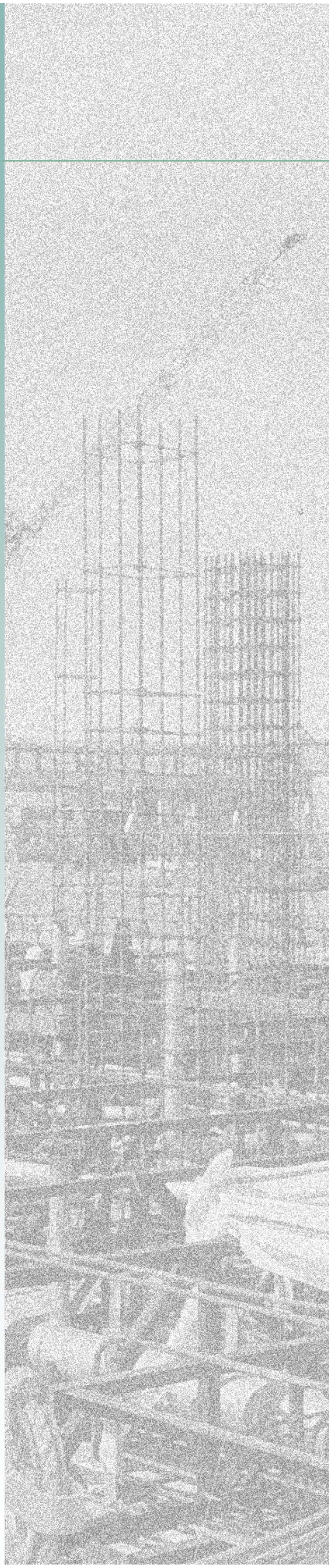

Hanford Tank Waste Treatment and Immobilization Plant

December 2005 Estimate at Completion

EXECUTIVE SUMMARY

January 30, 2006

Bechtel National, Inc.

Washington Group International
Integrated Engineering, Construction, and Management Solutions

The Waste Treatment Plant Construction Site, September 2005. Clockwise from top right, Pretreatment Facility, Analytical Laboratory, Low-Activity Waste Facility, and High-Level Waste Facility.

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Acronyms and Abbreviations

BOF	balance of facilities
BNFL	British Nuclear Fuels
BNI	Bechtel National, Inc.
DCMA	Defense Contract Management Agency
DOE	U.S. Department of Energy
DOE-ORP	U.S. Department of Energy, Office of River Protection
DWPF	Defense Waste Processing Plant
EAC	estimate at completion
EPA	Environmental Protection Agency
EPC	engineering, procurement, and construction
EVMS	earned value management system
FAC	forecast at completion
FY	fiscal year
HLW	high-level waste
Lab	Analytical Laboratory
LAW	low-activity waste
ODC	other direct costs
ORR	operational readiness review
PT	pretreatment
ROM	rough order of magnitude
TPA	Tri-Party Agreement
TPRA	technical and programmatic risk assessment
USACE	U.S. Army Corps of Engineers
WBS	work breakdown structure
WTP	Hanford Tank Waste Treatment and Immobilization Plant

1. Introduction

The WTP is currently estimated to cost $8,777 million plus contractor fee, supporting full-scale operation and facility turnover by May 2017.

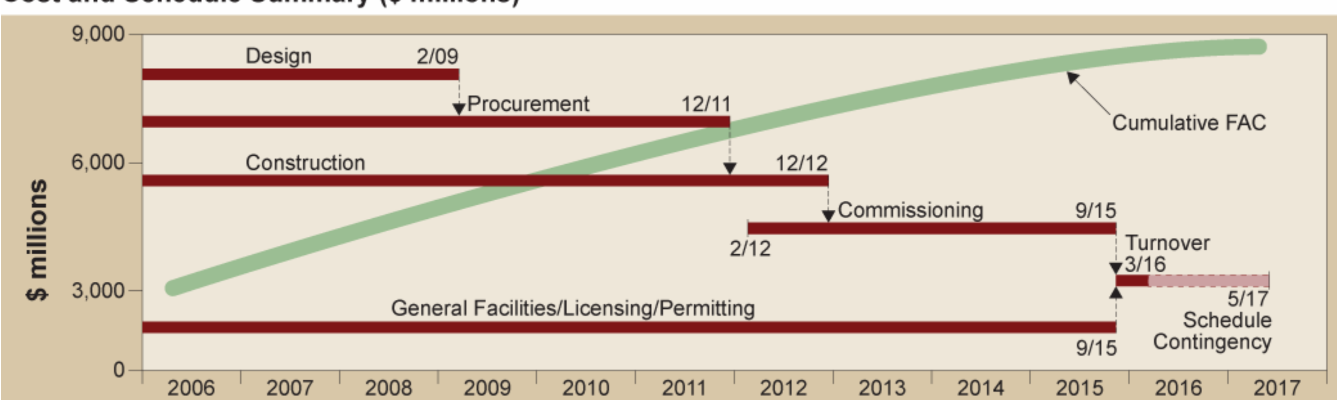
The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a first-of-a-kind technology project designed to solve one of our nation's most difficult nuclear waste problems—immobilizing 54 million gallons of highly radioactive waste. In 2000, the U.S. Department of Energy, Office of River Protection (DOE-ORP) awarded a $4 billion contract to Bechtel National, Inc. (BNI) and our subcontractor, Washington Group International (WGI), to complete WTP design, construction, and commissioning. Because WTP is the largest nuclear facility to be built in the United States in nearly three decades, DOE and Bechtel have had to effectively reconstitute the nuclear industry supply chain and create the largest nuclear engineering and construction workforce assembled since the 1970s.

Based on the results of the technical and programmatic risk assessment (TPRA), the WTP project team recommends that DOE maintain an additional allowance of $1,760 million to address risks outside the current scope of this project.

From the start, it was understood that this was not a typical construction project, and that significant technical and cost challenges would have to be overcome to complete the project on the timeline established in the Tri-Party Agreement (TPA) among the State of Washington, the Environmental Protection Agency, and DOE. Our initial cost estimate was based on a conceptual design that was approximately 5% complete. In 2003, when design was 40% complete, a decision was made to expand the plant's capability. Plant throughput for immobilizing high-level waste was increased by 300% and pretreatment capacity was increased by 40% to provide, for the first time, a facility design that could more closely meet Tri-Party Agreement milestones. The changes increased our FY 2003 forecast at completion (FAC) cost for the project to $5,406 million.

The December 2005 FAC for the project is $8,777 million. As shown in Figure 1, this includes $7,736 million for currently authorized workscope

Cost and Schedule Summary ($ millions)



Fiscal Year	Cost Through 2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Estimate at Completion	2,743	686	648	651	589	609	531	438	327	292	187	35	0	7,736
Management Reserve		10	25	25	65	65	130	150	200	155	76	75	65	1,041
Forecast at Completion*	2,743	696	673	676	654	674	661	588	527	447	263	110	65	8,777

**Does not include technical and programmatic risk assessment (TPRA) allowance or contractor fee*

Figure 1.

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Aerial Photos of WTP Progress

August 2001

October 2003

December 2005 031

plus a management reserve of $1,041 million to address uncertainties within that workscope. It does not include contractor fee or allowance for impacts outside the current scope of the project. The project schedule supports operation and facility turnover by May 2017.

There were several key reasons for this increase:

- Regulatory changes including a 38% increase to the contract-specified seismic criteria and increased fireproofing requirements
- Resolution of technology issues, including pulse jet mixers and hydrogen accumulation
- Changes in labor rates and plant equipment and material pricing
- Changes in material quantities based on the evolution of plant design
- Lower than expected engineering and construction productivity
- Reduced project funding levels that extended the schedule
- Revised comprehensive risk assessment

While many of these issues were outside the scope of the project, it is clear that previous project estimates did not anticipate factors leading to the increase. Lessons learned by Bechtel and DOE over the past 5 years have been incorporated into this estimate.

This document provides a summary of the December 2005 Estimate at Completion (EAC) for the WTP. The detailed estimate (approximately 44,000 pages contained in 87 volumes) is based on the existing detailed engineering design, which is 68% complete, and includes site productivity factors, labor wage rates, escalation, and other factors that influence project costs. The management reserve was developed at an 80% confidence level, which means there is an 80% probability that the project scope could be completed at or below the estimated cost. To arrive at this confidence level, we analyzed more than 400 separate cost and schedule uncertainties to quantify the funds and time that would be necessary to address the uncertainties. Our project team also performed a technical and programmatic risk assessment (TPRA) of risks outside the current scope of the project. Based on this assessment, the team recommends that DOE-ORP maintain an additional allowance of $1,760 million (calculated at an 80% confidence level).

The forecast at completion (FAC) consists of the estimate at completion (EAC) plus the management reserve (contingency).

While there is high confidence in the December 2005 EAC, which was based on $626 million FY 2006 funding, the further reduction in project funding to $490 million and the new requirement to separate funding for the project's five primary facilities will result in a further cost increase and schedule extension. We are currently revising the December 2005 EAC to account for these changes.

In parallel with this revision, we are systematically taking steps to ensure a successful path forward for this project. We have staffed the project with our most experienced managers, we are leveraging our corporate resources, and we are taking actions to strengthen project execution. We are also engaging industry experts to validate the technical and cost baselines and assure confidence in the WTP EAC.

