are the Fitzner/Eberhardt ALE Reserve and the Riverland Rail Yard area.

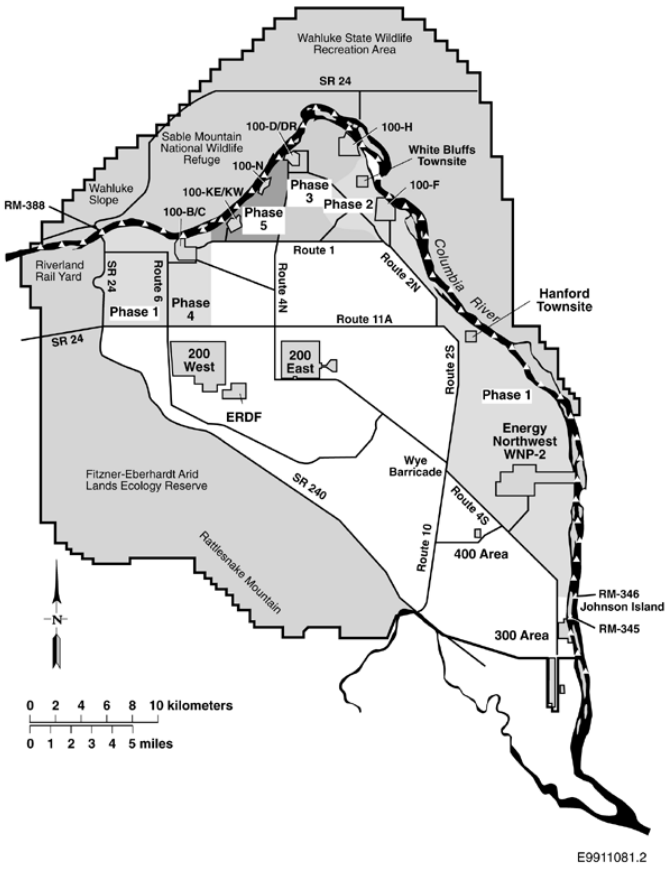

Fig. 2. The Columbia River Corridor.

These areas have been cleaned up and deleted from the EPA's NPL in 1996 and 1998, respectively.

Five phases were identified that would result in highly visible, near-term accomplishments, and which would demonstrate continued progress in terms of protecting the Columbia River. The geographic areas of each phase, progressing north from the 300 Area, around the horn segment of the Columbia River, and west to the Vernita Bridge, are shown in Fig. 2. The western portion of the Columbia River Corridor was included in Phase 1, because of the limited contamination in the area and in order to provide timely access to the B Reactor from SR 24, whenever B Reactor is developed into a museum. The boundaries of this 39-km^2 (15-mi^2) area are the Columbia River on the north, from the Vernita Bridge east to the 100-B/C Area; Route 6 on the east, Route 11A on the south; and SR 24 on the west.

Scopes of work were identified for each phase, in three-year increments, beginning in 2000, to determine an accelerated work scope along the Columbia River Corridor that could be completed for reasonable levels of annual funding. The scope of work identified for each phase is shown in Table I.

Table I. Opportunities to Accelerate Cleanup Along the Hanford Reach.

The Columbia River Corridor Project, when completed, will make 260 km^2 (100 mi^2) of the Hanford Site
and 67.6 km (42 mi) of the Hanford Reach available for alternative use.

Phase	Year	Description
1	2000	• 156 km^2 (60 mi^2) and 38.6 km (24 mi) of Hanford Reach • Decommissioning of more than 300 abandoned wells • Remediation of two waste sites that are included in 300 Area operable unit (300-FF-2) • Environmental restoration of old Hanford Townsite • B Reactor feasibility study for museum development
2	2003	• 18.2 km^2 (7 mi^2) and 8.1 km (5 mi) of Hanford Reach • ISS complete for D, DR, F, and H Reactors • Environmental restoration of White Bluffs Townsite • Remediation of 100-F Area
3	2006	• 44.2 km^2 (17 mi^2) and 9.6 km (6 mi) of Hanford Reach • Remediation of 100-H and 100-D/DR Areas
4	2009	• 23.4 km^2 (9 mi^2) and 3.2 km (2 mi) of Hanford Reach • Remediation of 100-B/C Area
5	Beyond 2009	• 18.2 km^2 (7 mi^2) and 8.1 km (5 mi) of Hanford Reach • ISS of KE and KW Reactors after spent nuclear fuel and debris removed from KE and KW fuel storage basins in 2007 • ISS of N Reactor scheduled to begin in 2013 • Remediation of 100-KE/KW Area and 100-N Area, in conjunction with ISS

An analysis was conducted of the cost estimates in the ER Project Long-Range Plan Baseline for the scope of work identified for each phase. (9) This analysis was used to determine the level of funding required to complete the accelerated work scopes for Phases 1, 2, and 3 by the end of FY 2000, 2003, and 2006, respectively. The FY 2000 to FY 2006 time frame was selected to be consistent with the dates identified for enhanced performance strategies and breakthrough objectives in the *Accelerated Cleanup Paths to Closure* document that was prepared for the Hanford Site. (10)

The total funding requirement for Phases 1, 2, and 3, based on the cost estimates in the ER Project Long-Range Plan Baseline, is shown in Table II.

