

# ENVIRONMENTAL COST ESTIMATE FOR THE PUREX COMPLEX

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

Contractor for the U.S. Department of Energy  
under Contract DE-AC06-08RL14788



**P.O. Box 1600  
Richland, Washington 99352**

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**APPROVED**  
*By Erin C. Meegan at 7:54 am, Nov 02, 2017*

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Release Approval

Date

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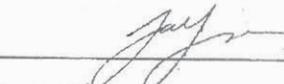
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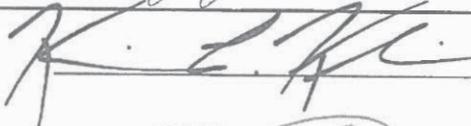
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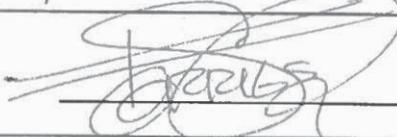
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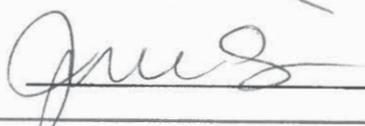
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## Terms

CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i>
CHPRC	CH2M HILL Plateau Remediation Company
D&D	decontamination and decommissioning
demo prep	demolition preparation
DOE	U.S. Department of Energy
ECE	environmental cost estimate
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FS	feasibility study
FTE	full time equivalent
FY	fiscal year
G&A	general and administrative
HHE	human health and the environment
IC	institutional control
MDBI	mobilization/demobilization/bonding/insurance
O&M	operations and maintenance
OH&P	overhead and profit
P&O	Pipe and Operating
PFM	Plutonium Finishing Plant
PRV	pressure reducing valve
PUREX	Plutonium-Uranium Extraction
S&M	surveillance and maintenance
TRACE V4	Tool for Response Action Cost Estimating, Version 4
TSS	technical support services
USACE	U.S. Army Corps of Engineers

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## 1 Introduction

This environmental cost estimate (ECE) was prepared to support the evaluation of removal action alternatives as documented in DOE/RL-2016-15, *Engineering Evaluation/Cost Analysis (EE/CA) for the PUREX Complex*, hereinafter called the Plutonium-Uranium Extraction (PUREX) Engineering Evaluation/Cost Analysis (EE/CA).

Cost estimates for each building/structure summarized in this ECE have been prepared to support the selection of the removal action alternative. Input parameters and related calculations used in the development of this cost estimate are found in ECF-200E15-0131, *Cost Estimate Inputs for Engineering Evaluation/Cost Analysis for the PUREX Complex*. The cost estimates reflect specific removal action alternative approaches, scope, assumptions, and exclusions as well as cost estimating methodologies. The removal action alternative cost estimates have expected ranges of accuracy described in Chapter 11.

## 2 Purpose of Estimate

This ECE provides costs needed to support the PUREX EE/CA (DOE/RL-2016-15) and an overview of removal action specific cost inputs, methodology, and results. The purpose of this ECE is to accomplish the following objectives:

- Describe the methodology applied in performing the cost estimates.
- Describe the general and removal action specific assumptions and inputs applied to the subject cost estimates.
- Summarize the removal action alternative cost estimates.

This ECE also documents the references that provide scope and information used to prepare these estimates.

This cost estimate has been prepared from the information available at the time of the estimate. The final cost of the project will depend on final design, selected scope of work, actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, final project costs will vary from the estimate presented here. Because of this, project feasibility and funding needs must be carefully reviewed before making specific financial decisions to help ensure proper project evaluation and adequate funding.

## 3 General Project Description

The PUREX EE/CA (DOE/RL-2016-15) identifies removal action alternatives and evaluates them against the following criteria: removal action objectives, effectiveness, implementability, and estimated cost. The Washington State Department of Ecology (Ecology) is the lead regulatory agency for this action. The U.S. Department of Energy (DOE) is voluntarily seeking Ecology review and concurrence in this removal action to help ensure consistency with ongoing or subsequent related remedial actions. Removal actions taken pursuant to this EE/CA will be conducted in compliance with DOE et al., 2012, *Hanford Federal Facility Agreement and Consent Order Hanford Public Involvement Plan*, public participation requirements established in 40 CFR 300.415(n), “National Oil and Hazardous Substances Pollution Contingency Plan,” “Removal Action,” and any applicable DOE policies. This EE/CA will undergo a 30 day public comment period. After the public comment period, a written response to significant comments will be provided in accordance with 40 CFR 300.820(a), “Administrative Record File for a Removal Action.” After consideration of the comments received from the public, DOE will confer with

Ecology in the issuance of an action memorandum that identify the selected alternative, whether the one recommended here or one of the other alternatives.

The PUREX Complex was designed and operated to recover plutonium, uranium, and neptunium from irradiated fuel elements received from the 100-N Reactor and the single-pass reactors on the Hanford Site.

PUREX was constructed between 1952 and 1956 and was in full operation between 1956 and 1972. Plant operations were then downgraded to wet standby until 1978, with process and support equipment operating on a regular basis and failed equipment either upgraded or replaced. From 1978 to 1983, the plant progressed from wet standby, through cold startup tests, to full operations. PUREX was in full operation for the second time, actively recovering plutonium from irradiated fuel, until 1988 when it was shut down again. Plant operations transitioned into cold standby from 1990 to 1992. In 1992, planning was initiated to change the status of PUREX from cold standby to deactivation (i.e., transition to shutdown).

Deactivation activities performed included the flushing of vessel system loops and tanks. All flushed vessels were emptied to a minimum heel, and associated piping was drained. Other deactivation activities included removing process liquids from the plant, shutting off utilities to the building, consolidating ventilation systems, and removing the need for the building to be occupied. Deactivation was completed in 1998, and the complex has been under surveillance and maintenance (S&M) since that time. General facility layout is shown in Figure 1. Table 1 lists all structures evaluated under the PUREX EE/CA (DOE/RL-2016-15), while Figure 2 depicts the layout of the evaluated structures.

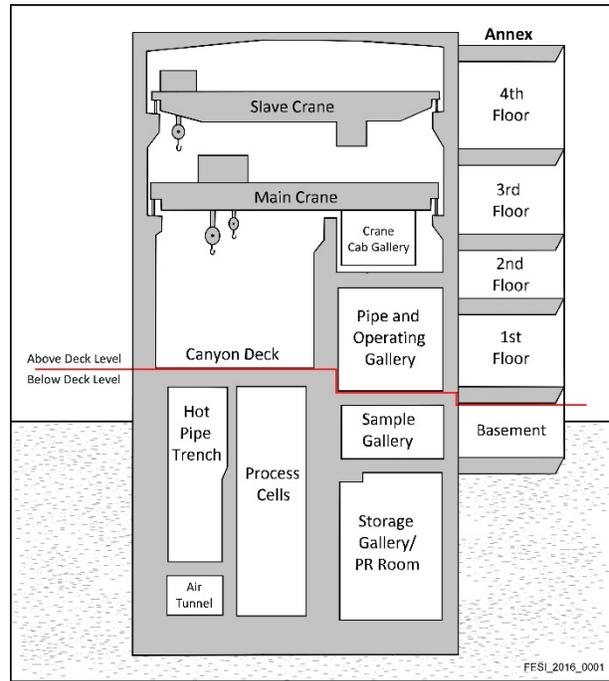


Figure 1. 202A Cross Section

Table 1. PUREX Complex Evaluated Structures

Structure Identification	Building/Structure Name
202A	PUREX Canyon Building West Annex Structure East Annex Structure

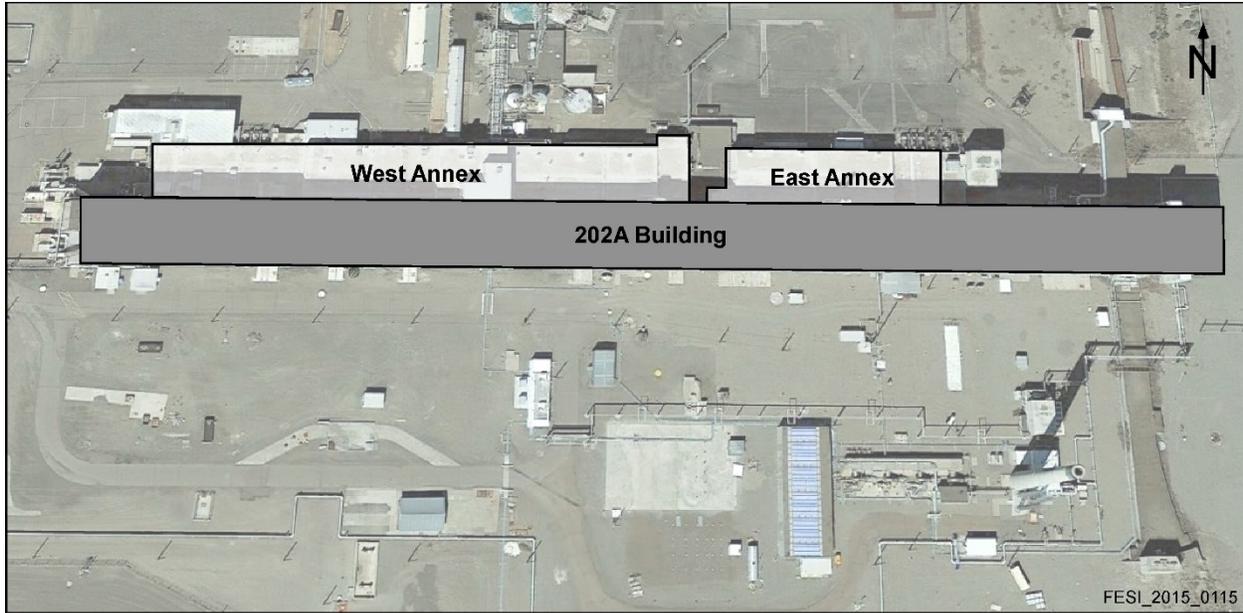


Figure 2. PUREX Complex Evaluated Structures

## 4 Scope of Work

This cost estimate for the PUREX EE/CA (DOE/RL-2016-15) was developed in accordance with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (OSWER 9355.0-75) and the Hanford internal cost estimating procedure for removal action decision making.

Quantities used in the creation of this estimate were based on the following documents:

- CP-59374, *Canyon Risk Mitigation Plan*
- ECF-200E15-0131, *Cost Estimate Inputs for Engineering Evaluation/Cost Analysis for the PUREX Complex*
- DOE/RL-95-78, *PUREX Facility Preclosure Work Plan*
- CP-14977, *Plutonium-Uranium Extraction Facility Documented Safety Analysis*
- Various Hanford Site drawings

### 4.1 Removal Action Alternatives

Removal action alternatives were developed for all buildings/structures evaluated within the PUREX Complex EE/CA. These buildings/structures include the 202-A Canyon Building and 291-A Ventilation System. The alternatives developed include specific actions to occur within each structure. Each successive alternative includes all of the structure specific actions involved in the previous alternative, with the addition of new actions for various structures as outlined in each of the alternative subsections.

Each alternative, with the exception of Alternative 1, includes the following types of actions: S&M, hazard abatement, demolition preparation (demo prep), and/or demolition. Waste generated from these actions will be treated and/or disposed of properly. These action activities are described below.

#### 4.1.1 Surveillance and Maintenance

S&M activities will be performed according to the most current S&M plan (DOE/RL-98-35, *Surveillance and Maintenance Plan for the Plutonium-Uranium Extraction (PUREX) Facility*). Activities conducted during the S&M phase are established to monitor containment of contaminants left in place, provide physical safety and security controls, and maintain the facility in a manner that will minimize risk to human health and the environment (HHE). S&M activities may be conducted on a routine and/or a nonroutine basis. Routine activities ensure that the structural and passive confinement integrity is maintained and may include periodic monitoring for potential radiological contamination, maintenance, identification, and minor repair of friable asbestos, general visual inspections, and annual roof inspections. Nonroutine activities include major responses to hazardous conditions (e.g., a leak in one area spreading radiological contamination to another area). Surveillance must satisfy the inspection requirements identified in Table 6-1, “PUREX Regulatory Compliance during Surveillance and Maintenance” of the S&M plan (DOE/RL-98-35). The S&M plan will be revised to reflect the current facility conditions and identify appropriate surveillance requirements, as needed.

#### 4.1.2 Hazard Abatement

Hazard abatement differs from S&M in that it allows for a proactive response to mitigate or reduce risk before a major response would be required. Hazard abatement may range from stabilization to complete removal of equipment and waste, as needed, to mitigate hazards. Identification of areas that will receive hazard abatement will be based on S&M activities and observations. Ventilation system modifications will be evaluated to support removal actions within the 202A Building, as needed.

#### 4.1.3 Demolition Preparation (Demo Prep)

Demo prep includes activities such as general housekeeping and removal of equipment and waste. Decontamination, fixing/stabilization of contamination, and isolation of systems may be performed. Overhead utilities and adjacent concrete and asphalt will be removed, as needed. Fluids will be drained from piping and equipment. Piping entering or exiting a structure may be plugged, blocked, or grouted to prevent potential release pathways to the environment, as appropriate. These activities will be managed in accordance with procedures that address removing, handling, and disposing of equipment and waste in a manner that protects the safety of workers and the public, minimizes spills and releases to the environment, and meets regulatory requirements.

#### 4.1.4 Demolition

Demolition can include hazard abatement and demo prep activities such as removing radioactive and hazardous substances from within and around buildings and structures; decontaminating, fixing contamination, and isolating systems; removing equipment; and plugging piping or drains entering or exiting belowgrade buildings/structures. Demolition of buildings and structures includes removal of abovegrade structures. The area will be stabilized (for example, backfill, contour, and vegetate) as necessary and appropriate. Demolition will be performed in a manner that protects HHE and reduces or eliminates the need for ongoing S&M activities.

### 4.2 Alternative 1 – No Action

The *Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)* requires the “No Action” alternative as a baseline for comparison with other removal action alternatives. Under the No Action alternative, it is assumed that 202A would be abandoned without any further action. No legal restrictions, institutional controls, or active measures are applied to 202A in this alternative. S&M activities would be discontinued, no additional facility stabilization would be performed, and degradation would continue indefinitely. Initial risks to HHE of the No Action alternative would be

minimal, and barring an unusual event, contaminants are assumed to remain confined within the structures. Risks over time are expected to increase as deterioration progresses and structural integrity is compromised. The possibility of a chemical and/or radiological contamination spread would increase due to lack of monitoring and controls. Physical hazards associated with partial structural collapse would also be anticipated.