2. Project Background

The WTP project scope is to design, build, and commission a plant to immobilize 54 million gallons of highly radioactive waste stored in 177 aging underground tanks at the DOE's Hanford Site near Richland, Washington. Accumulated between 1944 and 1989, when the Hanford Site produced plutonium and other nuclear materials for nuclear defense, the waste represents one of the nation's most serious cleanup problems. Sixty-seven of the tanks have leaked more than a million gallons of waste into the ground, threatening the nearby Columbia River, which borders the 586-square-mile reservation in south central Washington. The new plant will use a vitrification process to transform the waste into a chemically immobile glass that is environmentally safe and stable.

The WTP will help solve one of the nation's most serious cleanup problems—immobilizing the highly radioactive waste contained in underground storage tanks at the Hanford Site.

As shown in Figure 2, the WTP includes three primary processing facilities: the Pretreatment (PT) Facility, which separates the waste into its low-activity waste and high-level waste components; the High-Level Waste (HLW) Facility, which immobilizes (vitrifies) the high-level waste for offsite (proposed Yucca Mountain) disposal; and the Low-Activity Waste (LAW) Facility, which vitrifies the low-activity waste for onsite (Hanford) disposal. The WTP also includes the large Analytical Laboratory (Lab) and supporting facilities, referred to as the balance of facilities (BOF).

WTP Site Plan

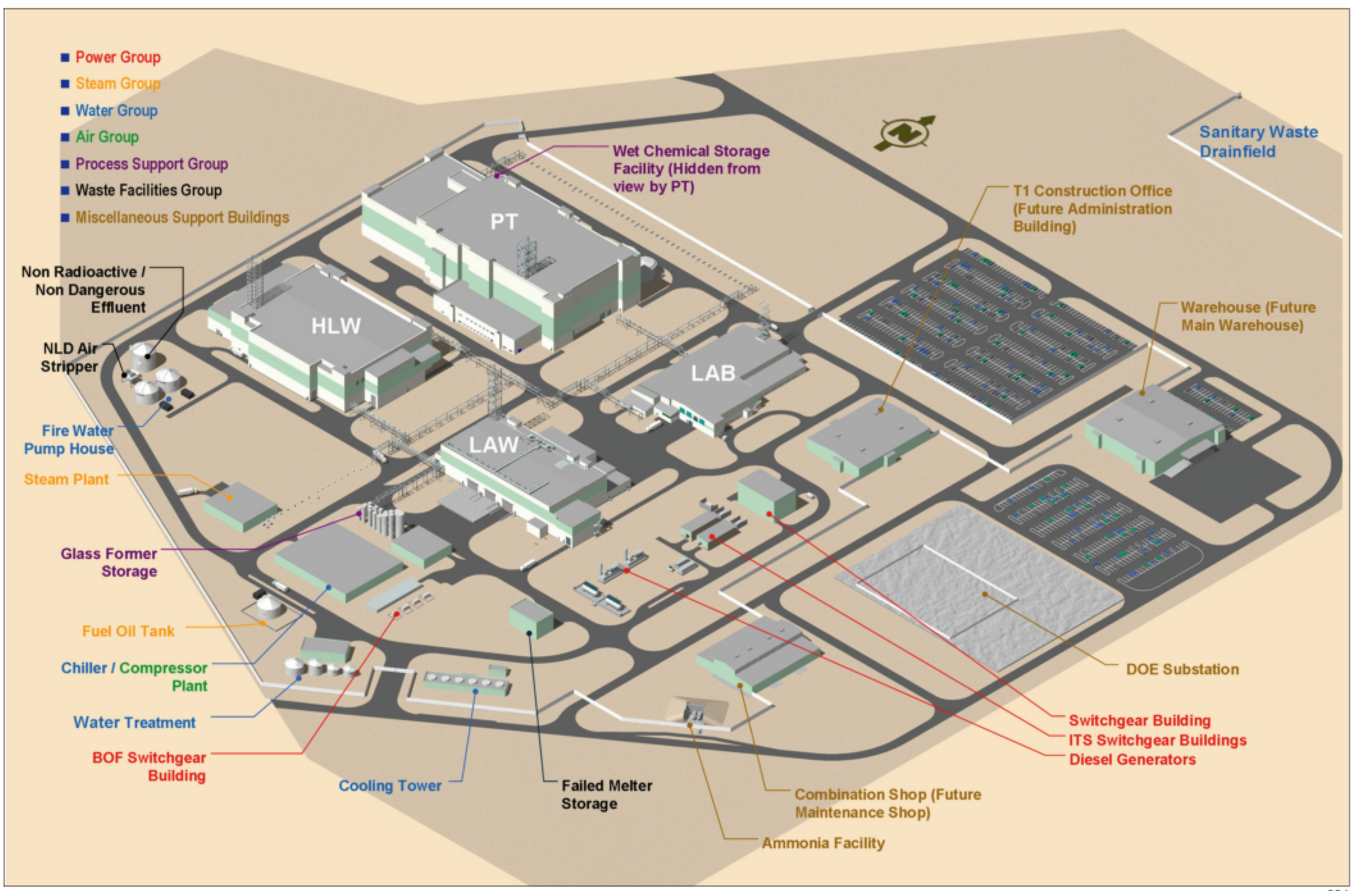

Figure 2.

WTP Quantity Comparisons

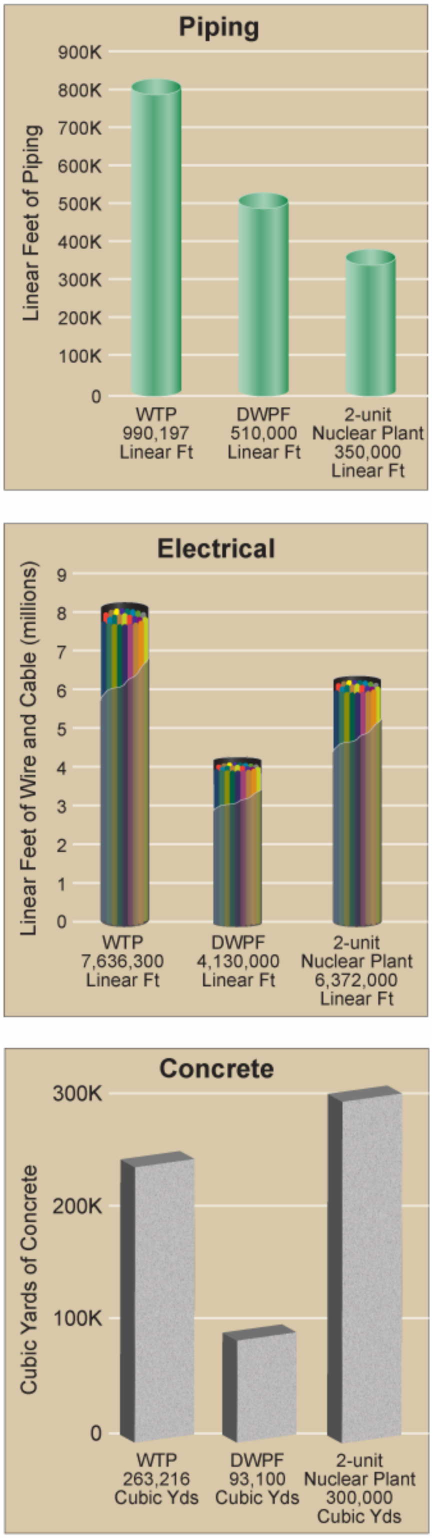

Figure 3. 005

Construction of the WTP is a massive undertaking, comparable in scope to simultaneous construction of two nuclear power plants. No nuclear facility of similar size has been built in the United States since the nuclear power construction boom that ended in the early 1980s.

The WTP is sometimes compared to the Defense Waste Processing Plant (DWPF), a radioactive waste vitrification plant built in the 1980s at the DOE Savannah River Site. However, the WTP will be approximately four times the size of DWPF, with four times the throughput capability, and is subject to broader and more stringent regulatory requirements. Figure 3 compares quantities of piping, electrical wiring, and concrete required for the construction of the WTP, the DWPF, and a two-unit nuclear power plant.

The WTP is technically demanding as well. In addition to the significant challenges of handling and vitrifying high-level radioactive waste, the WTP uses a caustic chemical process rather than the acidic process used in DWPF, making the WTP chemical process a first-of-a-kind design. The Hanford radioactive waste is not only toxic and radioactive—it is also chemically and physically heterogeneous. The characteristics of this feed material require that the WTP project integrate research and development of new technology into the plant design processes.

Examples of technology issues faced at the WTP include non-Newtonian mixing of the waste and management of radiolytic hydrogen generated within plant systems. While the development of new engineering solutions to these issues has increased WTP project costs, construction is now 28% complete and virtually no rework has been required.

Additionally, the program has regulatory milestones that have been agreed to by DOE, EPA, and the State of Washington in their Tri-Party Agreement. To accommodate these schedule milestones, the project has been managed as an integrated engineering, procurement, and construction (EPC) job. This means that procurement and construction overlap with engineering, allowing construction to begin and end sooner. This is a common approach for large projects.