Table II. Total Funding Required to Complete Phases 1, 2, and 3 of the Columbia River Corridor Initiative.

Phase	Description	FY00	FY01	FY02	FY03	FY04	FY05	FY06
		(Dollar amounts in millions)						
1	Remediation and disposal of contaminated soil and well decommissioning	5.0	--	--	--	--	--	--
2	Reactor ISS	16.6	17.2	17.3	17.4	--	--	--
	Remediation and disposal of contaminated soil	32.5	48.9	55.0	46.5	--	--	--
3	Remediation and disposal of contaminated soil	30.3	16.2	24.3	42.0	52.1	35.8	36.7
Total		84.4	82.3	96.6	105.9	52.1	35.8	36.7

IDENTIFYING A WORK SCOPE WITH NEAR-TERM, HIGHLY VISIBLE ACCOMPLISHMENTS AND SIGNIFICANT COST SAVINGS

Due to budget limitations and higher priorities placed on other Hanford Site projects, it is highly unlikely that the total funding required to complete the total accelerated work scope for Phases 1, 2, and 3 could be obtained. Therefore, an alternative work scope was identified that had a more feasible funding requirement while still meeting the original objective of the Columbia River Corridor Initiative -- that is, to develop a phased work scope with early, measurable, and highly visible accomplishments that would demonstrate progress in protecting the Columbia River.

The alternative project work scope that was identified included two elements:

- Complete Phase 1 of the Columbia River Corridor Initiative, as soon as practical.
- Accelerate the ISS for the F, DR, H, and D Reactors for completion by the end of 2003.

The work scope for Phase 1 will include the decommissioning and verification of more than 300 abandoned wells in the designated geographic area of Phase 1. Completing the decommissioning of the abandoned wells in the 156 km^2 (60 mi^2) identified in Phase 1 is not currently scheduled for completion until 2009. Also included in Phase 1 is the remediation of two waste sites (600-23 and J. A. Jones Construction Pit #1) that are within the 156-km^2 (60-mi^2) area of Phase 1. In the current long-range plans, the remediation of these two sites is included in the 300 Area operable unit. Phase 1 also includes the characterization and remediation of waste sites at the old Hanford Townsite. These waste sites contain pre-Manhattan Engineering District residential and agricultural contamination, and construction and residential waste resulting from a 51,000-person Hanford Engineer Works construction camp built at the townsite in 1943. In general, the contamination consists of surface debris, municipal solid and sanitary waste dumps, oil spills, building foundations, waste construction materials, and ash piles. (11) The remediation of the Hanford Townsite is currently scheduled for completion in 2003. The B Reactor Museum feasibility study will also be completed in Phase 1. Not included in Phase 1 is the remediation of five waste sites adjacent to the commercial nuclear power plant WNP-2, owned by Energy

Northwest (previously the Washington Public Power Supply System). The remediation of these sites will be completed at the time WNP-2 is decommissioned.

The estimated cost of Phase 1 is $5 million. If completed in 2000, Phase 1 will save an estimated $1.3 million and accelerate the current cleanup schedule for this work scope by nine years. Phase 1 will complete the remediation of 156 km^2 (60 mi^2) of the Hanford Site, making it available to be removed from the NPL. The removal of this land area will increase (to 60%) the total portion of the Hanford Site deleted from the NPL. In addition, Phase 1 will make 38.6 km (24 mi) of Hanford Reach river shore available for alternative use. The cost savings and the nine-year schedule reduction for the Phase 1 work scope are shown in Fig. 3.