Although Alternative 1 would not have an associated implementation cost under this analysis, it is understood that taking No Action would ultimately result in a substantial cost in the future due to addressing degradation of the facility. Alternative 1 is not consistent with DOE obligations under federal law to protect HHE; therefore, this alternative cannot be considered viable and is not considered further in this EE/CA. This alternative is used as a baseline for comparison only.

### 4.3 Alternative 2 – Continued S&M/Hazard Abatement 202A

The primary elements of Alternative 2 are as follows:

- Continued S&M of the PUREX Complex
- Hazard abatement of high priority areas within the 202A Building

The removal activities for Alternative 2 are summarized in Figure 3. The scope of Alternative 2 is described below.

#### 4.3.1 Surveillance and Maintenance

S&M program activities for the PUREX Complex would continue for 25 years. Surveillance and maintenance efforts are expected to increase over time in areas where no additional removal actions will take place due to continued degradation of structures and components. No facility life cycle upgrades will be performed.

#### 4.3.2 Hazard Abatement

Hazard abatement for the 202A Building would be performed. High priority areas are those areas that are determined to be high risk based on evaluation of the severity of hazards present (e.g. health and safety, or contaminant release), the reliability of available data, and the level of stakeholder interest and concern. At a minimum, high priority areas addressed under Alternative 2 are assumed to include N Cell, the Storage Gallery, the Pipe and Operating (P&O) Gallery, and the Sample Gallery. Other areas may be added, as identified during surveillance inspection.

### 4.4 Alternative 3 – Continued S&M/Hazard Abatement 202A/Demolition Preparation 202A Annex

Alternative 3, includes all activities in Alternative 2, with the primary element following in italics:

- Continued S&M of PUREX Complex (Alternative 2)
- Hazard abatement of high priority areas within the 202A Canyon (Alternative 2)
- *Demolition Preparation of the 202A West and East Annex*

The removal activities for Alternative 3 are summarized in Figure 4.

Demolition preparation would be performed for the 202A West and East Annex. Prior to demo prep of the 202A Annex structures, some hazard abatement activities may be performed, if necessary. Rooms in each annex structure would be emptied of wastes, equipment, furniture, and non-structural utilities, such as plumbing and power supply in preparation for eventual demolition. Asbestos removal would also be performed.

#### **4.5 Alternative 4 – Continued S&M/Hazard Abatement 202A/Demolition Preparation 202A Annex/Demolition 202A Annex/Demolition Preparation 202A Canyon Above Deck Areas**

Alternative 4, includes all activities in Alternative 3, with the primary element following in italics:

- S&M of the PUREX Complex (Alternative 2)
- Hazard abatement of the 202A Canyon (Alternative 2)
- Demolition preparation of the 202A West and East Annex (Alternative 3)
- *Demolition preparation of the 202A Canyon above deck areas*
- *Demolition of the 202A West and East Annex Structures*

The removal activities for Alternative 4 are summarized in Figure 5. The scope of the added removal activities is described in the following subsections.

##### **4.5.1 Demolition Preparation**

Demolition preparation activities will be performed in the 202A Building in above deck areas of the canyon, as appropriate. These areas are the P&O gallery, including the White Room, east pressure reducing valve (PRV) enclosure, canyon lobby and lobby storage, and the canyon deck area in the center of the 202A Building. Prior to demo prep, some hazard abatement activities may be performed, if necessary. Demolition preparation activities would include removal of wastes, equipment, and non-structural utilities such as plumbing, in preparation of eventual demolition or grouting.

##### **4.5.2 Demolition**

Alternative 4 includes demolition of the 202A Annex. Demolition preparation will take place prior to demolition. Under this alternative the 202A Annex would be demolished down to ground level and the basement level would be brought back to grade with fill material. Removal of transite from the exterior walls will be performed as part of the demolition, for proper management of the asbestos containing material. It should be noted that if utilities or controls located in the 202A Annex are discovered to be needed for future actions, then those utilities or controls will need to be reconfigured and relocated prior to demolition. Following demolition, any access points to the remaining canyon portion, will be isolated or sealed, as appropriate.

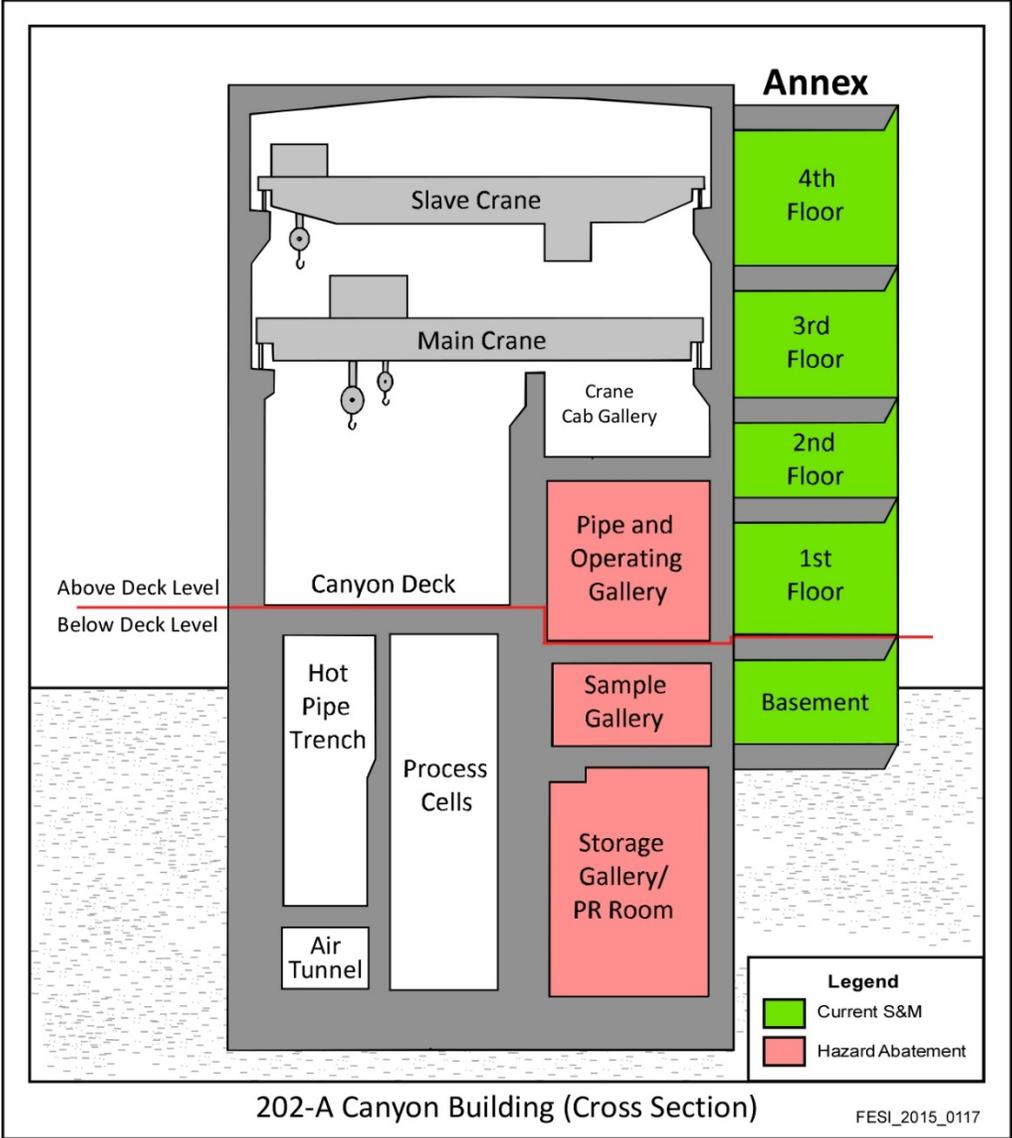


Figure 3. Alternative 2 Summary of Activities

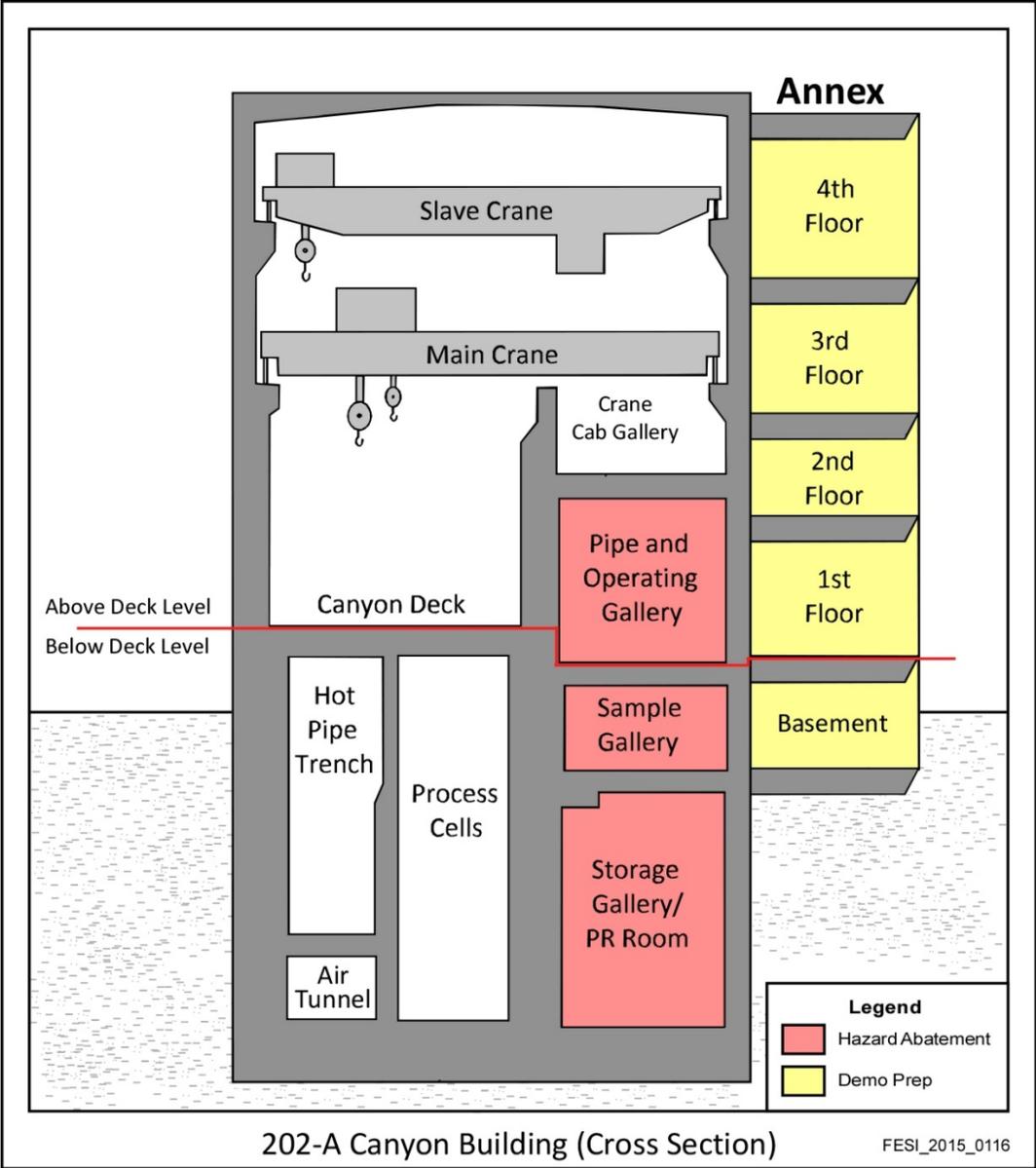


Figure 4. Alternative 3 Summary of Activities

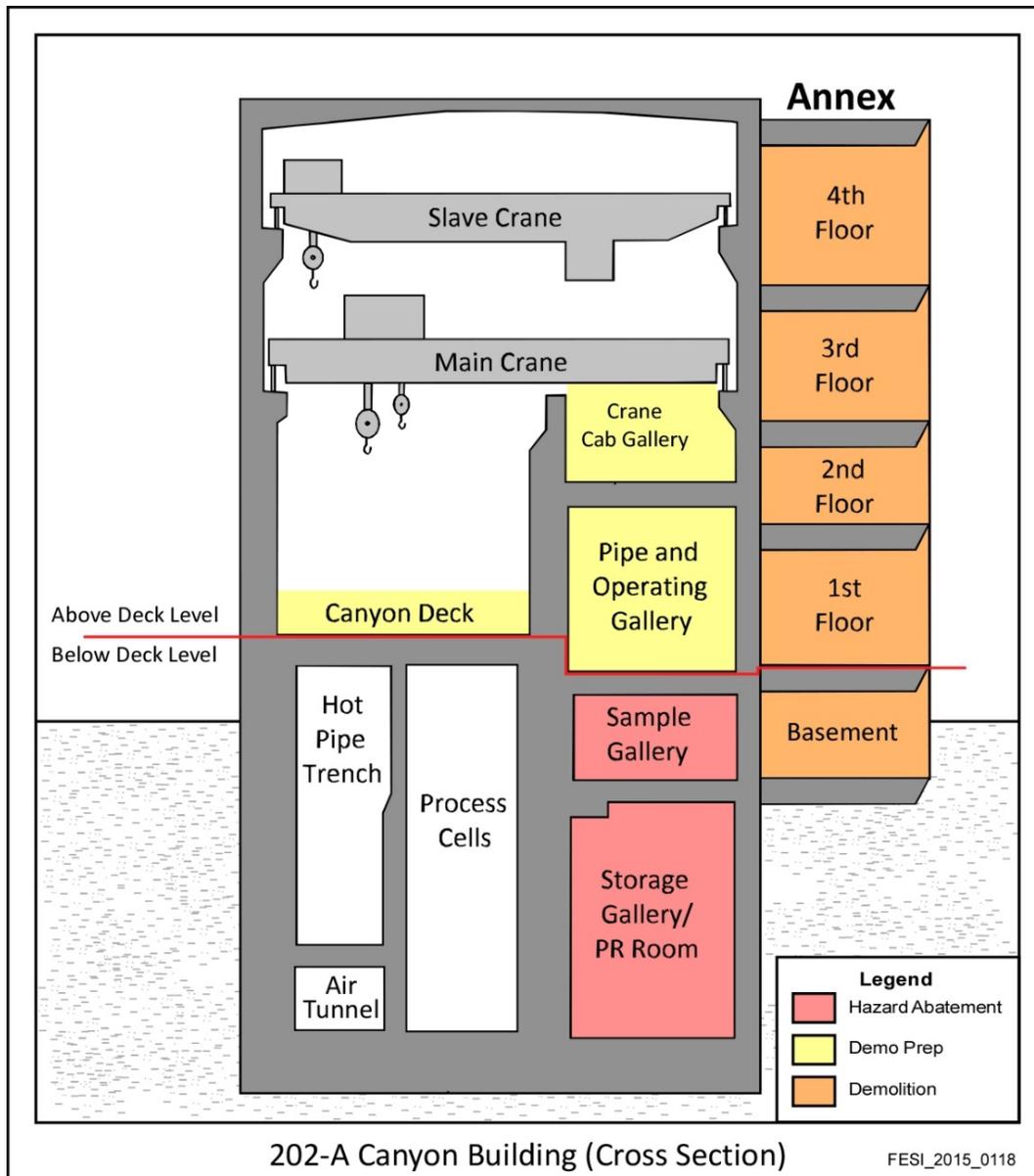


Figure 5. Alternative 4 Summary of Activities

## 5 Major Assumptions

The assumptions used in the estimate include general and specific cost assumptions.