2.1 WTP Contract

In 2000, the Department of Energy, Office of River Protection (DOE-ORP) awarded a cost-plus-incentive-fee contract to a project team of BNI and WGI to complete WTP design, procurement, construction, and commissioning for an estimated cost of nearly $4 billion. In March 2003 the contract baseline was increased to $5,406 million to reflect increased plant capacity and other changes.

Major scope items in the WTP contract include:

- Design and construction of the three nuclear facilities for pretreatment, high-level waste vitrification, and low-activity waste vitrification, along with an analytical laboratory and substantial supporting facilities

- Commissioning the facilities and testing them to prove that they meet production and efficiency criteria

The WTP contract incentive structure is performance-based, which means that BNI's fee varies according to its success in meeting pre-defined performance objectives. The contract specifies functional requirements for the process and facility design and the waste treatment capacity requirements. It also establishes the minimum, expected, and superior performance levels of the plant. Contractor fees (profit) are tied to each level.

Pretreatment Facility Hot Cell Vessel Welding, August 2004.

2.2 EAC History

This December 2005 EAC is the third in a series of EACs developed for the WTP since the 2003 project baseline was established. In March 2003, the DOE-ORP approved a project baseline estimate of $4,856 million plus $550 million in management reserve (contingency) funding to cover potential changes within the scope of the project.

The March 2003 project baseline incorporated several project modifications that were identified after BNI's proposal and associated cost estimate, including:

- 300% increase in HLW capacity
- 40% increase in pretreatment capacity
- Revised engineering productivity estimates
- Increases in the cost of commodities required for construction
- Resolution of technical issues discovered during a due diligence review of the BNFL design

Subsequent to the March 2003 contract baseline, the project delivered a 2004 EAC (July 2004), a preliminary 2005 EAC (April 2005), and this December 2005 EAC. Figure 4 summarizes events in the evolution of the project and the EAC since the March 2003 contract baseline.

EAC Evolution

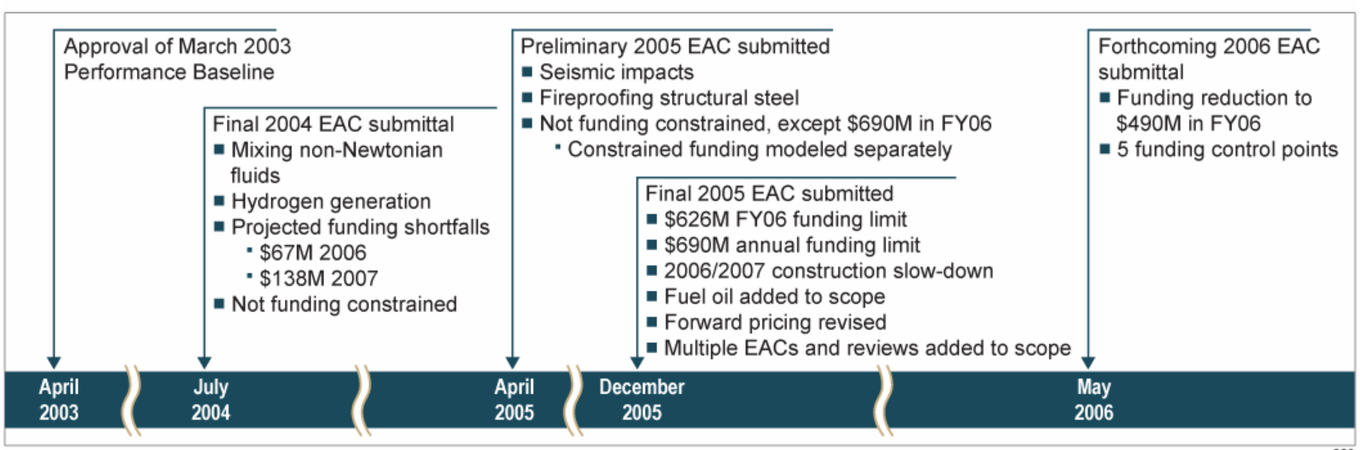

Figure 4.

3. Cost and Schedule Summary

The following sections describe the methodology and basis for determining the WTP cost and schedule estimates, provide details regarding those estimates, and discuss events that have impacted the project and caused changes in the cost and schedule.

Detailed design is 68% complete and construction is 28% complete, providing high confidence in the current cost and schedule estimate.

The December 2005 EAC reflects a project for which design is 68% complete and construction is 28% complete. The level of detailed design available at this point in the project provides a high level of confidence in the estimate.

3.1 Estimate Methodology and Basis

The December 2005 EAC is a bottom-up cost estimate, wherein the cost and schedule are based on the quantities of construction commodities (such as cubic yards of concrete and tons of steel) derived from the detailed design and the labor and non-labor resources required to complete design, construction, and commissioning. As shown in Figure 5, the estimate is based on the major work elements (facilities) and the processes used to design, build, and commission them. For each component of the plant, the detailed design specified the quantity of material (concrete, steel, pipe, etc.) and equipment (pumps, vessels,

Building a Quantity-Based Estimate

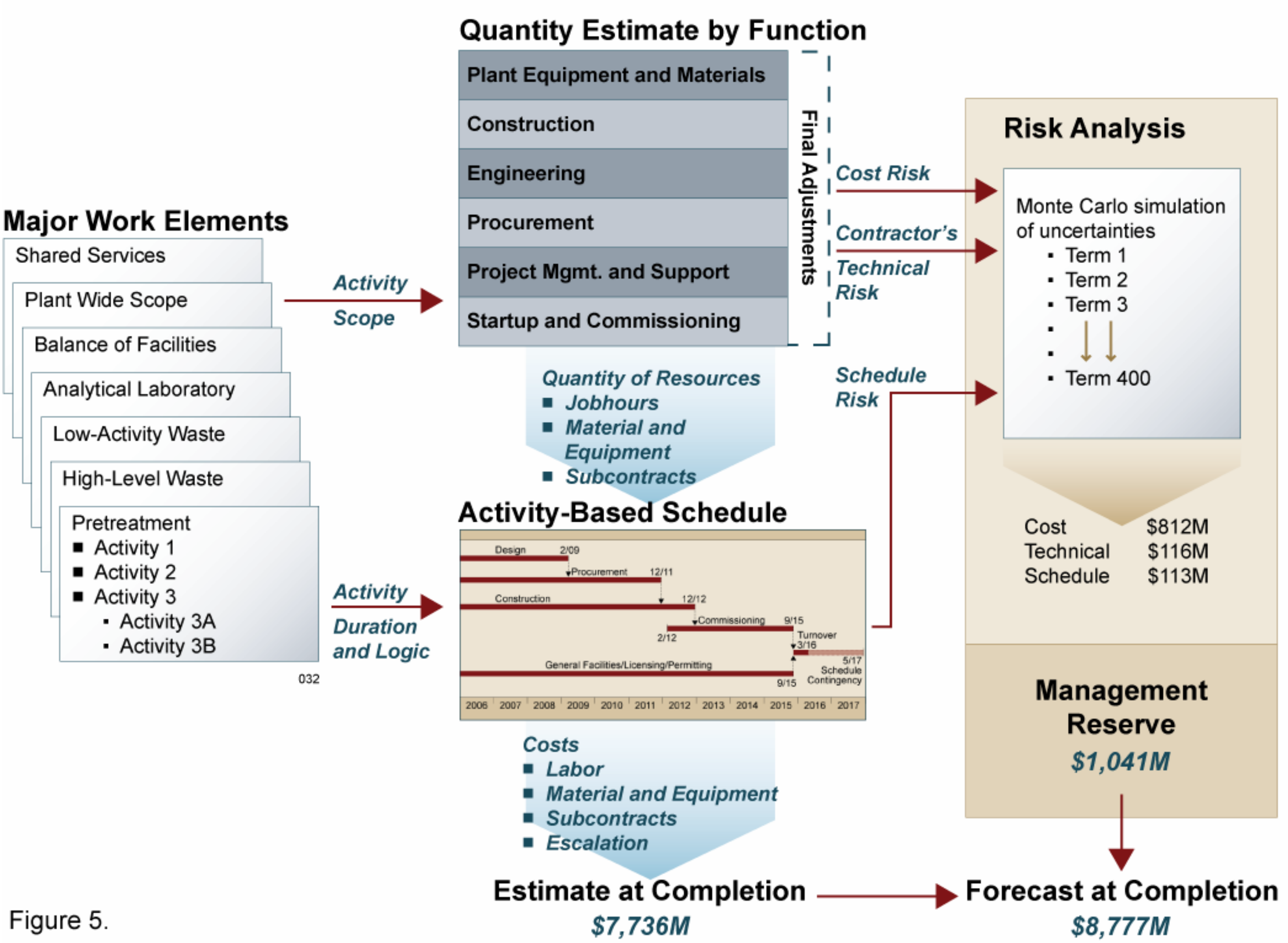

Figure 5.

instruments, etc.) required. These quantities then provided the basis for estimating craft, supervision, and management jobhours, total costs for materials and equipment, and required subcontracts.

The activities required to design, procure, install, and commission these components were then scheduled. The schedule is logic-driven and recognizes predecessor and successor relationships, meaning that if one task has to be complete before the next task can begin, this logic is built into the schedule. The schedule also incorporates constraints to recognize the availability of funds or personnel. The status of design, procurement, and construction have been factored into the schedule to include experience to date with productivity rates and procurement lead times.