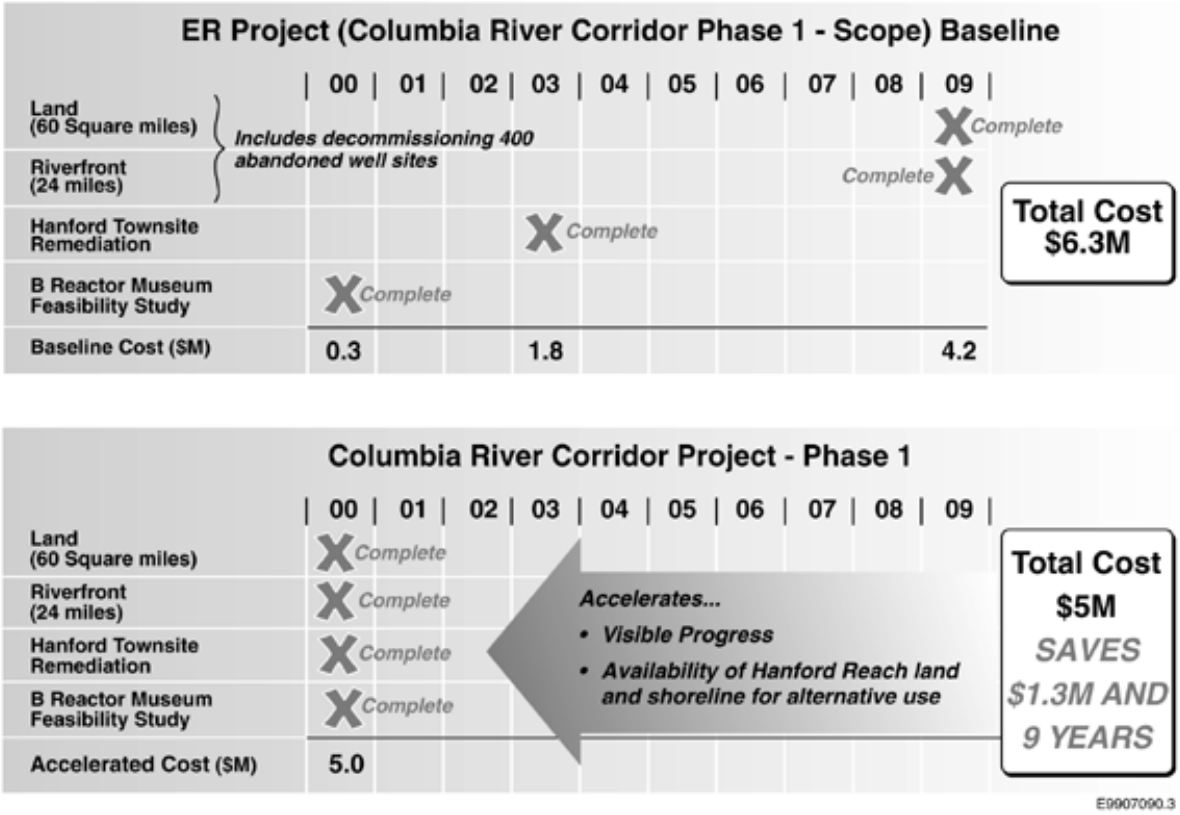

Fig. 3. The Phase 1 Work Scope for the Columbia River Corridor Project.

The second alternative work scope element was to accelerate the ISS of the next four reactors (F, DR, H, and D) for completion by the end of 2003. This can be achieved by using a multiple reactor ISS schedule, instead of the series schedule that is currently planned. If funded, the multi-reactor ISS project will complete the ISS of the next four reactors by the end of FY 2003, at a cost of $68.5 million. Compared to the $82.4 million total cost estimate for the series schedule for the ISS of these four reactors in the ER Project Long-Range Plan Baseline, the accelerated multi-reactor ISS project will save $13.9 million in cost and accelerate the schedule by six years. (9) The $13.9 million in cost savings includes $7 million in operating efficiencies and cost avoidance, and $6.9 million in reduced escalation. Operating efficiencies will result

from eliminating unnecessary duplication of management at multiple project sites, subcontracting for multiple scopes of work, and from retaining an experienced work force. The cost avoidance will result from not requiring demobilization, remobilization, work force reductions, and retraining of the new work force when the project is resumed. The $13.9 million cost savings and the six-year reduction in the ER Project schedule (from FY 2009 to FY 2003) for the multi-reactor ISS project are shown in Fig. 4.

CONCLUSIONS

While there has been significant progress made over the past few years in the cleanup of the Hanford Site, current cleanup plans do not identify any immediate, highly visible accomplishments for completion in the near future in either the Central Plateau or the Columbia River Corridor at the Hanford Site. However, the Columbia River Corridor does offer a number of opportunities to accelerate the cleanup of the Hanford Site, to demonstrate near-term, highly visible, measurable accomplishments, and (for a realistic level of annual funding) to show a high return-on-investment through cost savings and mortgage reduction.