### 5.1 General Assumptions and Inputs

General assumptions include the following direct cost factors, indirect cost factors, and other general pricing assumptions:

- Markups are included for mobilization/demobilization/bonding/insurance (MDBI), overhead and profit (OH&P), taxes, contingency, and general and administrative (G&A) (see Chapter 7).

- Markups for project management, removal action design costs, and construction management are included (see Chapter 9).
- The project will have a duration of 25 years.

## 5.2 Specific Assumptions

Specific assumptions are broken out by the following categories: Site Preparation, Labor, Waste Disposal, Waste Treatment, Sampling and Analysis, Operations and Maintenance (O&M) Costs, and Other.

### 5.2.1 Site Preparation

Site Preparation will be conducted prior to removal action activities, with the following assumptions:

- Securing the site, power connections, and set up of work zones, equipment, waste areas, and temporary facilities and utilities, which also includes 3 months of planning for initial activities, will be completed.
- Characterization sampling throughout the PUREX Canyon Building will be necessary to assess current conditions prior to work activities. The characterization campaign is estimated to last for 6 months and will require approximately 290 samples.
- A ventilation upgrade is assumed to be necessary in order to conduct removal action activities inside the galleries.
- Life safety upgrades are assumed to be necessary to meet requirements for proposed work activities within the 202-A Canyon building.
- Modifications to existing life safety documentation (fire hazards analysis and documented safety analysis), following completion of facility updates, are required prior to initiating removal action activities.

### 5.2.2 Labor

Labor costs and duration include the following assumptions:

- Cost and time are necessary for mockups. A mockup is a simulation exercise for workers to practice a hazardous activity in a controlled environment prior to attempting the actual activity. Mockup costs include labor, equipment, and materials.
- Table A-10 (Appendix A) provides the duration of each labor activity for all alternatives.
- The interior specialized crew is based on actual crew data from Plutonium Finishing Plant (PFP) cleanup work. This crew is assumed to complete all hazard abatement, demo prep, and grouting activities. This crew rate includes 20 full time equivalent (FTE), materials, taxes and licenses, and G&A. Table A-11 (Appendix A) provides a breakdown on worker types and hours.
- Decontamination and decommissioning (D&D) crew includes equipment costs (70 percent labor and 30 percent equipment). This crew is assumed to conduct all demolition activities. Table A-12 (Appendix A) provides a breakdown on worker types and hours.
- Labor activities are to be conducted sequentially, with only one crew working at any given time. Crews will be focused on a single cleanup activity until work is complete or a change in conditions warrants redeployment.

- Current radiological controls practices will continue for the duration of the project.
- An average of 19 work days per month is assumed.

### 5.2.3 Waste Disposal

Calculations for equipment volumes and weight for disposal are discussed in ECF-200E15-0131. Waste disposal includes the following assumptions:

- Hazard abatement activities will remove 50 percent of equipment from designated areas.
- Demo prep activities will remove 100 percent of equipment from designated areas.
- All contaminated wastes meeting acceptance criteria are to be disposed of at the Environmental Restoration Disposal Facility (ERDF) as low-level waste/mixed low-level waste.
- The average load to ERDF is 13 tons.
- There is assumed to be no removable equipment in the Crane Cab Gallery.
- The canyon crane will not be operated. Any equipment requiring the canyon crane for removal will remain on the Canyon Deck.
- Sorting of waste prior to disposal will not be necessary.
- Any equipment remaining in the canyon following hazard abatement and demo prep activities will be left in place and will not be consolidated into belowgrade areas of the canyon.

### 5.2.4 Waste Treatment

Waste treatment cost breakdown is described in Table A-13 (Appendix A) and contains the following assumptions:

- ERDF containers hold 13 tons of debris.
- Treatment for each ERDF container requires 4 hours to complete.
- 10 percent of waste will require treatment prior to ERDF disposal.

### 5.2.5 Waste Transportation

Transportation of waste contains the following assumptions:

- Total drive time from PUREX to ERDF is 0.4 hours ( $8 \text{ mi} \div 20 \text{ mi/hr.} = 0.4 \text{ hr.}$ ).
  - Distance to ERDF ( $\times 2$  for return trip) is 8 mi.
  - Average speed is 20 mi/hr.
- Two teamsters are required for transportation of waste to ERDF.
- Average wait time is 0.5 hours.

### 5.2.6 Sampling and Analysis

Sampling and analysis include the following assumptions:

- An initial characterization campaign will occur prior to major work within the 202A Canyon building. Table A-14 (Appendix A) provides a breakdown of this characterization sampling campaign.

- Confirmatory sampling following removal action activities will not be taken until initiation of the final remedial action.
- An allowance for sampling waste before transport to ERDF is included for all waste disposal activities.

### 5.2.7 O&M Costs

O&M includes the following cost assumptions:

- The S&M program cost for the PUREX Complex is assumed to equal the fiscal year (FY) 2013 cost. This rate is assumed to remain constant for the entirety of the project duration (25 years).
- Additional hazard abatement activities are assumed to be necessary throughout the 25-year project duration as new hazards are identified.
- Personnel support facilities will be necessary for the entire duration of the project (25 years). Support facilities will consist of two single wide trailers, two double wide trailers, and one restroom trailer. Cost breakdown is provided in Table A-15 (Appendix A).
- At the conclusion of the 25-year project duration, a final On-Scene Coordinator Report will be completed to summarize the activities completed.

### 5.2.8 Other Specific Assumptions

The following other specific assumptions are included:

- Air monitoring is assumed to occur during each removal action activity. The duration of air monitoring will be matched to the duration of labor activities for each removal action.
- Calculations for room volume, equipment volumes and weight, and void space volumes for grouting activities are discussed in ECF-200E15-0131. These measurements were used as inputs for waste disposal and grouting activity costs.
- On-Scene Coordinator Reports will be issued after completion of the following key removal actions:
  - Demolition Preparation of N Cell
  - Demolition of the 202A Annex
  - Final report following completion of removal action

## 6 Exclusions

This chapter identifies costs that have not been included in the estimate. The following items have been excluded from the estimate:

- Escalation – Separate escalation has not been included in these calculations. The costs are all based on FY 2016 costs.
- Institutional Controls (ICs) – Costs for CERCLA programmatic ICs are not included in this estimate.
- Significant amounts of contaminants/contaminated materials not previously identified are excluded.
- Waste material size reduction beyond the minimum needed to handle and transport to ERDF is not included.

- Costs associated with the final remedial decision are excluded. All removal action activities were designed to prepare the PUREX Complex for final disposition. As of March 2016, a final remedial decision has yet to be made for the PUREX Canyon Building. Current duration estimates for removal action activities do not consume entire 25-year project duration. Following completion of removal action activities, activities associated with final remedial activities may occur but are not included in this cost estimate.
- Facilities located within the PUREX Canyon Complex that have been evaluated under a separate EE/CA or are currently active are not included.

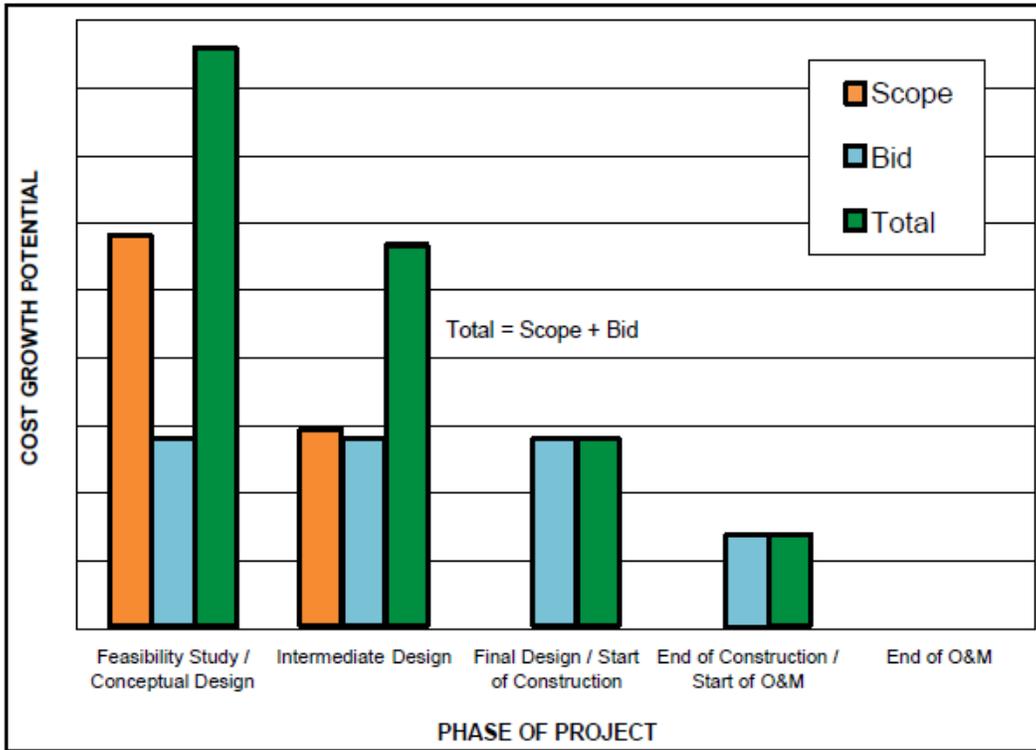
## 7 Markups

The following markups were utilized in the cost estimate and applied in the following order:

- MDBI – 10 percent markup is applied to capital cost subtotal costs to cover contractor mobilization, demobilization, bonding, and insurance.
- OH&P – 15 percent markup is applied to the capital cost subtotal with taxes for contractor overhead, and a 10 percent markup is applied to the capital cost subtotal for contractor profit.
- Taxes – 8.6 percent Washington State tax is applied to travel expenses, equipment, materials, other direct costs and subcontractors (with the exception of lab services and quoted costs from subcontractors). Sales tax is assumed included in costs based on previous systems and components used in this estimate.
- Contingency – 45 percent overall capital cost contingency was applied (25 percent capital scope contingency plus 20 percent capital bid contingency). An overall 50 percent contingency was applied for both annual and periodic O&M items. Additional information on contingencies is found in Chapter 8.
- CH2M Hill Plateau Remediation Company (CHPRC) G&A fee – 20 percent G&A markup is applied to the subtotal capital costs including contingencies.

## 8 Contingencies

Contingency is factored into a cost estimate to cover unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate from the available data at the time the estimate is prepared. It is used to reduce the risk of possible cost overruns. The two main types of contingency are scope and bid. Scope contingency covers unknown costs due to scope changes that may occur during design. Bid contingency covers unknown costs associated with constructing and implementing a given project scope. Figure 6 shows how the bid and scope contingencies typically change as a project progresses through typical stages of design and implementation. Figure 6 also shows the relationship between scope, bid, and total contingencies.



Source: EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, Exhibit 5-5.

Figure 6. Relationship of Scope, Bid, and Total Capital Cost Contingency

## 8.1 Scope Contingency

Scope contingency represents project risks associated with an incomplete design. This type of contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial design proceeds (Figure 8). For this reason, scope contingency is sometimes referred to as design contingency, which is the term commonly used by the U.S. Army Corps of Engineers (USACE). In general, scope contingency should decrease as design progresses and should be 0 percent at the 100 percent design stage.

At the early stages of remedial design (e.g., feasibility study [FS], which represents 0 through 10 percent design completion), concepts are not typically developed enough to identify all project components or quantities. Contributing factors include limited experience with certain technologies, potential requirements due to regulatory or policy changes, and inaccuracies in defining quantities or characteristics. Scope contingency would be expected to be higher for newer or emerging remedial technologies than for more well documented systems. For these reasons, scope contingency may vary between alternatives. A low percentage for scope contingency indicates an opinion that the project scope will undergo minimal change during design. A high percentage indicates an opinion that the project scope may change considerably between the FS and final design.

The scope contingency for this estimate has been set at 25 percent for all of the alternatives.

## 8.2 Bid Contingency

Bid contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial action construction or O&M proceeds (Figure 7). For this reason, bid contingency is sometimes referred to as construction contingency, which is the term commonly used by USACE.

Bid contingency accounts for changes that occur after the construction contract is awarded. This contingency represents a reserve for quantity overruns, modifications, change orders, and/or claims during construction. Considerations include the technological, geotechnical, and other unknowns applicable to the construction phase. Examples include changes due to adverse weather, material or supply shortages, or new regulations.

The range for bid contingency is typically from 10 to 20 percent. The bid contingency for this estimate has been set at 20 percent for all of the alternatives.