Both the cost estimate and schedule are built up from the individual activities and resources required to complete design, construction, and commissioning of the WTP.

Once the base estimate was established, the management reserve for the project was established. Management reserve (also known as contingency) is the funding and schedule that are added to an estimate to account for uncertainties in estimate detail, quantity, pricing, and productivity. For the WTP, the management reserve was calculated to provide an 80% probability that the project could be completed at or below the project's forecast at completion (FAC), which consists of the EAC plus the management reserve. Additionally, a schedule sensitivity analysis was conducted to determine the schedule contingency required.

Multiple Crews Place Pretreatment Facility Concrete, August 2003.

3.2 EAC Review and Validation

The project team has used experts from outside the WTP project to improve the quality of the December 2005 EAC and schedule, resulting in a more robust, high-confidence estimate. First and foremost, industry experts have provided support throughout the estimating process, bringing additional knowledge and capabilities to the team. Additionally, two major corporate reviews were conducted as part of the preparation of the EAC. First, a quality control review team composed of Bechtel project controls managers reviewed the EAC in detail. They conducted comprehensive reviews of the eight major volumes that comprise the EAC report and were specifically tasked with evaluating the traceability of the estimate. Second, a project execution assessment team, composed of the most senior corporate managers responsible for Engineering, Procurement, Construction, and Project Management across the Bechtel group of companies, was tasked with evaluating the project execution approach. Comments and observations from both teams have been incorporated into this EAC. An external review team, which includes corporate and industry experts, is also reviewing the EAC. Although the final report from the external review team is not yet complete, early observations from this team have been incorporated.

This EAC was benchmarked against similar nuclear, government, and high-hazard facility construction projects.

For validation purposes, the EAC was compared with the costs of similar nuclear, government, and high-hazard facilities. The industry benchmarks used for the comparison include nuclear power plants, chemical weapons destruction plants, and the DWPF at DOE's Savannah River Site.

Surveyors Perform Work at the WTP Site, May 2005.

DOE-ORP also contracted the U.S. Army Corps of Engineers (USACE) to review the preliminary 2005 EAC (April 2005) and provide findings and recommendations. The results of that review were incorporated, as appropriate, into the December 2005 EAC.

The estimating approach described here results in a three-way assurance of the quality of the estimate:

- The bottom-up nature of the estimate, including the substantial on-project experience used to derive the unit rates
- Benchmarking against industry performance and standards
- Multiple levels of internal and external reviews

3.3 Estimated Cost at Project Completion

The December 2005 EAC includes a detailed estimate of $7,540 million for direct costs for design, procurement, construction, and commissioning of the WTP. In addition, the estimate includes $196 million of final adjustments, resulting in an EAC of $7,736 million. Examples of these final adjustments include:

- DOE-ORP direction to include the cost of fuel oil as a contractor cost rather than being furnished by the government ($70 million)
- Incorporating BNI's Defense Contract Audit Agency-approved forward pricing rates as required on federal contracts ($67 million)
- Incorporating external review team and USACE comments

Figure 6 details the cost estimate for the major facilities at WTP, plant wide scope (costs that support multiple facilities, such as construction material, supervision, procurement staff, plant wide engineering, temporary facilities, site maintenance, and construction equipment), and shared services (services that are more efficiently performed centrally, such as human resource, accounting, and WTP project management). This figure also shows the management reserve of $1,041 million derived from the WTP risk assessments of estimate, schedule, and contractor technical risks. The last column in the figure shows the allocation of plant wide scope and shared services to the five major facilities. Figure 6 also includes the March 2003 contract baseline, against which the December 2005 EAC is reconciled.

Figure 7 presents the EAC categorized by capital costs, project office costs, commissioning costs,

December 2005 Estimate at Completion by Facility ($ millions)

Facility	Mar 2003 Contract Baseline	Dec 2005 EAC	Dec 2005 EAC w/ Allocation
Pretreatment	939	1,637	3,169
High-Level Waste	806	1,067	2,076
Low-Activity Waste	573	654	1,192
Analytical Laboratory	204	237	421
Balance of Facilities	295	350	682
Plant Wide Scope	1,457	2,623	allocated above
Shared Services	582	973	allocated above
Subtotal Estimate at Completion	4,856	7,540	7,540
Final Adjustments		196	196
Total Estimate at Completion	**4,856**	**7,736**	**7,736**
Management Reserve	550	1,041	1,041
Total Forecast at Completion*	**5,406**	**8,777**	**8,777**
**Does not include TPRA allowance or contractor fee*			

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Figure 6.

December 2005 Estimate at Completion by Category ($ millions)

Description	March 2003 Baseline	December 2005 EAC	Cost to Date Through Sept 2005	To Go Cost Oct 2005 Forward
Capital Costs				
Plant Equipment and Materials	940	1,292	500	792
Construction	1,391	2,571	737	1,834
Total Capital Costs	2,331	3,862	1,237	2,626
Project Office Costs				
Engineering	1,144	1,607	1,024	583
Procurement	138	268	91	176
PM and Support	582	973	349	625
Total Project Office Costs	1,864	2,848	1,464	1,384
Startup and Commissioning Costs	661	830	43	788
Total Cost Rollup	**4,856**	**7,540**	**2,743**	**4,797**
Final Adjustments		196		196
Total Estimate at Completion	**4,856**	**7,736**	**2,743**	**4,993**
Management Reserve	550	1,041		1,041
Total Forecast at Completion	**5,406**	**8,777**	**2,743**	**6,034**

014

Figure 7.

and management reserve. Capital costs include equipment, material, and subcontracts, as well as manual construction and field supervision labor. Project office costs include engineering (design, permitting, nuclear safety, and research and technology), procurement, and project management and support services.

3.4 Estimated Schedule

Figure 8 summarizes the WTP schedule by phase. Major schedule milestone dates include:

- February 2009—completion of design
- December 2012—completion of HLW facility construction
- September 2015—completion of hot production runs and hot commissioning
- March 2016—completion of facility turnover

These dates are funding-driven rather than the result of schedule logic. For example, the LAW and Lab facilities will have construction curtailed for about 2 years (between FY 2007 and FY 2009) so that funding can be directed toward PT and HLW construction, which are on the project's critical path.

Schedule Summary

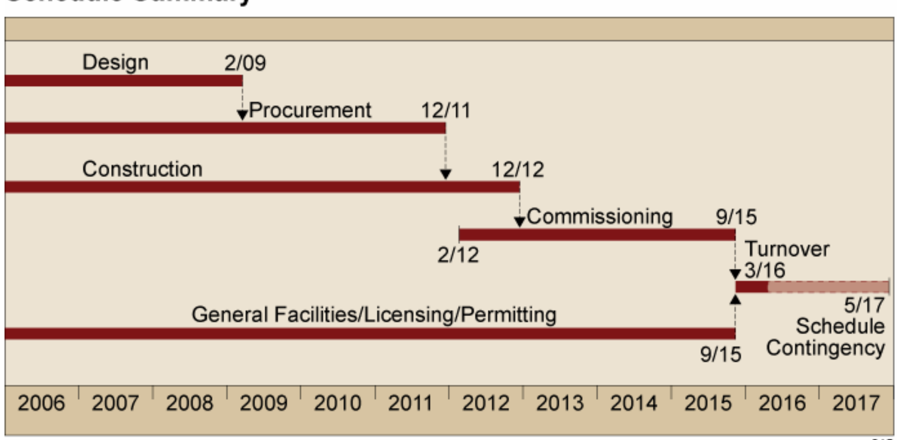

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Figure 8.

Workers Install a Turntable Drive in the Low-Activity Waste Facility, June 2005.

A schedule sensitivity analysis determined that 6 months of schedule contingency would be required for construction and 8 months for commissioning, resulting in a total of 14 months of schedule contingency. Adding this contingency and the time required for facility turnover results in an expected project completion date of May 2017.

While there is a high confidence in the December 2005 EAC based on current project scope, there are significant technical and programmatic risks associated with completing and commissioning the WTP. These risks could increase project costs by $1,760 million. This potential increase, which is calculated at the 80% confidence level, is not included in the current cost estimate. These risks are outside of the control of BNI and address items that would constitute a change to the contract scope or terms.

The EAC does not include the impacts of further project funding reductions per the FY 2006 Energy and Water Development appropriation. The appropriation provides $526 million for the WTP project, of which $490 million has been allocated for the scope rather than the $626 million that was assumed. This represents more than a 20% decrease in anticipated funding. The appropriation also stipulates separate funding requirements for each of the five facilities (PT, HLW, LAW, Lab, and BOF), which will create cost and schedule inefficiencies by increasing the number of funding control points from one (WTP project) to five. These impacts will be addressed in the May 2006 EAC.

Craft Worker Puts Final Touches on a Slab at the Pretreatment Facility, December 2005.

3.5 Current Project Status

Summarized below is the project status for three main elements of the project: Engineering, Procurement, and Construction.

3.5.1 Status of Engineering

In addition to specific design deliverables, Engineering is responsible for studies, procurement/construction support, interface with regulators, and mitigating technical issues such as the new seismic design. The first-of-a-kind nature of this project causes the engineering effort, including conceptual design and technology research and development, to be disproportionately large compared to a design/build project with known technology, scope, and systems.