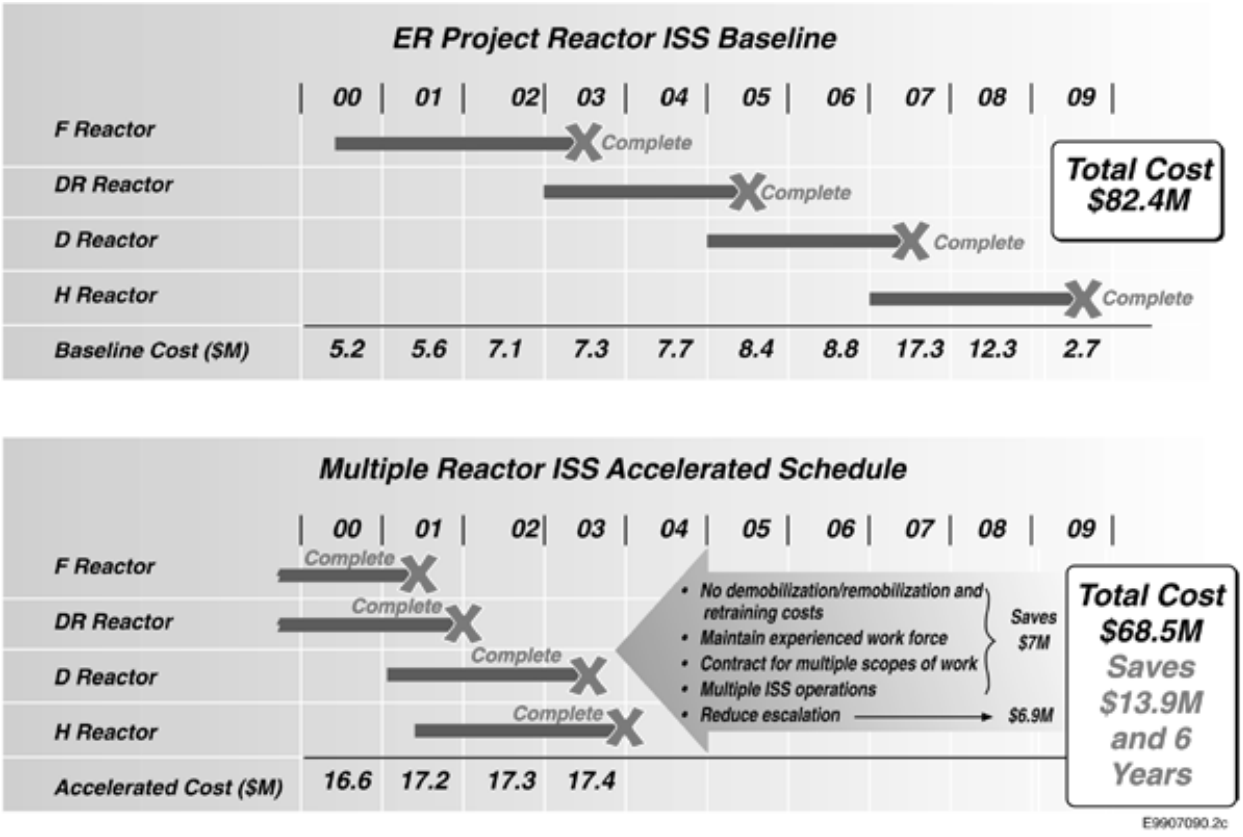

Fig. 4. Accelerated Schedule for Multiple Reactor ISS Projects.

Phase 1 of the Columbia River Corridor Initiative identifies a 156-km^2 (60-mi^2) portion of the Hanford Site, along the Hanford Reach of the Columbia River, that can be cleaned up in approximately 12 months for an estimated cost of $5 million. The cleanup would make this

156 km^2 (60 mi^2) of the Hanford Site, and 38.6 km (24 mi) of the Hanford Reach, available for alternative uses. Included in the Phase 1 scope of work is the cleanup of the historical Hanford Townsite, with the potential of making the townsite available as a destination for a pedestrian bicycle trail and a boat ramp location for access to the Columbia River. Completion of the environmental restoration of the 156 km^2 (60 mi^2) in Phase 1 would make this area available to be removed from the EPA's NPL. The Phase 1 work scope, if completed in FY 2000, will save $1.3 million and will accelerate the current schedule by nine years. This $1.3 million savings represents a 25% return-on-investment of the $5 million cost for the Phase 1 cleanup.

A second scope of work in the Columbia River Corridor that would have near-term, highly visible, and measurable accomplishments, and which would show a high return-on-investment, is the completion of the ISS of the next four shutdown Hanford Site reactors as one multiple-reactor ISS project. By using a multiple-reactor ISS schedule, instead of the series schedule currently planned, the ISS of the next four Hanford reactors could be completed by 2003. This multi-reactor approach will save $13.7 million in costs, and would accelerate the schedule by six years. This represents a 20% return-on-investment on the $68.6 million cost of the multiple-reactor ISS project. In addition, the early ISS of these four reactors will result in a cost avoidance/mortgage reduction of $2.5 million in facility surveillance and maintenance, which will occur during the nine-year schedule if the four reactor ISS projects are completed in series.

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