## 8.3 O&M Contingencies

O&M contingencies are applied to individual annual and periodic O&M cost line items. Since O&M scope is generally less defined than capital scope associated with a specific alternative design, and since O&M has variability in frequency, duration, activity level, and response to changes as O&M progresses, O&M cost contingencies are typically at least as high and often greater than capital cost contingencies. A total O&M contingency of 50 percent was used for each annual O&M cost line item for each alternative. A total O&M contingency of 50 percent was used for periodic O&M cost line items for all of the alternatives.

## 9 Project Management, Removal Design, Construction Management, and Technical Support Services

Project management, remedial design, and construction management capital costs are estimated using factors based on EPA 540-R-00-002. These factors are provided in Table 2.

Table 2. Percentages for Professional/Technical Services Capital Costs

Capital Cost Element	<\$100K (%)	\$100K-\$500K (%)	\$500K-\$2M (%)	\$2M-\$10M (%)	>\$10M (%)
Project Management	10	8	6	5	5
Remedial Design	20	15	12	8	6
Construction Management	15	10	8	6	6

Source: EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, Exhibit 5-8.

Since all of the alternatives have estimated costs greater than \$10 million, the following percentages were used in these estimates:

- Project Management: 5 percent
- Remedial Design: 6 percent
- Construction Management: 6 percent

Technical support services (TSS) include project management, technical coordination, and onsite logistics and support to implement O&M activities. TSS markup is applied to individual annual and periodic O&M cost line items with the TSS percentage varying based on the line item subtotal cost as shown in Table 3. The line item subtotal costs corresponding to the Table 3 cost ranges include MDBI, OH&P, Washington State sales tax, and O&M contingency.

Table 3. Percentages for Technical Support Services for O&M Costs

O&M Cost Element	<\$100K (%)	\$100K-\$500K (%)	\$500K-\$2M (%)	\$2M-\$10M (%)	>\$10M (%)
Technical Support Services	45	33	26	19	17

Note: Percentages are the sum of the project management, remedial design and construction management vales found in Table 2.

Since the individual annual and periodic O&M line item subtotals in the alternatives range from <\$100,000 to \$2M-\$10M, TSS markup percentages for the line items in the alternatives range from 45 to 19 percent. Appendix A tables for annual O&M markups and periodic O&M markups for each alternative list composite average TSS markup percentages.

## 10 Present Worth

The estimate includes present worth calculations for work performed in out years based on EPA 540-R-00-002.

Costs are presented as present worth values. The present worth value method establishes a common baseline for evaluating costs that occur during different time periods, thus allowing for direct cost comparisons between different alternatives. The present worth value represents the dollars that would need to be set aside today, at the defined real discount rate, to ensure that funds would be available in the future as they are needed to perform the response action alternative.

Present worth costs were estimated using the real discount rate published in Appendix C of OMB Circular No. A-94, 2015, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*. Based on this guidance and durations of 25 years for all alternatives, a real discount rate of 1.38 percent was used in the cost estimate present value calculations for these alternatives.

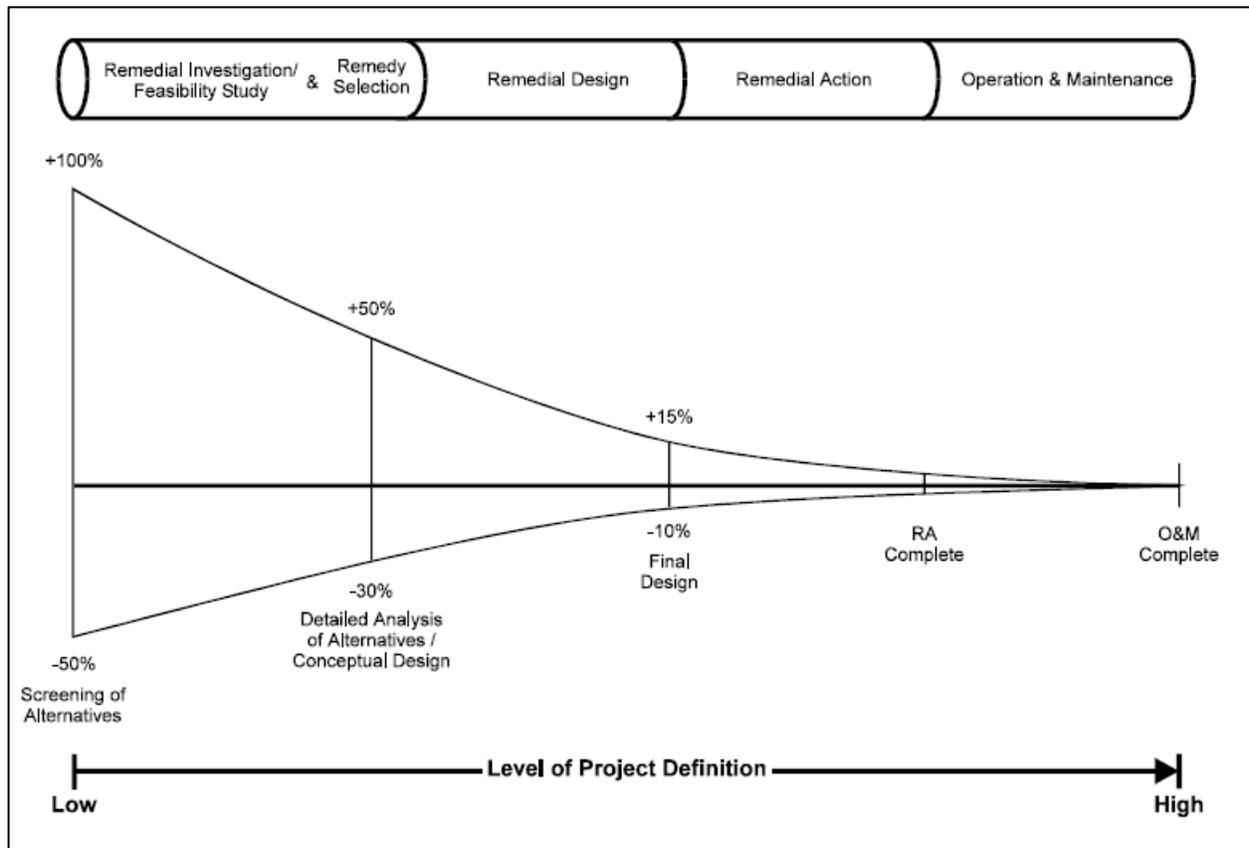
## 11 Estimate Classification

The expected accuracy range of the cost estimate at this stage is approximately plus 50 percent, minus 30 percent. This accuracy range is consistent with EPA 540-R-00-002 for the level of project definition available at this time.

The expected accuracy range is an indication of the degree to which the final cost outcome for a given project could vary from the estimated cost. Accuracy is traditionally expressed as a +/- percentage range around the point estimate after application of contingency, with a stated level of confidence that the actual cost outcome would fall within this range (+/- measures are a useful simplification, given that actual cost outcomes have different frequency distributions for different types of projects). Typically, this results in a 90 percent confidence that the actual cost will fall within the bounds of the low and high ranges.

The accuracy range of an estimate is dependent upon a number of characteristics of the estimate input information and estimating process. The extent and maturity of the input information, as measured by percentage completion (and related to level of project definition), are important determinants of accuracy. However, there are factors besides the available input information that also greatly affect estimate accuracy measures. Primary among these are the state of technology in the project and the quality of reference cost estimating data.

The accuracy of any given estimate is not fixed or determined by its classification category. Significant variations in accuracy from estimate to estimate are possible if any of the determinants of accuracy, such as maturity of technology selected, quality of reference cost data, quality of the estimating process, and skill and knowledge of the estimator vary. Accuracy is also not necessarily determined by the estimating methodology used or the effort expended. Estimate accuracy must be evaluated on an estimate-by-estimate basis, usually in conjunction with some form of risk analysis process. Figure 7 shows an example of the expected level of accuracy for a remedial action, which is similar to the removal actions this cost estimate supports.



Source: EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, Exhibit 2-3.

Figure 7. Expected Cost Estimate Accuracy

## 12 Cost Resources

The following list of various resources was used in the development of the cost estimate (see Tables A-16 and A-17 in Appendix A for unit costs and associated sources for items included in the cost estimate). Sources listed in the Appendix A tables include historical and other. Historical costs include actual costs or estimated costs from past Hanford Site projects. Other costs are sourced from CHPRC project

management, rate information gathered from subject matter experts, and estimator buildup utilizing information gathered from historical or other sources.

Labor unit prices reflect a burden rate including worker's compensation, unemployment taxes, fringe benefits, and medical insurance (2015 rates).

The cost estimate was generated using the most recent version of the Tool for Response Action Cost Estimating (TRACE) Version 4 (V4) workbook (Rev. 4) in Microsoft Excel®. Further information on this workbook may be found in the following documents:

- ECF-HANFORD-16-0004, *Tools for Response Action Cost Estimating (TRACE) V4 – Site Summary*
- ECF-HANFORD-16-0005, *Tools for Response Action Cost Estimating (TRACE) V4 – Site and WBS Setup*
- ECF-HANFORD-16-0006, *Tools for Response Action Cost Estimating (TRACE) V4 – Project Setup*
- ECF-HANFORD-16-0007, *Tools for Response Action Cost Estimating (TRACE) V4 – Overview*
- ECF-HANFORD-16-0008, *Tools for Response Action Cost Estimating (TRACE) V4 – Operations and Maintenance Unit Cost*
- ECF-HANFORD-16-0009, *Tools for Response Action Cost Estimating (TRACE) V4 – Capital Unit Cost*
- ECF-HANFORD-16-0010, *Tools for Response Action Cost Estimating (TRACE) V4 – Alternatives Cost Comparison*
- ECF-HANFORD-16-0011, *Tools for Response Action Cost Estimating (TRACE) V4 – Alternatives 01 through 06-Site-WBS*
- ECF-HANFORD-16-0012, *Tools for Response Action Cost Estimating (TRACE) V4 – Alternatives 01 through 06*

### 13 Estimate Methodology

The cost estimate for the PUREX EE/CA (DOE/RL-2016-15) was developed in accordance with EPA 540-R-00-002 and contractor cost estimating procedures. The TRACE V4 cost estimating workbook, in conjunction with historical cost data and estimated allowances, was used to develop the cost estimate for each of the removal action alternatives. Assumed project scope items were itemized, and unit costs were applied as shown in Tables A-1 through A-9 (Appendix A). Where available, costs for major systems were based on existing systems costs at the Hanford Site. Percentage allowances and lump sums were applied for some of the cost items, based on Hanford and environmental project experience.

This cost estimate has been prepared for guidance in project evaluation from the information available at the time of the estimate. The final cost of the project will depend on final design, selected scope of work, actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimate presented in this document. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

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® Excel is a registered trademark of Microsoft Corporation, Redmond, Washington.

## 14 Sensitivity Analysis

Sensitivity analysis for this cost estimate was not performed. The following factors might cause the estimate to change significantly:

- Levels of contamination
- Newly discovered hazardous conditions
- Availability of workers
- Change in worker safety protection due to field conditions or new monitoring requirements

Because of these factors, the remedy selection process must consider differences in response action cost uncertainties and risks in addition to response action specific cost estimates and ranges. Funding needs must be carefully reviewed before making specific financial decisions or establishing final budgets.

## 15 Labor Costs

CHPRC labor rates for management, engineering, safety oversight, and technical support are based on the CHPRC-approved planning rates for FY 2015.

For this estimate, labor needs were developed through discussions with CHPRC project management. As a high level estimate, in-depth work planning and crew development was not conducted. Labor needs were grouped into two work crew categories: interior specialized and general D&D.

Following the development of these two work crew categories, past estimates and actual costs from Hanford Site projects were studied.

The interior specialized work crew was identified for all interior cleanout work of contaminated structures. For this estimate, actual crew data from recent work conducted within PFP were evaluated. The average monthly cost and labor breakdown for a single full time crew were calculated and can be found in Table A-11 (Appendix A).

The general D&D labor category was selected for all facility demolition activities. The labor breakdown and monthly cost for this crew type were extracted from past cost estimates and can be found in Table A-12 (Appendix A).

## 16 Sales Tax

Washington State sales tax has been applied to all materials and equipment purchases at 8.6 percent and is included in the markups discussed in Chapter 7.

Future cost escalation is not calculated in this estimate. All costs are presented in 2016 dollars.

## 17 Cost Summary

Table 4 presents overall capital, annual, periodic, total non-discounted, and total discounted (present value) costs for the PUREX Complex.

Table 4. Summary of Costs

		Alternative 1	Alternative 2	Alternative 3	Alternative 4
<b>Total Non-Discounted Cost</b>		\$0	\$193.7 M	\$207.4 M	\$237.9 M
<b>Total Capital Cost</b>		\$0	\$129.8 M	\$143.5 M	\$174.0 M
<b>Total Annual O&amp;M Cost</b>		\$0	\$36.4 M	\$36.4 M	\$36.4 M
<b>Total Periodic O&amp;M Cost</b>		\$0	\$27.5 M	\$27.5 M	\$27.5 M
<b>Total Present Value Cost (Discounted)</b>		\$0	\$177.9 M	\$190.6 M	\$217.7 M
<b>Total Present Value Cost Range</b>	-30%	\$0	\$124.6 M	\$133.4 M	\$152.4 M
	+50%	\$0	\$266.9 M	\$285.8 M	\$326.5 M

Notes: Cost totals may differ slightly from the displayed values due to rounding  
 Cost Estimates are order-of-magnitude with an expected accuracy range of +50%/-30%

Cost estimate summary tables and associated quantity tables are presented in Appendix A.