Engineering Status

Based on Job Hours Through September 25, 2005

Facility	EAC	To Date	% Complete
Pretreatment	3,767,885	2,494,715	66%
High-Level Waste	2,333,216	1,754,058	75%
Low-Activity Waste	1,452,543	1,251,656	86%
Analytical Laboratory	433,469	362,639	84%
Balance of Facilities	629,334	500,588	80%
Plant Wide Scope (1)	5,699,862	3,334,989	59%
Engineering Total	**14,316,309**	**9,698,644**	**68%**

(1) *Includes a large portion of engineering, design, and post-design support to construction, commissioning, and regulatory activities*

009

Figure 9.

Figure 9 provides the engineering percent complete based on total engineering hours by facility and total project. Overall, the engineering design for the WTP was 68% complete as of September 25, 2005.

In February 2005, based on the results of a new study conducted by Pacific Northwest National Laboratories, DOE-ORP directed BNI to use revised seismic criteria that result in a 38% increase in the ground motion from a worst-case earthquake than the criteria included in the WTP contract. The seismic criteria are critical components that engineers factor into their calculations when they design facilities and equipment to safely withstand a major earthquake. The adoption of the new seismic criteria impacted more than 14,000 engineering deliverables (calculations, drawings, and requisitions), which must be revised or reconfirmed. In August 2005, BNI completed dynamic analyses of the PT and HLW facilities to translate the ground motion criteria into in-structure seismic loads that can be used for more detailed design. The USACE has reviewed and concurred with the project's design criteria and seismic analysis methodology, clearing the way to complete design modifications. The initial detailed design performed by BNI was sufficiently robust to eliminate the need for tear-out of construction work already completed, and avoid an even more significant cost and schedule impact.

A February 2005 PNNL study predicted a 38% increase in earthquake ground motion above the design criteria specified in the contract.

3.5.2 Status of Procurement

Procurement awards and administers purchase orders for equipment and materials, and subcontracts for specialty services. Figure 10 shows that procurement was 44% complete as of September 2005. This status is based on committed value (the cumulative value of funding apportioned to awarded orders) as a percentage of the total budgeted value for equipment, materials, and services.

Procurement of bulk materials and equipment poses a significant challenge in this project. The WTP requires an amount of nuclear-grade material and equipment comparable to two nuclear power plants. To meet our procurement needs we have had to essentially rebuild the nuclear manufacturing industry supply base. In many instances, we have sent BNI personnel to our suppliers' facilities to help them rebuild their nuclear quality programs, assist them with their design work, and teach

Procurement Status

Based on Committed Value Through September 30, 2005

Category	# of Material or Subcontract Requisitions		Dollar Value of Requisitions (Cost in $M)		
	Planned Total # of Awards	# Awarded To Date	Total Budget $	*Committed Value $	% Complete Based on $ Value
Direct Capital Equipment/Material	546	370	1,292	540	42%
Other Material	N/A	N/A	842	183	22%
Subcontracts	527	314	1,043	677	65%
Total Project	**1,073**	**684**	**3,177**	**1,400**	**44%**

*Committed Value is the total cumulative dollar value of funding that has been committed to signed purchase orders or subcontracts.

Figure 10.

011

them how to inspect their own work—this is even true with some of the long-time nuclear suppliers whose nuclear programs had atrophied. We have now qualified more than 150 suppliers to nuclear quality standards and, since 2003, the WTP has received more than 75,000 line items of materials and equipment with less than 1% deficiency rate. Also, DOE's Small Business Manager of the Year Award was recently awarded to the WTP Small Business Advocate, reflecting the project's advocacy and commitment to the small business community.

Construction Status
Based on Physical Work Completion
Through September 25, 2005

Commodity	Percent Complete
Site Work	70.6%
Concrete	48.4%
Steel	15.4%
Architectural	11.6%
Piping	10.0%
Electrical	10.4%
Instrumentation and Control	0.0%
Coatings	1.8%
Equipment	8.9%
Temporary Construction	38.6%
Construction Services	32.8%
Total Construction	**28.1%**

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Figure 11.

3.5.3 Status of Construction

The construction status summary (Figure 11) shows the percent complete for the various commodities that support WTP construction, as well as overall construction status. Based on this evaluation, project construction was 28% complete as of September 2005.

Our key construction challenge is to achieve the estimated productivity for installation of bulk materials and equipment. To help meet this challenge, the project is developing a 3D model with expanded capabilities that tie the model to the live construction schedule. By allowing the team to visualize how the HLW and PT facilities will be built over time, the team can select a construction sequence for simultaneous work fronts, expediting construction of these critical-path facilities. This state-of-the-art use of 3D modeling will help the project achieve the estimated installation rates.

3.6 Reconciliation to Contract Baseline

Changes to the WTP project from the March 2003 contract baseline to the current EAC, which total $2.8 billion, consist of approved changes to date and additional changes related to the status and direction for the project. These changes are summarized in Figure 12.

Reconciliation Summary

	Cost ($M)
March 2003 Contract Baseline	**4,856**
Approved changes to contract base	183
Changes incorporated into the December 2005 EAC	2,501
Final adjustments to the December 2005 EAC	196
December 2005 EAC	**7,736**
Net changes to the March 2003 contract baseline	**2,880**
Note: Does not include management reserve or contractor fee	

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Figure 12.

The most significant impacts to the EAC resulted from the following:

- Revised seismic design criteria
- Design changes to accomplish mixing of non-Newtonian fluids
- Issues surrounding hydrogen generation in piping and vessels
- Annual funding cap of $690 million
- FY 2006 funding reduction from $690 million to $626 million

The EACs developed prior to December 2005 were developed to be compliant with the TPA schedule milestones and were not constrained by funding limits—it was assumed that funds needed for optimum project execution would be available either through management of carryover funds from prior years or from as-needed funding requests. The December 2005 EAC, however, was developed with adherence to a funding cap of $690 million per year, and a further reduction to $626 million in FY 2006, resulting in deferred work.

Deferred work can cost two to three times as much to perform in the future.

As illustrated in Figure 13, deferred work (due either to a funding cut or a scope increase) can cost two to three times as much to perform in the future on a project that extends for several years, such as the WTP. This is caused by inflation (called escalation in the estimate), disruption and inefficiency, and carrying costs for the project (e.g., cost of project management, facilities, regulatory activities, utilities, etc.) in the additional months of the project.

The reconciliation of the December 2005 EAC to the March 2003 contract baseline EAC follows the structure of the estimate and therefore addresses terms such as quantities, rates, escalation, pricing, and new scope. For simplification, changes are grouped into one of four cost change categories defined as follows:

- ***Time-dependent and funding costs*** ($870 million) are due to schedule extensions and consist of costs such as escalation, facility maintenance, and project office staff, as explained in Figure 13. This category does not include direct costs associated with scope increases.
- ***Design evolution costs*** ($717 million) are due to the maturing of the plant design since the contract baseline was established in 2003. These costs are generally a result of changes in design and construction, and associated construction quantities.
- ***Project events and disruption costs*** ($715 million) are direct costs due to new or substantially changed scope, and the associated loss in productivity from the disruption of those events. Project events are typically caused by new technical information received since the contract baseline was established (e.g., revised seismic criteria). Disruption specifically refers to the costs associated with the result of changes such as unplanned ramp-up or ramp-down of work, unplanned reductions in force, inefficient skill mixes of onsite personnel, or redirection of work that is already under way.
- ***Pricing costs and other cost changes*** ($383 million) are due to changes in pricing of labor, materials, and equipment since the contract baseline was established and other changes that are either a result of a transfer of costs between facilities or minor changes that are not otherwise categorized.

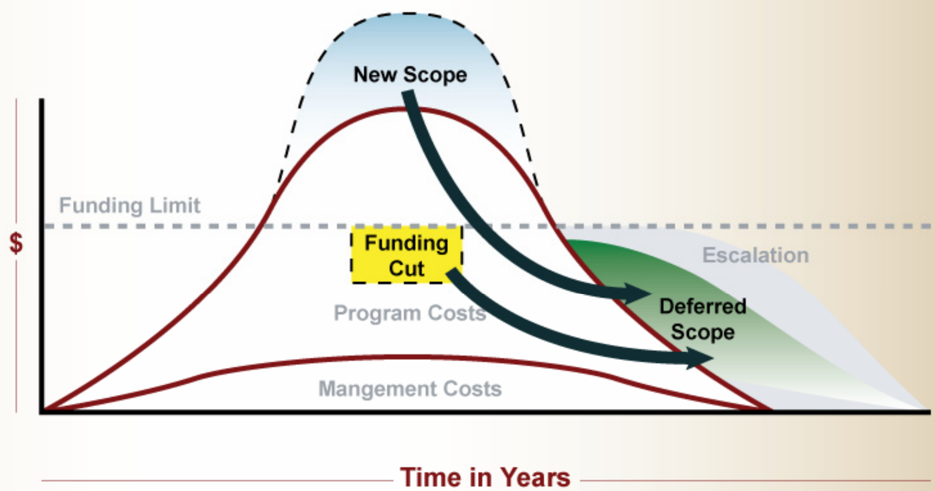

Pretreatment Facility, December 2005.