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## Appendix A

### Capital and O&M Cost Estimate

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## Terms

AMU	aqueous make-up unit
CHPRC	CH2M HILL Plateau Remediation Company
CM	cubic meter
D&D	decontamination and decommissioning
DSA	documented safety analysis
EA	each
EE/CA	engineering evaluation/cost analysis
ERDF	Environmental Restoration Disposal Facility
FHA	fire hazards analysis
FTE	full-time equivalent
FY	fiscal year
G&A	general and administrative
LLW	low-level waste
LS	lump sum
MDBI	mobilization/demobilization/bonding/insurance
MLLW	mixed low-level waste
MO	month
O&M	operations and maintenance
PUREX	Plutonium/Uranium Extraction (Plant)
TRACE V4	Tool for Response Action Cost Estimating Version 4
TRU	transuranic
WBS	work breakdown structure
YR	year

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## A1 Introduction

Tables A-1 through A-9 are from the Tool for Response Action Cost Estimating (TRACE) Version 4 (V4) cost estimate workbook for the Plutonium/Uranium Extraction (PUREX) Complex, with formatting modifications and the addition of overall alternative-specific composite average Technical Support Services allowances for annual and periodic operations and maintenance (O&M) costs (TRACE V4 varies this allowance by line item). The TRACE V4 Capital Cost Estimate and O&M Cost Estimate tables include:

1. Site: A site integer is user-assigned corresponding to each Site Name, allowing TRACE V4 to subtotal costs for sites within each alternative.
2. Site Name: User-assigned site name within each alternative.
3. WBS Top Tier: Highest level work breakdown structure (WBS) groupings that TRACE V4 can use to create WBS specific cost subtotals. WBS groupings are user-assigned and associated with each capital and O&M cost line item.
4. Description: User enters cost descriptions in TRACE V4 Capital Unit Cost and O&M Unit Cost worksheets. The unit costs are linked with specific unit cost line item numbers already present in the TRACE V4 workbook in the worksheet rows where the unit cost descriptions and other information are entered. User then selects unit costs on the alternative specific Capital Cost Estimate and O&M Cost Estimate worksheets from pull-down lists and the unit cost number and description are automatically displayed in the Capital and O&M Cost Estimate Description columns.
5. Quantity: User entered or linked quantity for the line item activity.
6. Unit: Unit associated with the cost line item quantity and unit cost.
7. Unit Cost: TRACE V4 automatically populates the unit cost column on the Capital and O&M cost estimate worksheets based on the cost item selected by the user in the Description column.
8. Subtotal: TRACE V4 automatically calculates line item cost subtotals as the product of the specific line item quantity and unit cost.
9. Source: TRACE V4 displays source groupings as: HISTORICAL or OTHER on the Capital and O&M Cost Estimate worksheets. Additional unit cost source information is noted in the TRACE V4 Capital Unit Cost and O&M Unit Cost worksheets.
10. Start Year: User entered year relative to the alternative base year (0 = base year, 1 = 1 year after base year, etc.) when the line item activity starts. TRACE V4 uses the Start Year, End Year, and Interval to associate each capital and O&M cost line item with a specific year or years when the activity occurs. TRACE V4 then uses year-specific discount factors to multiply by each cost in each specific year of occurrence to sum and calculate Present Value costs.
11. End Year: User entered year relative to the base year when the line item activity ends.
12. Interval: User entered interval in years between occurrences of the line item activity.
13. Notes: User supplied notes

Tables A-1 through A-9 also show line item specific markups for capital and O&M costs and successive cost subtotals as the markups are applied in TRACE V4.

Tables A-16 and A-17 are the TRACE V4 Capital Unit Cost Summary and O&M Unit Cost Summary worksheets showing the cost line item numbers, descriptions, unit costs, and unit cost source information and notes. All PUREX Complex capital cost and O&M cost worksheets pull unit cost information from these sheets based on drop-down lists specific the capital and O&M unit costs from the Capital and O&M Unit Cost Summary worksheets.

## **A2 Capital Cost Estimate for Alternative 2**

The capital cost line items for Alternative 2 are found in Table A-1. These line items include all activities to occur under the Alternative 2 removal action as described in DOE/RL-2016-15, *Engineering Evaluation/Cost Analysis for the PUREX Complex* (PUREX EE/CA). Table A-1 also includes a summary of all markups, taxes, and contingencies applied to Alternative 2 capital costs.

Alternative 2			
Location:	PUREX Complex	Base Year:	2017
Phase:	EE/CA	Date:	9/12/2016
Description:	Current Surveillance and Maintenance with Hazard Abatement of 202A Canyon Building		

Table A-1. Alternative 2 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
1	PUREX Complex	Mob/Demob; Temp. Utilities and Facilities	01 Site Preparation	1	LS	\$1,500,000	\$1,500,000	OTHER	0	0	1	Secure site; power connections; set up work zones and equipment & waste areas; set up temporary facilities and utilities.
1	PUREX Complex	Facility Modification or Upgrade	60 Ventilation System Modification	1	LS	\$10,000,000	\$10,000,000	OTHER	0	0	1	Budget allowance for bringing ventilation system into compliance for proposed work activities
1	PUREX Complex	Facility Modification or Upgrade	62 Life Safety Updates	1	LS	\$1,500,000	\$1,500,000	OTHER	0	0	1	Updates to facility to bring into compliance with life safety requirements of DSA and FHA documents
1	PUREX Complex	Document Preparation	1051 DSA / FHA Review and Update	1	EA	\$100,000	\$100,000	OTHER	0	0	1	Updates to life safety documentation in response to facility modifications
1	PUREX Complex	Monitoring, Testing, Sampling and Analysis	650 Characterization Sampling	290	EA	\$5,000	\$1,450,000	OTHER	0	0	1	Characterization sampling campaign throughout PUREX Canyon Building to identify contaminants of concern and associated concentrations prior to hazard abatement activities
1	PUREX Complex	Monitoring, Testing, Sampling and Analysis	801 Work Crew, Interior Specialized	6	MO	\$300,000	\$1,800,000	HISTORICAL	0	0	1	Characterization sampling campaign labor
1	PUREX Complex	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	6	MO	\$20,000	\$120,000	OTHER	0	0	1	Site air monitoring during characterization sampling activities
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	6	MO	\$20,000	\$120,000	OTHER	0	0	1	Site air monitoring during Hazard Abatement activities
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	12	MO	\$20,000	\$240,000	OTHER	1	3	1	Site air monitoring during Hazard Abatement activities
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	10	MO	\$20,000	\$200,000	OTHER	4	4	1	Site air monitoring during Hazard Abatement activities
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	0	0	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	4	MO	\$300,000	\$1,200,000	HISTORICAL	0	0	1	Hazard Abatement Labor, Storage Gallery (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	55	Ton	\$69.70	\$3,834	OTHER	0	0	1	Storage Gallery demo prep waste disposal assumed LLW/MLLW
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	0	0	1	Hazard Abatement Labor, Sample Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	10	MO	\$300,000.00	\$3,000,000	HISTORICAL	1	1	1	Hazard Abatement Labor, Sample Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	188	Ton	\$69.70	\$13,104	OTHER	1	1	1	Sample Galleries Hazard Abatement waste disposal. Assumed LLW/MLLW.
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000.00	\$600,000	HISTORICAL	1	1	1	Hazard Abatement Labor, Pipe & Operating Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	10	MO	\$300,000	\$3,000,000	HISTORICAL	2	2	1	Hazard Abatement Labor, Pipe & Operating Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	356	Ton	\$69.70	\$24,813	OTHER	2	2	1	Pipe & Operating Galleries Hazard Abatement waste disposal. Assumed LLW/MLLW.
2	202-A	Treatment and Disposal	817 ERDF Waste Treatment	60	Ton	\$11.28	\$677	OTHER	2	2	1	ERDF cost for treatment/stabilization of waste.

Table A-1. Alternative 2 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	2	2	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	2	2	1	Demo Prep Labor, N Cell (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	12	MO	\$300,000.00	\$3,600,000	HISTORICAL	3	3	1	Demo Prep Labor, N Cell (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	10	MO	\$300,000	\$3,000,000	HISTORICAL	4	4	1	Demo Prep Labor, N Cell (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	810 ERDF WF	400	CM	\$1,963	\$785,128	OTHER	4	4	1	Storage cost for N Cell TRU waste, not including treatment
2	202-A	Treatment and Disposal	850 TRU Waste Treatment / Repackaging	400	CM	\$38,000	\$15,200,000	OTHER	4	4	1	Treatment Cost for N Cell TRU waste
2	202-A	Document Preparation	1057 On-Scene Coordinator Report - Final	1	EA	\$100,000	\$100,000	OTHER	4	4	1	Closure report following cleanout of N Cell
2	202-A	Treatment and Disposal	819 ERDF Waste Transportation	47	Load	\$90.00	\$4,230.00	OTHER	4	4	1	Transportation cost for all LLW/MLLW waste generated during hazard abatement activities. Assumed waste disposal at ERDF
<b>Alternative 2 Capital Cost Markups</b>												
Subtotal with MDBI						\$53,747,964						
Contractors Overhead					15%	\$5,191,195		Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.				
Contractors Profit					10%	\$3,460,796		Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.				
Subtotal with OH&P						\$62,399,955						
Washington State Sales Tax					8.6%	\$667,403		Applied to 30% of Subtotal with Subcontractor OH&P, excluding lines items designated as 100% labor				
Subtotal with Sales Tax						\$63,067,358						
Scope Contingency					25%	\$15,766,839		As per EPA 540-R-00-002, Exhibit 5-7				
Bid Contingency					20%	\$12,613,472						
Subtotal with Contingency						\$91,447,669						
Project Management					5%	\$4,572,383		As per EPA 540-R-00-002, Exhibit 5-8				
Remedial Design					6%	\$5,486,860		As per EPA 540-R-00-002, Exhibit 5-8				
Construction Management					6%	\$5,486,860		As per EPA 540-R-00-002, Exhibit 5-8				
Subtotal						\$106,993,772						
CHPRC DD/G&A					20%	\$21,398,754		CHPRC FY 2016 Rates-Multipliers				
Total Capital Costs						\$128,392,526		Total Capital Costs				
<b>Total Non-discounted</b>						<b>\$129,770,820</b>		<b>Total Non-Discounted Value of Capital Cost</b>				
<b>Total Present Value</b>						<b>\$124,545,494</b>		<b>Total Present Value of Capital Costs</b>				

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A19), respectively. Costs calculated using displayed values may vary from results found in this table due to rounding. Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

### **A3 Operations and Maintenance Estimate for Alternative 2**

All O&M items for Alternative 2 are found in Table A-2. These items include all annual and periodic costs to occur under the Alternative 2 removal action as described in DOE/RL-2016-15. Table A-2 also includes a summary of all markups, taxes, and contingencies applied to Alternative 2 annual and periodic costs.

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Table A-2. Operations and Maintenance Cost Estimate for Alternative 2

Annual O&M Cost												
Site	Site Name	WBS			Unit	Cost	Subtotal	Unit Source	Start Year	End Year	Interval	Notes
		Top Tier	Description	Qty								
1	PUREX Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Facility Maintenance	1102 Bathroom Trailer	1	YR	\$30,000	\$30,000	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Annual Surveillance	800 Surveillance and Maintenance Program	1	YR	\$375,000	\$375,000	Historical	0	25	1	Annual facility surveillance activities.
Periodic O&M Cost												
1	PUREX Complex	Hazard Abatement	1104 Hazard Abatement Allowance	1	EA	\$1,500,000	\$1,500,000	Other	0	25	5	Periodic Hazard Abatement allowance to mitigate hazards discovered during work activities.
1	PUREX Complex	Document Preparation	954 On-Scene Coordinator Report - Final	1	EA	\$100,000	\$100,000	Other	25	25	1	Final summary report following completion of all removal action activities.
Alternative 2 Annual O&M Markups												
<b>Subtotal with MDBI</b>						<b>\$469,800</b>						
Contractors Overhead		15%				\$70,470			Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.			
Contractors Profit		10%				\$46,980			Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.			
<b>Subtotal with OH&amp;P</b>						<b>\$587,250</b>						
Washington State Sales Tax		8.6%				\$12,094			Applied to 30% of subtotal with Subcontractor OH&P, excluding line items designated as 100% labor.			
<b>Subtotal with Sales Tax</b>						<b>\$599,344</b>						
O&M Contingency		50%				\$299,672						
<b>Subtotal with Contingency</b>						<b>\$899,016</b>						
Technical Support Services		29.76%				\$267,517			Percentage for Technical Support Services varies for each line item and ranges from 26% to 45%. Percentage presented is weighted average for all annual O&M items.			
<b>Subtotal</b>						<b>\$1,166,533</b>						
CHPRC DD/G&A		20%				\$233,306			CHPRC FY 2016 Rates-Multipliers			
Cost Per Year						\$1,399,839			Total Annual Capital Costs			
<b>Total Non-discounted</b>						<b>\$36,395,804</b>			<b>Total Non-Discounted Value of Annual O&amp;M Costs</b>			
<b>Total Present Value</b>						<b>\$30,407,972</b>			<b>Total Present Value of Annual O&amp;M Costs</b>			
Alternative 2 Periodic O&M Markups												
<b>Subtotal with MDBI</b>						<b>\$9,949,781</b>						
Contractors Overhead		15%				\$1,492,467			Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.			
Contractors Profit		10%				\$994,978			Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.			
<b>Subtotal with OH&amp;P</b>						<b>\$12,437,226</b>						
Washington State Sales Tax		8.6%				\$320,880			Applied to 30% of subtotal with Subcontractor OH&P, excluding line items designated as 100% labor.			

<b>Alternative 2 Periodic O&amp;M Markups</b>			
<b>Subtotal with Sales Tax</b>		<b>\$12,758,107</b>	
O&M Contingency	50%	\$6,379,053	
<b>Subtotal with Contingency</b>		<b>\$19,137,160</b>	
Technical Support Services	19.88%	\$3,803,513	Percentage for Technical Support Services varies for each line item and ranges from 19% to 33%. Percentage presented is weighted average for all periodic O&M items.
Subtotal		\$22,940,673	
CHPRC DD/G&A	20%	\$4,588,132	CHPRC FY 2016 Rates-Multipliers
<b>Total Non-discounted</b>		<b>\$27,528,805</b>	<b>Total Non-Discounted Value of Periodic O&amp;M Costs</b>
<b>Total Present Value</b>		<b>\$22,989,592</b>	<b>Total Present Value of Periodic O&amp;M Costs</b>

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A19), respectively.

Costs calculated using displayed values may vary from results found in this table due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

## A4 Total Present Value Estimate for Alternative 2

Total present value for all capital costs and annual and periodic O&M costs for Alternative 2 are found in Table A-3. This summary table provides the total present value for all costs associated with Alternative 2 as well as the -30/+50% expected accuracy range for this alternative.

**Table A-3. Alternative 2 Total Present Value**

Capital Costs	\$124.5 M	Total Present Value of Capital Costs
Annual O&M Costs	\$30.4 M	Total Present Value of Annual O&M Activities
Periodic O&M Costs	\$23.0 M	Total Present Value of Periodic O&M Activities
Alternative 2 Total Present Value	\$177.9 M	Total Present Value of Alternative 2
Expected Accuracy Range for Total Present Value is -30% to +50%		
-30%		\$124.6 M
+50%		\$266.9 M

Note: Costs calculated using displayed values may vary from results found in this table due to rounding  
 Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

### **A5 Capital Cost Estimate for Alternative 3**

The capital cost line items for Alternative 3 are found in Table A-4. These line items include all activities to occur under the Alternative 3 removal action, as described in DOE/RL-2016-15. Table A-4 also includes a summary of all markups, taxes, and contingencies applied to Alternative 3 capital costs.

Alternative 3			
Location:	PUREX Complex	Base Year:	2017
Phase:	EE/CA	Date:	9/12/2016
Description:	Alternative 2 plus: Demo Prep of Annex		

Table A-4. Alternative 3 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
1	PUREX Complex	Mob/Demob; Temp. Utilities and Facilities	01 Site Preparation	1	LS	\$1,500,000	\$1,500,000	OTHER	0	0	1	Secure site; power connections; set up work zones and equipment & waste areas; set up temporary facilities and utilities.
1	PUREX Complex	Facility Modification or Upgrade	60 Ventilation System Modification	1	LS	\$10,000,000	\$10,000,000	OTHER	0	0	1	Budget allowance for bringing ventilation system into compliance for proposed work activities
1	PUREX Complex	Facility Modification or Upgrade	62 Life Safety Updates	1	LS	\$1,500,000	\$1,500,000	OTHER	0	0	1	Updates to facility to bring into compliance with life safety requirements of DSA and FHA documents
1	PUREX Complex	Document Preparation	1051 DSA / FHA Review and Update	1	EA	\$100,000	\$100,000	OTHER	0	0	1	Updates to life safety documentation in response to facility modifications
1	PUREX Complex	Monitoring, Testing, Sampling and Analysis	650 Characterization Sampling	290	EA	\$5,000	\$1,450,000	OTHER	0	0	1	Characterization sampling campaign throughout PUREX Canyon Building to identify contaminants of concern and associated concentrations prior to hazard abatement activities
1	PUREX Complex	Monitoring, Testing, Sampling and Analysis	801 Work Crew, Interior Specialized	6	MO	\$300,000	\$1,800,000	HISTORICAL	0	0	1	Characterization sampling campaign labor
1	PUREX Complex	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	6	MO	\$20,000	\$120,000	OTHER	0	0	1	Site air monitoring during characterization sampling activities
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	6	MO	\$20,000	\$120,000	OTHER	0	0	1	Site air monitoring during Hazard Abatement activities
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	12	MO	\$20,000	\$240,000	OTHER	1	3	1	Site air monitoring during Hazard Abatement activities
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	10	MO	\$20,000	\$200,000	OTHER	4	4	1	Site air monitoring during Hazard Abatement activities
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	0	0	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	4	MO	\$300,000	\$1,200,000	HISTORICAL	0	0	1	Hazard Abatement Labor, Storage Gallery (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	55	Ton	\$69.70	\$3,834	OTHER	0	0	1	Storage Gallery Hazard Abatement waste disposal assumed LLW/MLLW
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	0	0	1	Hazard Abatement Labor, Sample Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	10	MO	\$300,000	\$3,000,000	HISTORICAL	1	1	1	Hazard Abatement Labor, Sample Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	188	Ton	\$69.70	\$13,104	OTHER	1	1	1	Sample Galleries Hazard Abatement waste disposal. Assumed LLW/MLLW.
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	1	1	1	Hazard Abatement Labor, Pipe & Operating Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	10	MO	\$300,000	\$3,000,000	HISTORICAL	2	2	1	Hazard Abatement Labor, Pipe & Operating Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	356	Ton	\$69.70	\$24,813	OTHER	2	2	1	Pipe & Operating Galleries Hazard Abatement waste disposal. Assumed LLW/MLLW.

Table A-4. Alternative 3 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
2	202-A	Treatment and Disposal	817 ERDF Waste Treatment	60	Ton	\$11.28	\$677	OTHER	2	2	1	ERDF cost for treatment/stabilization of waste.
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	2	2	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	2	2	1	Demo Prep Labor, N Cell (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	12	MO	\$300,000	\$3,600,000	HISTORICAL	3	3	1	Demo Prep Labor, N Cell (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	10	MO	\$300,000	\$3,000,000	HISTORICAL	4	4	1	Demo Prep Labor, N Cell (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	810 ERDF WF	400	CM	\$1,963	\$785,128	OTHER	4	4	1	Storage cost for N Cell TRU waste, not including treatment
2	202-A	Treatment and Disposal	850 TRU Waste Treatment / Repackaging	400	CM	\$38,000	\$15,200,000	OTHER	4	4	1	Treatment Cost for N Cell TRU waste
2	202-A	Document Preparation	1057 On-Scene Coordinator Report - Final	1	EA	\$100,000	\$100,000	OTHER	4	4	1	Closure report following cleanout of N Cell
2	202-A	Treatment and Disposal	819 ERDF Waste Transportation	47	Load	\$90	\$4,230	OTHER	4	4	1	Transportation cost for all LLW/MLLW waste generated during hazard abatement activities. Assumed waste disposal at ERDF
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	2	MO	\$20,000	\$40,000	OTHER	4	4	1	Site air monitoring during demo prep activities within 202-A Annex areas
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	12	MO	\$20,000	\$240,000	OTHER	5	5	1	Site air monitoring during demo prep activities within 202-A Annex areas
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	4	MO	\$20,000	\$80,000	OTHER	6	6	1	Site air monitoring during demo prep activities within 202-A Annex areas
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	4	4	1	Demo Prep Labor, 202-A Annex areas (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	12	MO	\$300,000	\$3,600,000	HISTORICAL	5	5	1	Demo Prep Labor, 202-A Annex areas (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	4	MO	\$300,000	\$1,200,000	HISTORICAL	6	6	1	Demo Prep Labor, 202-A Annex areas (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	2088	Ton	\$69.70	\$145,534	OTHER	6	6	1	Annex areas Demo Prep waste disposal. Assumed LLW/MLLW
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	6	6	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Treatment and Disposal	817 ERDF Waste Treatment	209	Ton	\$11.28	\$2,358	OTHER	6	6	1	ERDF cost for treatment/stabilization of waste. Assumed 10% of total waste requires treatment.
2	202-A	Treatment and Disposal	819 ERDF Waste Transportation	161	Load	\$90	\$14,490	OTHER	6	6	1	Transportation cost for all LLW/MLLW waste generated during demo prep activities within 202-A annex areas. Assumed waste disposal at ERDF

<b>Alternative 3 Capital Cost Markups</b>			
<b>Subtotal with MDBI</b>		<b>\$60,317,583</b>	
Contractors Overhead	15%	\$5,285,637	Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.
Contractors Profit	10%	\$3,523,758	Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.
<b>Subtotal with OH&amp;P</b>		<b>\$69,126,978</b>	
WA State Sales Tax	8.6%	\$681,948	Applied to 30% of Subtotal w/ Subcontractor OH&P, excluding line items designated as 100% labor
<b>Subtotal</b>		<b>\$69,808,926</b>	
Scope Contingency	25%	\$17,452,232	As per EPA 540-R-00-002, Exhibit 5-7
Bid Contingency	20%	\$13,961,785	
<b>Subtotal with Contingency</b>		<b>\$101,222,943</b>	
Project Management	5%	\$5,061,147	As per EPA 540-R-00-002, Exhibit 5-8
Remedial Design	6%	\$6,073,377	As per EPA 540-R-00-002, Exhibit 5-8
Construction Management	6%	\$6,073,377	As per EPA 540-R-00-002, Exhibit 5-8
<b>Subtotal</b>		<b>\$118,430,844</b>	
CHPRC DD/G&A	20%	\$23,686,169	CHPRC FY 2016 Rates-Multipliers
Total Capital Cost		\$142,117,012	Total Capital Cost
<b>Total Non-discounted</b>		<b>\$143,495,306</b>	<b>Total Non-Discounted Value of Capital Cost</b>
<b>Total Present Value</b>		<b>\$137,160,989</b>	<b>Total Present Value of Capital Costs</b>

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A19), respectively.

Costs calculated using displayed values may vary from results found in this table due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

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## **A6 Operations and Maintenance Estimate for Alternative 3**

All O&M items for Alternative 3 are found in Table A-5. These items include all annual and periodic costs to occur under the Alternative 3 removal action as described in DOE/RL-2016-15. Table A-5 also includes a summary of all markups, taxes, and contingencies applied to Alternative 3 annual and periodic costs.

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Table A-5. Operations and Maintenance Cost Estimate for Alternative 3

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Cost	Subtotal	Unit Source	Start Year	End Year	Interval	Notes
<b>Annual O&amp;M Cost</b>												
1	PUREX Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Facility Maintenance	1102 Bathroom Trailer	1	YR	\$30,000	\$30,000	Historical	0	25	1	Annual rental and maintenance.
1	PUREX Complex	Annual Surveillance	800 Surveillance and Maintenance Program	1	YR	\$375,000	\$375,000	Historical	0	25	1	Annual facility surveillance activities.
<b>Periodic O&amp;M Cost</b>												
1	PUREX Complex	Hazard Abatement	1104 Hazard Abatement Allowance	1	EA	\$1,500,000	\$1,500,000	Other	0	25	5	Periodic Hazard Abatement allowance to mitigate hazards discovered during work activities.
1	PUREX Complex	Document Preparation	954 On-Scene Coordinator Report - Final	1	EA	\$100,000	\$100,000	Other	25	25	1	Final summary report following completion of all removal action activities.
<b>Alternative 3 Annual O&amp;M Markups</b>												
Subtotal with MDBI						\$469,800						
Contractors Overhead					15%	\$70,470			Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.			
Contractors Profit					10%	\$46,980			Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.			
Subtotal with OH&P						\$587,250						
Washington State Sales Tax					8.60%	\$12,094			Applied to 30% of subtotal with Subcontractor OH&P, excluding line items designated as 100% labor.			
Subtotal with Sales Tax						\$599,344						
O&M Contingency					50%	\$299,672						
Subtotal with Contingency						\$899,016						
Technical Support Services					29.76%	\$267,517			Percentage for Technical Support Services varies for each line item and ranges from 26% to 45%. Percentage presented is weighted average for all annual O&M items.			
Subtotal						\$1,166,532						
CHPRC DD/G&A					20%	\$233,306			CHPRC FY 2016 Rates-Multipliers			
Cost Per Year						\$1,399,839			Total Annual Capital Costs			
<b>Total Non-discounted</b>						<b>\$36,395,804</b>			<b>Total Non-Discounted Value of Annual O&amp;M Costs</b>			
<b>Total Present Value</b>						<b>\$30,407,972</b>			<b>Total Present Value of Annual O&amp;M Costs</b>			
<b>Alternative 3 Periodic O&amp;M Markups</b>												
Subtotal with MDBI						\$9,949,781						
Contractors Overhead					15%	\$1,492,467			Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.			
Contractors Profit					10%	\$994,978			Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.			
Subtotal with OH&P						\$12,437,226						
Washington State Sales Tax					8.60%	\$320,880			Applied to 30% of subtotal with Subcontractor OH&P, excluding line items designated as 100% labor.			
Subtotal with Sales Tax						\$12,758,107						
O&M Contingency					50%	\$6,379,053						
Subtotal with Contingency						\$19,137,160						

<b>Alternative 3 Periodic O&amp;M Markups</b>			
Technical Support Services	19.88%	\$3,803,513	Percentage for Technical Support Services varies for each line item and ranges from 19% to 33%. Percentage presented is weighted average for all periodic O&M items.
Subtotal		\$22,940,673	
CHPRC DD/G&A	20%	\$4,588,132	CHPRC FY 2016 Rates-Multipliers
<b>Total Non-discounted</b>		<b>\$27,528,805</b>	<b>Total Non-Discounted Value of Periodic O&amp;M Costs</b>
<b>Total Present Value</b>		<b>\$22,989,592</b>	<b>Total Present Value of Periodic O&amp;M Costs</b>

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A19), respectively.

Costs calculated using displayed values may vary from results found in this table due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

### A7 Total Present Value Estimate for Alternative 3

Total present value for all capital costs and annual and periodic O&M costs for Alternative 3 are found in Table A-6. This summary table provides the total present value for all costs associated with Alternative 3 as well as the -30/+50% expected accuracy range for this alternative.

**Table A-6. Alternative 3 Total Present Value**

Capital Costs	\$137.2 M	Total Present Value of Capital Costs
Annual O&M Costs	\$30.4 M	Total Present Value of Annual O&M Activities
Periodic O&M Costs	\$23.0 M	Total Present Value of Periodic O&M Activities
Alternative 3 Total Present Value	\$190.6 M	Total Present Value of Alternative 3
Expected Accuracy Range for Total Present Value is -30% to +50%		
-30%		\$133.4 M
+50%		\$285.8 M

Note: Costs calculated using displayed values may vary from results found in this table due to rounding.  
 Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

## **A8 Capital Cost Estimate for Alternative 4**

The capital cost line items for Alternative 4 are found in Table A-7. These line items include all activities to occur under the Alternative 4 removal action as described in DOE/RL-2016-15. Table A-7 also includes a summary of all markups, taxes, and contingencies applied to Alternative 4 capital costs.