Figure 14, on page 15, identifies the resulting cost impact of changes in each of these categories from the 2003 contract baseline EAC to the December 2005 EAC. These cost change categories are interrelated, and portions of a single project event appear in different categories. For example, the revised seismic criteria impact multiple categories.

Cost and Funding Impacts

The funding requirements for a typical engineering, procurement, construction (EPC) project follow a bell-shaped curve as project efforts ramp up, peak, then ramp back down. To optimize resources on a funding-constrained project, where level funding is anticipated, the excess funds available early in the project are carried over to later years when the funding required exceeds the expected funding limits.

If new project scope is identified during the course of the project, activities must be deferred until funds can be made available. Similarly, if project funding is reduced, the activities that were planned for that funding must be deferred to a point in time where funds are available. For WTP, this represents approximately 6 years. Funding cuts also create costly disruption such as layoffs and suspension of procurements.



By deferring scope, the project schedule is extended, creating additional time-dependant costs due to escalation and the requirement to continue maintaining facilities and project office staff. For WTP, under the current funding and schedule profile, a notional $100M funding cut creates an estimated $120M net increase in the EAC from time dependent costs, escalation, and disruption

Figure 13.

027

Incorporating the revised seismic criteria requires increased labor, materials, and equipment for the engineering analysis and construction to meet the new seismic specifications. It led to curtailment of construction activities, with an associated ramp-down, and later ramp-up, of the construction workforce, while Engineering revised calculations and facility designs. It also requires restaffing the project with civil or structural engineering personnel, which may involve relocation costs, site training costs, and learning curve inefficiencies (project events and disruption costs).

Cost Change Impacts

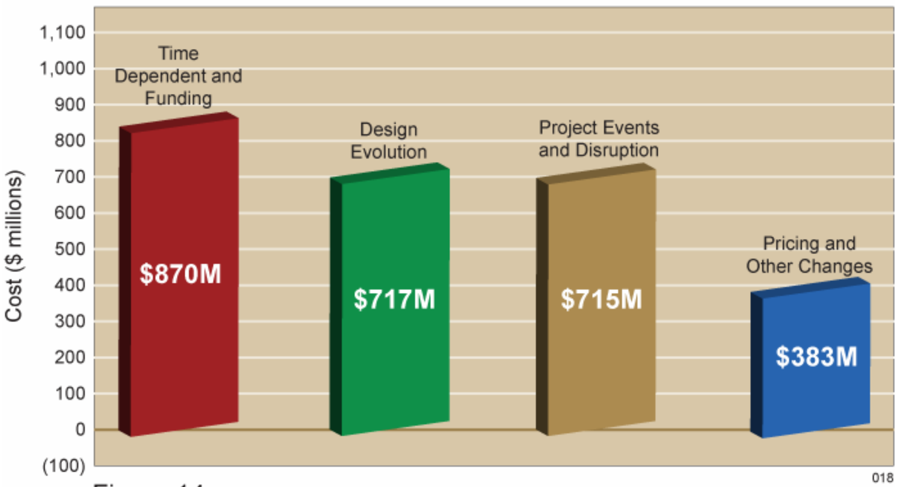


Figure 14.

Under existing funding limits, the additional work and other additional costs translate directly into an estimated 2-year schedule extension. Indirect costs including escalation and extension of project office costs are incurred (time-dependent and funding costs).

In total, the revised seismic criteria is estimated to have an impact to the program of $700 million to $900 million and 26 months of schedule delay.

Because of this interrelationship of causal factors, and the significant additional analysis required to prepare an event-based reconciliation, we have developed our reconciliation consistent with how the EAC was developed. Figure 15 and Figure 16 summarize the WTP reconciliation by facility and by function.

Cost Reconciliation by Facility ($ millions)

Cost Change Category	PT	HLW	LAW	LAB	BOF	Plant Wide	Shared Services	Total
2003 Contract Baseline	**939**	**806**	**573**	**204**	**295**	**1,457**	**582**	**4,856**
Time Dependent	82	58	29	18	26	380	277	870
Design Evolution	208	123	26	7	23	303	26	717
Project Events and Disruption	330	94	7	6	(1)	229	49	715
Pricing and Other Changes	78	(15)	19	2	6	253	40	383
Subtotal changes:	698	261	81	33	55	1,165	391	2,684
Subtotal by Facility	1,637	1,067	654	237	350	2,623	973	7,540
Final Adjustments								196
Estimate at Completion Excluding Management Reserve								**7,736**

Note: Numbers may not calculate to total due to rounding.

019

Figure 15.

Cost Reconciliation by Function ($ millions)

Cost Change Category	Engineering & Permitting	Procurement	Capital/ Construction	Commissioning	Shared Services	Total
2003 Contract Baseline	**1,144**	**138**	**2,331**	**661**	**582**	**4,856**
Time Dependent	106	39	336	112	277	870
Design Evolution	168	(0)	480	43	26	717
Project Events and Disruption	145	74	454	(8)	49	715
Pricing and Other Changes	43	17	261	22	40	383
Subtotal changes:	463	130	1,531	169	391	2,684
Subtotal by Function	1,607	268	3,862	830	973	7,540
Final Adjustments						196
Estimate at Completion Excluding Management Reserve						**7,736**
Note: Numbers may not calculate to total due to rounding.						

Figure 16. 020

The schedule in the December 2005 EAC is 70 months longer than the March 2003 contract baseline and includes 14 months of schedule contingency. The schedule extension is a result of two issues: (1) the impact of changes to activities on the project's critical path schedule, and (2) costs exceeding available funding, requiring activities to be deferred. A summary of the schedule reconciliation is shown in Figure 17.

4. Cost and Schedule Uncertainties

The December 2005 EAC is an estimate and, as with all estimates, includes uncertainties. The uncertainties consist of two categories—those within the current scope of the contract and those that are outside of the scope of the contract. Management reserve, also known as contingency, accounts for uncertainties in the estimate that are associated with in-contract scope. A technical and programmatic risk assessment allowance, described on page 19, is recommended for uncertainties that are outside of the scope of the contract.

WTP Schedule Reconciliation Summary

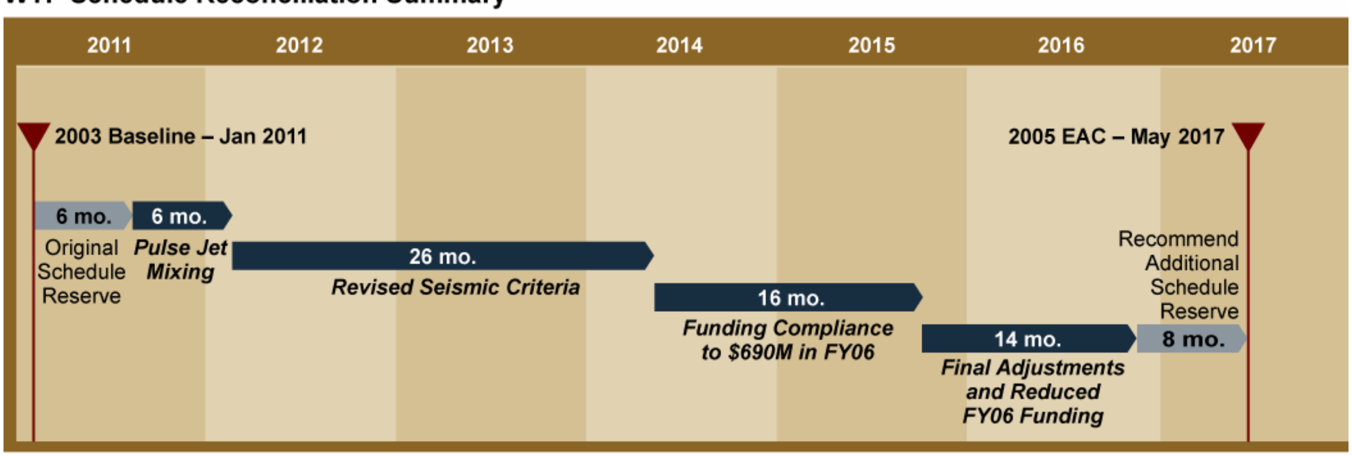


Figure 17. 022

4.1 Management Reserve

Management reserve accounts for uncertainty within the estimate and is generally within the control and the responsibility of the contractor. Total project management reserve includes components of both cost and schedule uncertainty in the estimate, as well as technical risks borne by the contractor. The cost uncertainty is due primarily to variances in estimating terms such as:

- Commodity and equipment quantities—the total amount of commodities (such as concrete and steel) and equipment that need to be designed and constructed.
- Craft productivity—the number of manual craft hours needed to install a unit of a commodity, such as a cubic yard of concrete
- Nonmanual hours—the number of hours needed for all nonmanual operations, including engineering, construction supervision, project management, quality assurance, etc.
- Labor pricing—the wages assumed for all employees
- Material and equipment pricing—the price of material such as concrete, rebar, and wire, and the price of equipment required to support installation

Management reserve accounts for uncertainty within the estimate and is generally within the control and responsibility of the contractor.