Alternative 4			
Location:	PUREX Complex	Base Year:	2017
Phase:	EE/CA	Date:	9/12/2016
Description:	Alternative 3 plus: Demolition of Annex, Demo Prep of 202A Abovegrade Areas		

Table A-7. Alternative 4 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
1	PUREX Complex	Mob/Demob; Temp. Utilities and Facilities	01 Site Preparation	1	LS	\$1,500,000	\$1,500,000	OTHER	0	0	1	Secure site; power connections; set up work zones and equipment & waste areas; set up temporary facilities and utilities.
1	PUREX Complex	Facility Modification or Upgrade	60 Ventilation System Modification	1	LS	\$10,000,000	\$10,000,000	OTHER	0	0	1	Budget allowance for bringing ventilation system into compliance for proposed work activities
1	PUREX Complex	Facility Modification or Upgrade	62 Life Safety Updates	1	LS	\$1,500,000	\$1,500,000	OTHER	0	0	1	Updates to facility to bring into compliance with life safety requirements of DSA and FHA documents
1	PUREX Complex	Document Preparation	1051 DSA / FHA Review and Update	1	EA	\$100,000	\$100,000	OTHER	0	0	1	Updates to life safety documentation in response to facility modifications
1	PUREX Complex	Monitoring, Testing, Sampling and Analysis	650 Characterization Sampling	290	EA	\$5,000	\$1,450,000	OTHER	0	0	1	Characterization sampling campaign throughout PUREX Canyon Building to identify contaminants of concern and associated concentrations prior to hazard abatement activities
1	PUREX Complex	Monitoring, Testing, Sampling and Analysis	801 Work Crew, Interior Specialized	6	MO	\$300,000	\$1,800,000	HISTORICAL	0	0	1	Characterization sampling campaign labor
1	PUREX Complex	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	6	MO	\$20,000	\$120,000	OTHER	0	0	1	Site air monitoring during characterization sampling activities
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	6	MO	\$20,000	\$120,000	OTHER	0	0	1	Site air monitoring during Hazard Abatement activities
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	12	MO	\$20,000	\$240,000	OTHER	1	3	1	Site air monitoring during Hazard Abatement activities
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	10	MO	\$20,000	\$200,000	OTHER	4	4	1	Site air monitoring during Hazard Abatement activities
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	0	0	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	4	MO	\$300,000	\$1,200,000	HISTORICAL	0	0	1	Hazard Abatement Labor, Storage Gallery (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	55	Ton	\$69.70	\$3,834	OTHER	0	0	1	Storage Gallery Hazard Abatement waste disposal assumed LLW/MLLW
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	0	0	1	Hazard Abatement Labor, Sample Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	10	MO	\$300,000	\$3,000,000	HISTORICAL	1	1	1	Hazard Abatement Labor, Sample Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	188	Ton	\$69.70	\$13,104	OTHER	1	1	1	Sample Galleries Hazard Abatement waste disposal. Assumed LLW/MLLW.
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	1	1	1	Hazard Abatement Labor, Pipe & Operating Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	10	MO	\$300,000	\$3,000,000	HISTORICAL	2	2	1	Hazard Abatement Labor, Pipe & Operating Galleries (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	356	Ton	\$69.70	\$24,813	OTHER	2	2	1	Pipe & Operating Galleries Hazard Abatement waste disposal. Assumed LLW/MLLW.

Table A-7. Alternative 4 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End Year	Interval	Notes
2	202-A	Treatment and Disposal	817 ERDF Waste Treatment	60	Ton	\$11.28	\$677	OTHER	2	2	1	ERDF cost for treatment/stabilization of waste.
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	2	2	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	2	2	1	Demo Prep Labor, N Cell (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	12	MO	\$300,000	\$3,600,000	HISTORICAL	3	3	1	Demo Prep Labor, N Cell (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	10	MO	\$300,000	\$3,000,000	HISTORICAL	4	4	1	Demo Prep Labor, N Cell (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	810 ERDF WF	400	CM	\$1,963	\$785,128	OTHER	4	4	1	Storage cost for N Cell TRU waste, not including treatment
2	202-A	Treatment and Disposal	850 TRU Waste Treatment / Repackaging	400	CM	\$38,000	\$15,200,000	OTHER	4	4	1	Treatment Cost for N Cell TRU waste
2	202-A	Document Preparation	1057 On-Scene Coordinator Report - Final	1	EA	\$100,000	\$100,000	OTHER	4	4	1	Closure report following cleanout of N Cell
2	202-A	Treatment and Disposal	819 ERDF Waste Transportation	47	Load	\$90	\$4,230	OTHER	4	4	1	Transportation cost for all LLW/MLLW waste generated during hazard abatement activities. Assumed waste disposal at ERDF
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	2	MO	\$20,000	\$40,000	OTHER	4	4	1	Site air monitoring during demo prep activities within 202-A Annex areas
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	12	MO	\$20,000	\$240,000	OTHER	5	5	1	Site air monitoring during demo prep activities within 202-A Annex areas
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	4	MO	\$20,000	\$80,000	OTHER	6	6	1	Site air monitoring during demo prep activities within 202-A Annex areas
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	2	MO	\$300,000	\$600,000	HISTORICAL	4	4	1	Demo Prep Labor, 202-A Annex areas (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	12	MO	\$300,000	\$3,600,000	HISTORICAL	5	5	1	Demo Prep Labor, 202-A Annex areas (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	4	MO	\$300,000	\$1,200,000	HISTORICAL	6	6	1	Demo Prep Labor, 202-A Annex areas (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	2088	Ton	\$69.70	\$145,534	OTHER	6	6	1	Annex areas Demo Prep waste disposal. Assumed LLW/MLLW
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	6	6	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Treatment and Disposal	817 ERDF Waste Treatment	209	Ton	\$11.28	\$2,358	OTHER	6	6	1	ERDF cost for treatment/stabilization of waste. Assumed 10% of total waste requires treatment.
2	202-A	Treatment and Disposal	819 ERDF Waste Transportation	161	Load	\$90	\$14,490	OTHER	6	6	1	Transportation cost for all LLW/MLLW waste generated during demo prep activities within 202-A annex areas. Assumed waste disposal at ERDF
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	8	MO	\$20,000	\$160,000	OTHER	6	6	1	Site air monitoring during demolition of 202-A Annex structures
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	4	MO	\$20,000	\$80,000	OTHER	7	7	1	Site air monitoring during demolition of 202-A Annex structures
2	202-A	Document Preparation	1053 Demolition Analysis	1	EA	\$100,000	\$100,000	OTHER	6	6	1	Allowance for design and planning of building removal
2	202-A	Demolition and Removal	803 Work Crew, General D&D	8	MO	\$190,000	\$1,520,000	OTHER	6	6	1	Labor for demolition of Annex structures
2	202-A	Demolition and Removal	803 Work Crew, General D&D	4	MO	\$190,000	\$760,000	OTHER	7	7	1	Labor for demolition of Annex structures

Table A-7. Alternative 4 Capital Costs

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Unit Cost	Subtotal	Source	Start Year	End  Year	Interval	Notes
2	202-A	Treatment and Disposal	811 ERDF WG	1849	Ton	\$69.70	\$128,875	OTHER	7	7	1	Demolition debris disposal, Annex structures. Disposed as LLW/MLLW
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	7	7	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Treatment and Disposal	817 ERDF Waste Treatment	185	Ton	\$11.28	\$2,086	OTHER	7	7	1	ERDF cost for treatment/stabilization of waste. Assumed 10% of total waste requires treatment.
2	202-A	Treatment and Disposal	819 ERDF Waste Transportation	143	Load	\$90	\$12,870	OTHER	7	7	1	Transportation cost for all LLW/MLLW waste generated during demolition of annex structures. Assumed waste disposal at ERDF
2	202-A	Demolition and Removal	1059 Backfill and Compaction	1377	ECY	\$5	\$6,883	OTHER	7	7	1	Cost for Backfilling of AMU Basement
2	202-A	Document Preparation	1057 On-Scene Coordinator Report - Final	1	EA	\$100,000	\$100,000	OTHER	7	7	1	Site Closeout Report for demo of Annex Structure in support of closure plan for AMU TK-156
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	8	MO	\$20,000	\$160,000	OTHER	7	7	1	Site air monitoring during demo prep activities within 202-A above grade areas
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	12	MO	\$20,000	\$240,000	OTHER	8	8	1	Site air monitoring during demo prep activities within 202-A above grade areas
2	202-A	Monitoring, Testing, Sampling and Analysis	662 Site Air Monitoring	10	MO	\$20,000	\$200,000	OTHER	9	9	1	Site air monitoring during demo prep activities within 202-A Canyon Deck
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	8	MO	\$300,000	\$2,400,000	HISTORICAL	7	7	1	Demo Prep Labor, 202-A above grade areas (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	12	MO	\$300,000	\$3,600,000	HISTORICAL	8	8	1	Demo Prep Labor, 202-A above grade areas (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	4	MO	\$300,000	\$1,200,000	HISTORICAL	9	9	1	Demo Prep Labor, 202-A above grade areas (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	563	Ton	\$69.70	\$39,241	OTHER	9	9	1	202-A above grade areas Demo Prep waste disposal. Assumed LLW/MLLW
2	202-A	Demolition and Removal	801 Work Crew, Interior Specialized	6	MO	\$300,000	\$1,800,000	HISTORICAL	9	9	1	Demo Prep Labor, 202-A Canyon Deck (includes 20 FTE, materials, taxes and licenses, and G&A)
2	202-A	Treatment and Disposal	811 ERDF WG	8	Ton	\$69.70	\$558	OTHER	9	9	1	202-A Canyon Deck Demo Prep waste disposal. Assumed LLW/MLLW
2	202-A	Monitoring, Testing, Sampling and Analysis	656 Miscellaneous Sampling and Analysis (non-soil)	1	LS	\$50,000	\$50,000	OTHER	9	9	1	Allowance for sampling of debris prior to disposal in ERDF
2	202-A	Treatment and Disposal	817 ERDF Waste Treatment	58	Ton	\$11.28	\$654	OTHER	9	9	1	ERDF cost for treatment/stabilization of waste. Assumed 10% of total waste requires treatment.
2	202-A	Treatment and Disposal	819 ERDF Waste Transportation	44	Load	\$90	\$3,960	OTHER	9	9	1	Transportation cost for all LLW/MLLW waste generated during demo prep activities within 202-A above grade areas. Assumed waste disposal at ERDF

<b>Alternative 4 Capital Cost Markups</b>			
<b>Subtotal w/ MDBI</b>		<b>\$74,194,222</b>	
Contractors Overhead	15%	\$5,882,133	Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.
Contractors Profit	10%	\$3,921,422	Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.
<b>Subtotal w/ OH&amp;P</b>		<b>\$83,997,777</b>	
WA State Sales Tax	8.6%	\$804,086	Applied to 30% of Subtotal w/ Subcontractor OH&P, excluding line items designated as 100% labor
<b>Subtotal</b>		<b>\$84,801,863</b>	
Scope Contingency	25%	\$21,200,466	As per EPA 540-R-00-002, Exhibit 5-7
Bid Contingency	20%	\$16,960,373	
<b>Subtotal with Contingency</b>		<b>\$122,962,702</b>	
Project Management	5%	\$6,148,135	As per EPA 540-R-00-002, Exhibit 5-8
Remedial Design	6%	\$7,377,762	As per EPA 540-R-00-002, Exhibit 5-8
Construction Management	6%	\$7,377,762	As per EPA 540-R-00-002, Exhibit 5-8
<b>Subtotal</b>		<b>\$143,866,361</b>	
CHPRC DD/G&A	20%	\$28,773,273	CHPRC FY 2016 Rates-Multipliers
Total Capital Cost		\$172,639,636	Total Capital Cost
<b>Total Non-discounted</b>		<b>\$174,017,930</b>	<b>Total Non-Discounted Value of Capital Cost</b>
<b>Total Present Value</b>		<b>\$164,287,167</b>	<b>Total Present Value of Capital Costs</b>

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A19), respectively.

Costs calculated using displayed values may vary from results found in this table due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

## A9 Operations and Maintenance Estimate for Alternative 4

All O&M items for Alternative 4 are found in Table A-8. These items include all annual and periodic costs to occur under the Alternative 4 removal action as described in DOE/RL-2016-15. Table A-8 also includes a summary of all markups, taxes, and contingencies applied to Alternative 4 annual and periodic costs.

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Table A-8. Operations and Maintenance Cost Estimate for Alternative 4

Site	Site Name	WBS Top Tier	Description	Qty	Unit	Cost	Subtotal	Unit Source	Start Year	End Year	Interval	Notes
<b>Annual O&amp;M Cost</b>												
1	PUREX Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance
1	PUREX Complex	Facility Maintenance	1100 Single Wide Trailer	1	YR	\$12,000	\$12,000	Historical	0	25	1	Annual rental and maintenance
1	PUREX Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance
1	PUREX Complex	Facility Maintenance	1101 Double Wide Trailer	1	YR	\$20,400	\$20,400	Historical	0	25	1	Annual rental and maintenance
1	PUREX Complex	Facility Maintenance	1102 Bathroom Trailer	1	YR	\$30,000	\$30,000	Historical	0	25	1	Annual rental and maintenance
1	PUREX Complex	Annual Surveillance	800 Surveillance and Maintenance Program	1	YR	\$375,000	\$375,000	Historical	0	25	1	Annual facility surveillance activities
<b>Periodic O&amp;M Cost</b>												
1	PUREX Complex	Hazard Abatement	1104 Hazard Abatement Allowance	1	EA	\$1,500,000	\$1,500,000	Other	0	25	5	Periodic Hazard Abatement allowance to mitigate hazards discovered during work activities
1	PUREX Complex	Document Preparation	954 On-Scene Coordinator Report - Final	1	EA	\$100,000	\$100,000	Other	25	25	1	Final summary report following completion of all removal action activities
<b>Alternative 4 Annual O&amp;M Markups</b>												
Subtotal with MDBI						\$469,800						
Contractors Overhead				15%		\$70,470		Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.				
Contractors Profit				10%		\$46,980		Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.				
Subtotal with OH&P						\$587,250						
Washington State Sales Tax				8.60%		\$12,094		Applied to 30% of subtotal with Subcontractor OH&P, excluding line items designated as 100% labor.				
Subtotal with Sales Tax						\$599,344						
O&M Contingency				50%		\$299,672						
Subtotal with Contingency						\$899,016						
Technical Support Services				29.76%		\$267,517		Percentage for Technical Support Services varies for each line item and ranges from 26% to 45%. Percentage presented is weighted average for all annual O&M items.				
Subtotal						\$1,166,532						
CHPRC DD/G&A				20%		\$233,306		CHPRC FY 2016 Rates-Multipliers				
Cost Per Year						\$1,399,839		Total Annual Capital Costs				
<b>Total Non-discounted</b>						<b>\$36,395,804</b>		<b>Total Non-Discounted Value of Annual O&amp;M Costs</b>				
<b>Total Present Value</b>						<b>\$30,407,972</b>		<b>Total Present Value of Annual O&amp;M Costs</b>				
<b>Alternative 4 Periodic O&amp;M Markups</b>												
Subtotal with MDBI						\$9,949,781						
Contractors Overhead				15%		\$1,492,467		Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.				
Contractors Profit				10%		\$994,978		Per R.S. Means, 2010, <i>Building Construction Cost Data</i> , 68 <sup>th</sup> annual edition. Excludes line items with OH&P already included.				
Subtotal with OH&P						\$12,437,226						
Washington State Sales Tax				8.60%		\$320,880		Applied to 30% of subtotal with Subcontractor OH&P, excluding line items designated as 100% labor.				
Subtotal with Sales Tax						\$12,758,107						
O&M Contingency				50%		\$6,379,053						
Subtotal with Contingency						\$19,137,160						
Technical Support Services				19.88%		\$3,803,513		Percentage for Technical Support Services varies for each line item and ranges from 19% to 33%. Percentage presented is weighted average for all periodic O&M items.				
Subtotal						\$22,940,673						
CHPRC DD/G&A				20%		\$4,588,132		CHPRC FY 2016 Rates-Multipliers				

<b>Alternative 4 Periodic O&amp;M Markups</b>			
<b>Total Non-discounted</b>		<b>\$27,528,805</b>	<b>Total Non-Discounted Value of Periodic O&amp;M Costs</b>
<b>Total Present Value</b>		<b>\$22,989,592</b>	<b>Total Present Value of Periodic O&amp;M Costs</b>

Note: Key terms and references used in the tables within this appendix are defined in the Terms list and References section (Section A19), respectively.

Costs calculated using displayed values may vary from results found in this table due to rounding.

Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

## A10 Total Present Value Estimate for Alternative 4

Total present value for all capital costs and annual and periodic O&M costs for Alternative 4 are found in Table A-9. This summary table provides the total present value for all costs associated with Alternative 4 as well as the -30/+50% expected accuracy range for this alternative.

**Table A-9. Alternative 4 Total Present Value**

Capital Costs	\$164.3 M	Total Present Value of Capital Costs
Annual O&M Costs	\$30.4 M	Total Present Value of Annual O&M Activities
Periodic O&M Costs	\$23.0 M	Total Present Value of Periodic O&M Activities
Alternative 4 Total Present Value	\$217.7 M	Total Present Value of Alternative 4
Expected Accuracy Range for Total Present Value is -30% to +50%		
-30%		\$152.4 M
+50%		\$326.5 M

Note: Costs calculated using displayed values may vary from results found in this table due to rounding.  
 Cost estimates are order-of-magnitude with an expected accuracy range of +50%/-30%.

### A11 Project Duration Summary Table

Table A-10 presents the estimated durations for all labor activities to occur within the PUREX Complex, as described in DOE/RL-2016-15.

Table A-10. Estimated Labor Durations

Action	Duration (Months)
<b>Alternative 2</b>	
Characterization Sampling (Interior Specialized Crew)	6
Hazard Abatement of Storage Gallery (Interior Specialized Crew)	4
Hazard Abatement of Sample Gallery (Interior Specialized Crew)	12
Hazard Abatement of Pipe & Operating Gallery (Interior Specialized Crew)	12
Demo Prep of N Cell (Interior Specialized Crew)	24
<b>Alternative 3</b>	
Demo Prep of Annex (Interior Specialized Crew)	18
<b>Alternative 4</b>	
Demolition of Annex (General D&D Crew)	12
Demo Prep of Canyon Deck (Interior Specialized Crew)	6
Demo Prep of above grade areas of 202-A (Interior Specialized Crew)	24

## A12 Interior Specialized Crew Breakdown

Table A-11 presents the cost breakdown for the interior specialized crew proposed for removal actions within the 202-A PUREX Canyon Building. This table presents the total cost for each labor category and proposed monthly usage. In addition to crew labor, this estimate includes materials, subcontractor labor, taxes and licenses, overhead, and general and administrative (G&A) allocations. This information is derived from actual crew data from the Plutonium Finishing Plant for the months of October 2015 and November 2015. The average of these two months are used for this cost estimate.

Table A-11. Interior Specialized Crew Breakdown

Category	Average Monthly Expenses (\$1,000s)	Average Monthly Crew Size (FTE)
0 - Labor and Staff Aug	201.51	
C060 - Millwrights	0.37	0.03
C081 - Plumbers & Pipe (Pipefitter)	16.70	1.64
C121 - Other Crafts (Insulators)	1.64	0.16
M010 - First Line Supervisors	17.93	0.96
R051 - Nuclear Waste Process Operator	28.37	2.28
R052 - Nuclear Waste Process Operator (D&D)	68.77	8.68
R070 - Utilities System Operators	9.25	1.09
T050 - Health Physics Technicians	58.61	5.89
Z030 - Variance Distribution	-0.30	0.00
Z050 - Non-Standard Pay	0.18	0.00
1 - Materials	43.13	
10 - Material and Equipment	42.34	
FR - Freight	0.79	
2 - Subcontractors	5.55	
24 - Taxes and Licenses	5.55	
6 - Overhead Allocations	48.85	
7D - General & Administrative	48.85	
Grand Total	299.04	20.73
Modified Total for Estimate	\$300,000.00	20

## A13 General D&D Crew Breakdown

Table A-12 presents the labor breakdown for the general decontamination and decommissioning (D&D) crew proposed for demolition activities within the PUREX Complex. This table presents the actual crew breakdown for a recent demolition activity at the 200 West “Gypsy Camp”. A similar crew makeup is assumed for this cost estimate. In addition, recent cost estimates for the PUREX facility were used to develop a D&D crew cost. The cost estimate for the PUREX North Closure Plan, ECE-200E15-00003 utilizes a daily crew of 6 personnel, split equally between hot-zone and support personnel. Actual crew breakdown will vary depending on activity but is assumed to utilize personnel similarly to the gypsy camp demolition.

**Table A-12. Actual Crew Breakdown from Gypsy Camp Demolition**

AG00 - Contract Labor	2.42%
C010 – Carpenters	1.34%
C020 – Electricians	0.11%
C121 - Other Crafts-Insulators	3.16%
E040 - Electrical Engineers	0.04%
E070 - Mechanical Engineers	0.07%
E100 - Plant Engineers	0.03%
E120 - Safety Engineers	2.16%
E130 - Other Engineers	1.21%
M010 - First Line Supervisors	13.25%
M020 - Managers & Executives	4.80%
P070 - Planner/Scheduler/Estimator	9.70%
P080 - Health Physicists	0.80%
P090 - Industrial Hygienists	5.45%
P140 - Safeguards & Security Spec	0.06%
P160 - Technical Writer	2.54%
P170 - Other Professionals	0.32%
R051 - Nuclear Waste Process Operator (NCO)	6.92%
R052 - Nuclear Waste Process Operator (D&D)	1.45%
S010 – Chemists	36.37%
S020 - Environmental Scientists	0.33%
T021 - Drafters – Exempt	3.90%
T050 - Health Physics Technicians	0.14%
AG00 - Contract Labor	3.43%
<b>General D&amp;D Cost Breakdown</b>	
Average Daily Cost (Assumed)	\$10,000
Number of Working Days per Month (Assumed)	19
Total Monthly Cost	\$190,000
Crew Expense (70%)	\$133,000
Equipment & Materials Expense (30%)	\$57,000

## A14 Waste Treatment Cost Breakdown

Table A-13 presents the cost breakdown for waste treatment conducted at the Environmental Restoration Disposal Facility (ERDF) prior to disposal of low-level waste or mixed low-level waste (LLW/MLLW).

Table A-13. ERDF Treatment Buildup

<b>ERDF Treatment Buildup</b>	
ERDF Hourly Rate	\$36.66
Production Rate (Hours to Treat One Container)	4
Cost per Container	\$146.64
Average ERDF Load, Tons	13
Treatment Cost per Ton	\$11.28

## A15 Characterization Sampling Buildup

Table A-14 presents the cost breakdown for characterization sampling to be conducted prior to work activities within the 202-A Canyon Building.

Table A-14. PUREX Characterization Sampling Buildup

3 Galleries @ 20 Samples each	60
2 Annex Areas @ 20 samples each	40
West-End Canyon Rooms (5) + Deck + RR Tunnel @ 20 samples each	140
AMU Levels @ 10 Samples each	50
Total Number of Samples	290
Cost for Each Sample	\$5,000
Total Cost	\$1,450,000

## A16 Support Facilities

Table A-15 presents the monthly cost breakdown for support facilities to be installed prior to initial removal activities within the PUREX Complex. Costs provided by CHPRC facilities personnel.

Table A-15. PUREX Support Facilities Buildup

<b>Support Facility</b>	<b>Cost per Facility (Month)</b>
Single Wide Trailers (2)	\$1,000/Month Per Trailer
Double Wide Trailers (2)	\$1,700/Month Per Trailer
Bathroom Trailer (1)	\$2,500/Month Per Trailer

## A17 Capital Unit Cost Summary

Table A-16 presents the unit cost for each line item of this estimate. References for cost sources are included in the Notes/References columns.

Table A-16. Capital Unit Cost

Line Number	Item	Unit Cost	Units	Source	Add Overhead and Profit?	Labor Only?	% of Non-Labor Item to be Taxed	Notes/References
1	Site Preparation	\$1,500,000	LS	Other	Yes	No	30%	CHPRC Project Manager allowance to: secure site; power connections; set up work zones and equipment & waste areas; set up temporary facilities and utilities.
60	Ventilation System Modification	\$10,000,000	LS	Other	Yes	No	30%	CHPRC Project Manager allowance for bringing ventilation system into compliance for proposed work activities
62	Life Safety Updates	\$1,500,000	LS	Other	Yes	No	30%	CHPRC Project Manager allowance for bringing ventilation system into compliance for proposed work activities
650	Characterization Sampling	\$5,000	EA	Other	Yes	No	100%	CHPRC Project Manager Estimate
656	Miscellaneous Sampling and Analysis (non-soil)	\$50,000	LS	Other	Yes	No	30%	CHPRC Project Manager Allowance
659	ERDF Disposal Soil Cost (\$/Sample)	\$497	EA	Historical	Yes	No	30%	Environmental Integration Unit Cost
662	Site Air Monitoring	\$20,000	MO	Other	Yes	No	30%	CHPRC Project Manager Allowance
801	Work Crew, Interior Specialized	\$300,000	MO	Historical	No	No	0%	From Plutonium Finishing Plant Actuals
803	Work Crew, General D&D	\$190,000	MO	Other	Yes	No	30%	Estimator Buildup, assumed 70% labor and 30% equipment and materials

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Table A-16. Capital Unit Cost

Line Number	Item	Unit Cost	Units	Source	Add Overhead and Profit?	Labor Only?	% of Non-Labor Item to be Taxed	Notes/References
810	ERDF WF	\$1,962.82	CM	Other	Yes	No	0%	ERDF Waste Rates 9/30/2015
811	ERDF WG	\$69.70	Ton	Other	Yes	No	0%	ERDF Waste Rates 9/30/2015
817	ERDF Waste Treatment	\$11.28	Ton	Other	Yes	No	0%	Estimator Buildup
819	ERDF Waste Transportation	\$90	Load	Other	Yes	No	0%	Estimator Buildup
850	TRU Waste Treatment/ Repackaging	\$38,000	CM	Other	Yes	No	0%	Fully burdened rate estimate from CHPRC Waste and Fuels Management Project
1051	DSA/FHA Review and Update	\$100,000	EA	Other	Yes	No	30%	CHPRC Project Manager Allowance
1053	Demolition Analysis	\$100,000	EA	Other	Yes	No	30%	CHPRC Project Manager Allowance
1057	On-Scene Coordinator Report - Final	\$100,000	EA	Other	Yes	No	30%	CHPRC Project Manager Allowance
1059	Backfill and Compaction	\$5	ECY	Other	Yes	No	100%	Estimator Allowance

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## A18 O&M Unit Cost Summary

Table A-17 presents the cost breakdown for each O&M line item of this estimate. References for cost sources are included in the Notes/References columns.

Table A-17. O&M Unit Cost Summary

Line Number	Item	Unit Cost	Units	Source	Add Overhead and Profit?	Labor Only?	% of Non-Labor Item to be Taxed	Notes/References
800	Surveillance and Maintenance Program	\$375,000	YR	Historical	Yes	No	30%	Annual surveillance and maintenance program cost for PUREX Complex (2013)
954	On-Scene Coordinator Report - Final	\$100,000	EA	Other	Yes	No	30%	CHPRC PM allowance
1100	Single Wide Trailer	\$12,000	YR	Historical	Yes	No	0%	Yearly rental and operation costs (\$1,000/Mo)
1101	Double Wide Trailer	\$20,400	YR	Historical	Yes	No	0%	Yearly rental and operation costs (\$1,700/Mo)
1102	Bathroom Trailer	\$30,000	YR	Historical	Yes	No	0%	Yearly rental and operation costs (\$2,500/Mo)
1104	Hazard Abatement Allowance	\$1,500,000	EA	Other	Yes	No	30%	CHPRC PM allowance

## A19 References

- DOE/RL-2016-15, 2016, *Engineering Evaluation/Cost Analysis for the PUREX Complex*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.
- ECE-200E15-00003, 2016, *Cost Estimate for the PUREX North Closure Plan*, Draft, CH2M HILL Plateau Remediation Company, Richland, Washington.
- EPA 540-R-00-002, 2000, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, OSWER 9355.0-75, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: [http://yosemite1.epa.gov/ee/epa/ria.nsf/vwAN/S200010.pdf/\\$file/S200010.pdf](http://yosemite1.epa.gov/ee/epa/ria.nsf/vwAN/S200010.pdf/$file/S200010.pdf).
- HSSA, 1984, *Site Stabilization Agreement for All Construction Work for the U.S. Department of Energy at the Hanford Site*, as amended, between J.A. Jones Construction Services Company and Morrison Knudsen Company, Inc., and the Building and Construction Trades Department of the AFL CIO and its affiliated international unions, and the International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America. Available at: <http://www.hanford.gov/pmm/files.cfm/HSSA-05.pdf>.
- Means, R.S., 2010, *Building Construction Cost Data*, 68<sup>th</sup> Annual Edition, R.S. Means, Company Inc., Kingston, Massachusetts.

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