The project uses a sophisticated Monte Carlo simulation of cost uncertainties to analyze management reserve. This approach is a well established practice within the engineering and construction industry for analyzing and quantifying risk. Each functional group (Engineering, Procurement, Construction, etc.) developed a model consisting of terms for material and equipment, labor, and subcontracts for its work. "Terms" refer to various elements of the to-go project cost estimate that share common risk profiles. The WTP project is modeled by approximately 400 terms. The variables that quantify the risk associated with quantity, pricing, and productivity are then applied to each term. These variables are based on a standard set of probability distributions to ensure consistency in the input by the various functions.

Running the Monte Carlo model approximately 5,000 times with randomized variables generated a statistically significant forecast of project management reserve. This forecast is in the form of a confidence curve that shows management reserve versus probability of under-running that management reserve. Figure 18 illustrates the WTP project

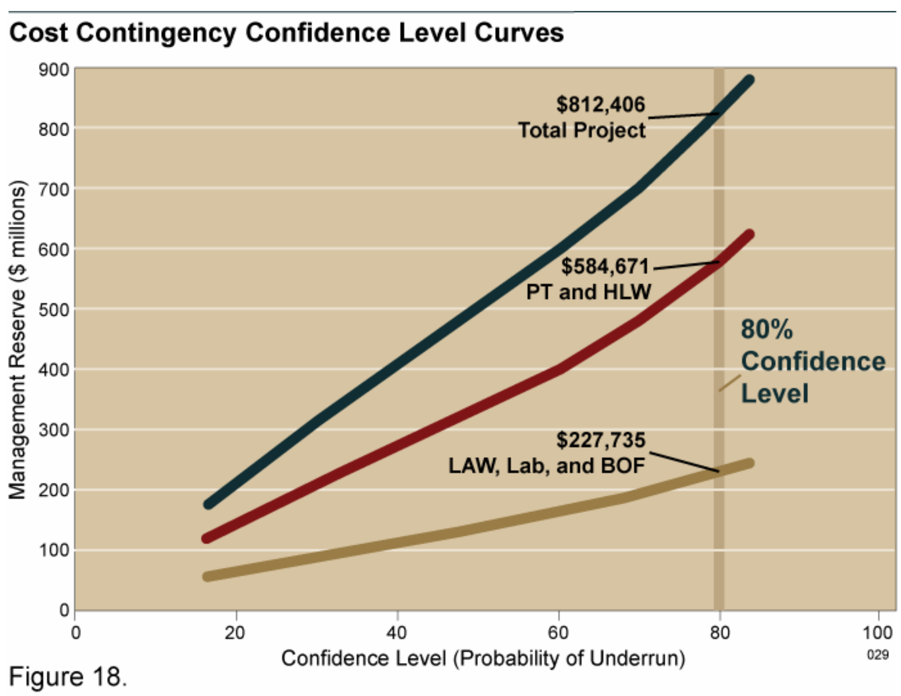


Figure 18.

An Analytical Laboratory Shield Window Is Lowered into Place, September 2005.

confidence curve. The EAC includes the 80% confidence level value of \$812 million in the management reserve for cost uncertainty. While this analysis is used to arrive at a recommended total management reserve for the project, it is reasonable to further divide the management reserve between the high-level waste handling facilities (PT/HLW) and the lower-activity and support facilities (LAW/Lab/BOF), as shown in Figure 20. This division is logical because both PT and HLW are Category 1 nuclear facilities, are impacted by the new seismic design criteria, use largely the same vendors and suppliers, are on parallel completion schedules, and are at comparable points in engineering completion (approximately 65%). On the other hand, LAW, Lab, and BOF are largely not Category 1, are not impacted by seismic issues, have few technical challenges remaining, have few constraints other than funding, and are at a higher level of engineering completion (approximately 80%).

While Monte Carlo analysis is very good at modeling the probabilities within a defined problem, it is dependent on the terms and variables assigned. Confidence in the individual terms is primarily a function of the state of plant design. Because conceptual design is now essentially complete and detailed design is well advanced, we have high confidence in the terms. Confidence in the variables is also a function of the state of the design (for quantities) as well as project-specific experience (for productivity). Again, the advanced design and substantial completed field work result in high confidence in the assigned variables.

Schedule uncertainty and the required management reserve are estimated using Monte Carlo techniques similar to cost uncertainty. For schedule uncertainty, the terms are the scheduled activities on or near the critical path, and the variables are the potential range of durations for specific activities. The analysis focused on five key milestones—completion of each of the four major facilities and completion of hot commissioning. The result shows that completion of HLW and completion of hot commissioning are the main drivers of schedule risk, with a recommended schedule risk allowance of 6 months for each activity at 80% confidence. Based on experience across the DOE complex, the project is recommending an additional 2 months of schedule risk for the operational readiness review process during hot commissioning. The result is 14 months of schedule contingency that is included and priced in the EAC. The cost increase attributable to this schedule contingency, comprised of escalation and time-dependent project costs, is \$113 million.

The WTP management reserve of \$1,041 million includes cost risk (\$812 million), schedule risk (\$113 million), and contractor technical risk (\$116 million).

The management reserve also includes a component for specific technical risks that are within the scope of the project. An example of these risks is a contractor-selected technology that might not work as expected. Once again the analysis of contractor technical risks uses Monte Carlo analysis of many different terms and variables (risks) to derive an 80% confidence risk allowance. The total technical risk management reserve is $116 million.

The sum of the cost risk ($812 million), schedule risk ($113 million), and contractor technical risk ($116 million) is the recommended $1,041 million management reserve for the WTP project, providing an 80% confidence of meeting or underrunning the EAC.

4.2 Technical and Programmatic Risk Assessment

The TPRA allowance accounts for uncertainties in the program, and is generally the responsibility of the owner (DOE in this case). To determine the recommended TPRA allowance, the project conducted an assessment of known technical and programmatic risks. The assessment identified 22 technical risks and 23 programmatic risks.

The TPRA allowance accounts for uncertainty in the program that is outside of the project scope, and is generally the responsibility of the owner.

Since early in the project, the TPRA process has focused more on technology risks and less on programmatic risks. During this assessment, multiple programmatic risks evolving from possible DOE and other regulatory actions were added. Risks associated with project readiness reviews, plant upgrades to achieve DOE's goal of a 17-year operations mission, the reduction in FY 2006 funding to $490 million, and the imposition of five funding control points have been included in the risk assessment.

An external technical review team recently suggested a number of plant enhancements and other changes that have the potential to create future cost increases. These have also been factored into the TPRA using estimated values for the best and worst cases.

BNI performed a Monte Carlo analysis on the range of best, most likely, and worst-case values ranging from $262 million to $3,743 million. The recommended TPRA allowance of $1,760 million provides an 80% confidence level. An analysis of the potential risks, sorted by the controlling entity, is provided in Figure 19. It is important to note that if TPRA items are realized, additional annual funding would be needed to avoid an additional schedule delay.

Controllers of TPRA Risk

Controlling Entity	Value ($M)*	Most Significant Items of Risk
DOE	1,228	17-year mission Change in commissioning approach Multiple operational readiness reviews Impacts from borehole drilling Subcontracting clauses Technical changes
Congress	330	Reduced FY 2006 funding 5 control points New safety regulation 10CFR851
Regulators	72	Air emmission requirements Black cell in service Erosion Phased licensing
Other	130	Process scale-up risks Resin performance Premature melter failure Impacts from Thorp event
Total	**1,760**	

**Calculated at 80% confidence level*

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Figure 19.

5. Path Forward

Until recently, project execution has been modeled on proven EPC project management principles, using an integrated, design-build strategy to meet the project's regulatory

Workers Tie Off Rebar on the Low-Activity Waste Facility, April 2003.

milestones. Generally, this means overlapping of project phases, working to the critical path, creating enough engineering backlog to ensure that procurement and construction constraints are minimized, and operating on multiple work fronts to allow flexibility in managing craft and field nonmanual staff. This schedule-driven execution strategy was designed to ensure schedule compliance with Tri-Party Agreement milestones.

Due to the forecasted cost for resolving technical issues (such as the revised seismic criteria) and project funding constraints, the project has shifted to a funding-compliant plan. The schedule in the EAC is now funding-compliant, but does not meet certain Tri-Party Agreement milestones as a result. The integrated design-build approach still applies, but the project strategy has shifted in the following ways to optimize the project schedule within the funding constraints:

- The engineering effort is concentrated on implementing revised seismic criteria in the design of the PT and HLW facilities and equipment.
- Certain critical-path purchase orders and subcontracts have been canceled or suspended.
- Construction has been slowed on the critical-path, seismically affected PT and HLW facilities.
- Construction on the LAW and Lab facilities and BOF continue, with the goal of enclosing the facilities and curtailing fieldwork by the end of 2006 to make additional funds available for PT and HLW, which are on the critical path for the project.
- The project will shift back to construction of PT and HLW in FY 2007 after Engineering completes seismic analyses and LAW, Lab, and BOF are placed in conditions amenable to construction curtailment.
- In FY 2009 construction will resume on LAW, Lab, and BOF in parallel with PT and HLW, as annual funding allows.

In addition, the project has reorganized to better reflect the new funding-driven execution strategy. Project Management was consolidated to reduce costs, Engineering was centralized to better focus on the seismic design and optimize the mix of engineering disciplines, Construction was centralized in response to the greatly reduced workload and staffing, and support organizations like Procurement and Project Controls were reorganized to better manage funding constraints across the project. The resulting organization matches the execution plan and optimizes staffing levels.

5.1 Opportunities for Improvement

The December 2005 EAC is based on the current execution plan, factual pricing, and unit rate data. The project will continue to seek opportunities to reduce the cost and shorten the schedule.

When opportunities are identified, they are categorized as either in-scope or out-of-scope. Three specific areas of in-scope opportunity have been identified:

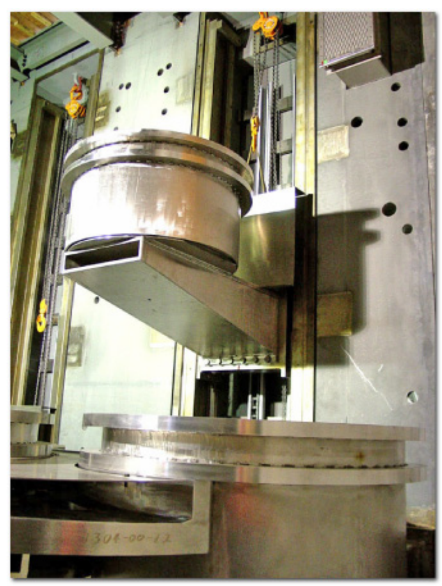
- ***Schedule.*** Much of the previous execution strategy at WTP has been based on a schedule-driven approach to meeting TPA milestones. With the seismic and funding issues impacting these milestones, execution strategies can be revisited with greater emphasis on cost savings.
- ***WTP construction long-range planning.*** The detailed design of the plant is now advanced enough for the 3D model of the plant to be electronically tied to the construction schedule, dynamically illustrating construction sequencing. This advanced scheduling tool will allow more efficient planning of construction equipment, material, and labor.
- ***Improved efficiency of the labor force, both craft and nonmanual.*** Once the seismic issue is fully resolved and the project funding is stabilized, it may be possible to staff below the levels in the EAC staffing plan, and thus generate cost savings, if the project is able to attain steady-state performance.

Out-of-scope opportunities are those that are not within BNI's control. Many out-of-scope opportunities center on external interfaces, such as with the future WTP operations contractor, the tank farm contractor, or the regulators. For example, early integration of the operating contractor could expedite hot commissioning and facility turnover. Regulatory changes can have significant impacts on WTP cost and schedule, either positive or negative. Plausible negative regulatory actions are addressed in the TPRA, but new improved efforts to integrate regulatory requirements would represent an opportunity. BNI will work with DOE-ORP to realize these opportunities and identify ways to reduce life-cycle costs.

Some of the tools and methods used to identify and incorporate opportunities on the WTP include:

- Six Sigma process improvement program
- Value engineering
- Total installed and operating cost program
- Lessons learned
- Program execution strategies

These methods have already generated substantial cost savings on the project. For example, our Six Sigma program has documented \$117 million in actual cost savings, and the EAC includes another \$69 million in expected savings from these same efforts. Likewise, our total installed and operating cost program delivered \$225 million in savings to the project.



Low-Activity Waste Facility Pour Cave, May 2005.

Low-Activity Waste Facility, December 2005.

5.2 EAC Review and Revision

Preparation of the December 2005 EAC spanned 6 months, and the process of review, validation, and updating to reflect the most recent WTP funding reduction will continue. Figure 20 is a timeline for follow-on EAC activities, including incorporation of this latest funding reduction.

External reviews are prominent in the path forward for the EAC. The WTP project has commissioned an external team of industry and academic experts to review the December EAC. The external review team includes two subteams and an oversight committee. The oversight committee consists of senior executives who will review high-level issues and oversee two subteams: a technical review team and a cost team. The technical review team will conduct a comprehensive review and analysis of the WTP flow sheet to identify risks associated with meeting contract deliverables. The cost team will conduct a cost and schedule validation of the EAC.

In parallel with the external review, BNI will prepare a May 2006 EAC for the current $490 million FY 2006 funding situation. Initially, BNI will deliver a rough-order-of-magnitude (ROM) estimate based on the December 2005 EAC. The results of the ROM estimate, the external review, and additional execution strategy planning will become inputs to an updated 2006 EAC using the $490 million FY 2006 funding. Upon

WTP EAC Plan for FY06

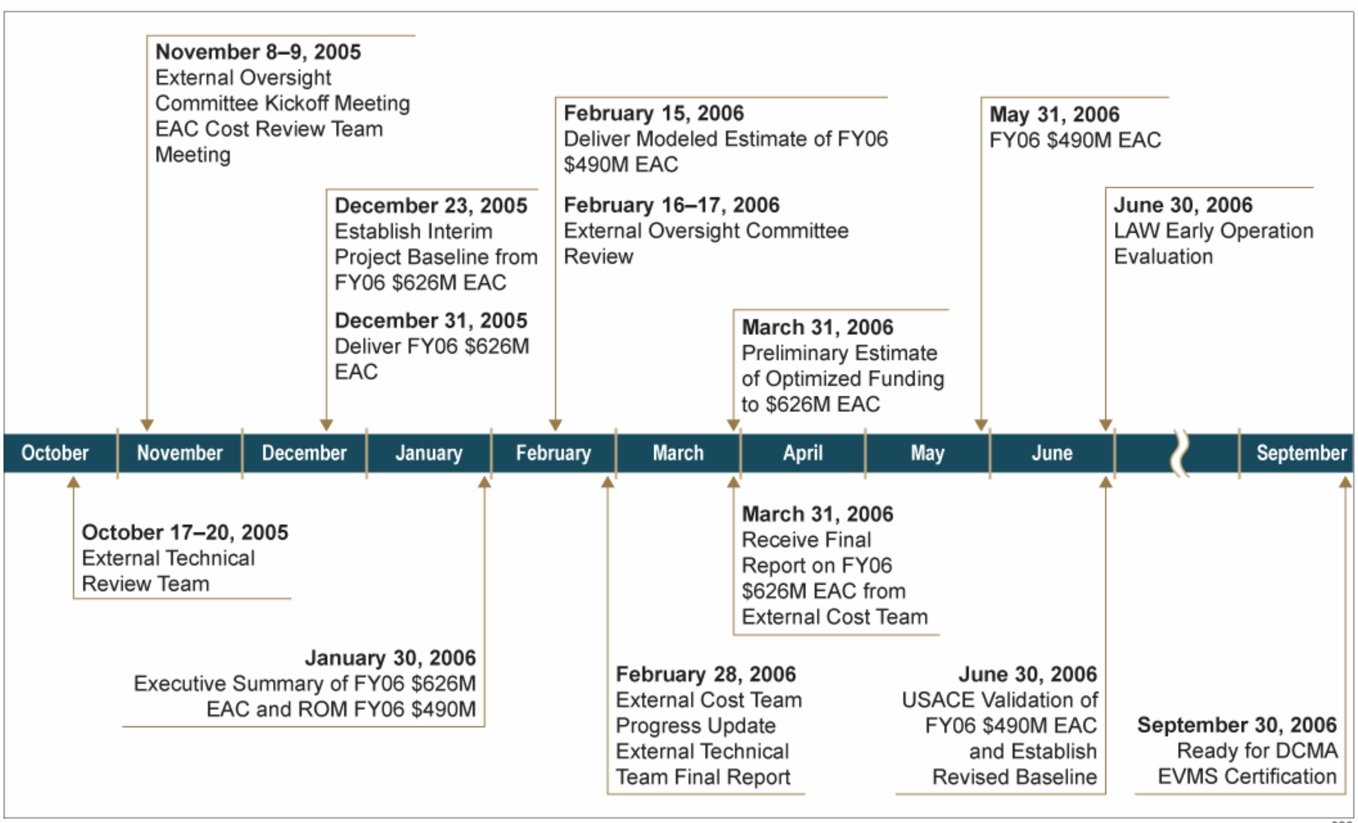


Figure 20.

approval by DOE, the updated 2006 EAC will become the new WTP project baseline.

Other parallel activities are related to the continuing EAC development. The December 2005 EAC will become an interim project baseline for FY 2006 and will serve as the basis from which cost and schedule progress, performance, and forecasts will be measured until the EAC based on the $490 million funding is validated by the USACE. In order to remain within the funding limit of $490 million for FY 2006, the project must continue to deviate from the interim project baseline (which was based on $626 million) by implementing actions such as craft and nonmanual destaffing, deferral, and suspension of procurements, and deferral of FY 2006 work activities into subsequent fiscal years. Implementation of these actions, while necessary to comply with funding limitations, will result in near-term unfavorable cost and schedule performance indices against the interim project baseline.

BNI will also prepare an estimate of an optimized funding case for DOE-ORP use in budget planning. The optimized funding case will demonstrate the cost and schedule savings achievable with unconstrained annual funding. Strategic planning will continue regarding evaluation of a plan to finish and operate the LAW facility early. This plan could allow earlier waste processing. This evaluation includes identification of advantages and disadvantages of such an approach. Finally, during this period, BNI's Project Controls and Project Management organizations will complete the steps necessary for certification of the project's earned value management system (EVMS) by the Defense Contract Management Agency (DCMA).

The ultimate result of this effort will be a realistic, defensible, validated baseline that is managed under a system in which the government has high confidence.

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The Columbia River