

SPREADSHEET VERIFICATION AND RELEASE FORM	1. SVF SVF-3009 Rev. 00
Prepared For the U.S. Department of Energy, Assistant Secretary for Environmental Management By Washington River Protection Solutions, LLC., PO Box 850, Richland, WA 99352, Contractor For U.S. Department of Energy, Office of River Protection, under Contract DE-AC27-08RV14800	

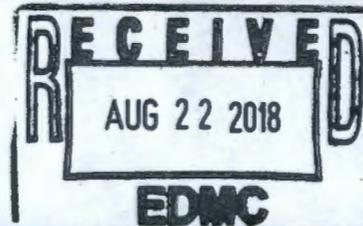
2. CORE INFORMATION			
<b>2a. Spreadsheet Owner</b>	EATON, BRYCE E	<b>2b. Organization</b>	TNK WST INVENTORY & CHARACTZTN
<b>2c. Spreadsheet File Name:</b>	Pu241_Soil_Estimate.xlsx	<b>2d. Version No.</b>	0
<b>2e. HISI ID #</b>	3673		

3. SPREADSHEET FUNCTION AND PURPOSE	
<b>3a. Overall Spreadsheet Function and Purpose:</b>	
Obtain conservative estimate for Plutonium 241 in C-farm soil from the years 2008-2011 by using Best Basis Inventory liquid and solid template values to calculate a conservative range of isotopic ratios for Plutonium 241 using the ratio of Pu-241 to Pu-239/Pu-240. Isotopic ratios calculated from template values are provided for each sample year with the ratios decayed to that specific sample year.	
<b>3b. Reason/Scope for Issue/Revision:</b>	
Requested by Cynthia Tabor of Closure and Corrective Measures for a Plutonium 241 in C-farm vadose soil study.	

4. SPREADSHEET CATEGORY AND GRADING					
<b>4a. Category</b>	<input type="checkbox"/> Safety		<input checked="" type="checkbox"/> Non-Safety		
<b>4b. Grade:</b>	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C	<input checked="" type="checkbox"/> D	<input type="checkbox"/> E
<b>4c. Spreadsheet Use:</b>	<input type="checkbox"/> Multiple-Use		<input checked="" type="checkbox"/> Single Use		

5. APPROVALS			
Title	Printed Name	Signature	Date
Spreadsheet Owner	EATON, BRYCE E	EATON, BRYCE E	09/17/2014
Spreadsheet Verifier:	ANDERSON, MASON A	ANDERSON, MASON A	09/17/2014
Quality Assurance:	SCHAFFER, BRAD	SCHAFFER, BRAD	09/11/2014
Owner's Manager:	BAUNE, HEATHER L	BAUNE, HEATHER L	09/18/2014
LCCB Approval (222-S Only):			

<b>Clearance Approval:</b>		<div style="border: 2px solid red; padding: 10px; width: fit-content; margin: auto;"> <p style="font-weight: bold; color: red; margin: 0;">DATE:</p> <p style="font-weight: bold; color: red; margin: 0;">Sep 22, 2014</p> <div style="border: 1px solid red; padding: 5px; display: inline-block; margin-top: 5px;"> <p style="font-weight: bold; color: red; margin: 0;">HANFORD RELEASE</p> </div> </div>
<b>Restriction Type:</b>		
<input type="checkbox"/> Public <input checked="" type="checkbox"/> Undefined <input type="checkbox"/> Unclassified Controlled Nuclear Information (UCNI) <input type="checkbox"/> Export Control Information (ECI) <input type="checkbox"/> Official Use Only Exemption 2-Circumvention of Statute (OUO-2)	<input type="checkbox"/> Official Use Only Exemption 3-Statutory Exemption (OUO-3) <input type="checkbox"/> Official Use Only Exemption 4-Commercial/Proprietary (OUO-4) <input type="checkbox"/> Official Use Only Exemption 5-Privileged Information (OUO-5) <input type="checkbox"/> Official Use Only Exemption 6-Personal Privacy (OUO-6) <input type="checkbox"/> Official Use Only Exemption 7-Law Enforcement (OUO-7)	
<b>Signature:</b>	<b>Date:</b>	
APPROVED <small>By Tiffany Phillips at 4:21 pm, Sep 22, 2014</small>		
<b>Document Control Release Approval:</b>		
<b>Signature:</b> PHILLIPS, TIFFANY M	<b>Date:</b> 09/22/2014	
<b>Trademark Disclaimer</b>		
Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or any agency thereof or its contractors or subcontractors. Printed in the United States of		



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America.		

6. RELATED DOCUMENTS AND REFERENCES			
<b>6.1 Internal Documents</b>		<input type="checkbox"/> N/A	
Type of Document	Document Number	Rev.	Title
GENERAL DOCUMENTS OR REPORT	RPP-19822	00A	HANFORD DEFINED WASTE MODEL - REVISION 5.0
SPREADSHEET VERIFICATION AND RELEASE FORM	SVF-1261	00	SPREADSHEET VERIFICATION RECORDS FOR SPREADSHEET SOLID BBI TEMPLATE FY 2007.XLS

Please see continuation sheet

<b>6.2 External Documents</b>
N/A Per email 9/22/14 TMP

7. SPREADSHEET DESCRIPTION DOCUMENT		
<b>SDD Doc. No./Rev.</b>	Rev.	<input checked="" type="checkbox"/> N/A - Grade is D, E, or N/A (documentation is provided in Section 8 below)

8. SPREADSHEET DOCUMENTATION FOR GRADES D, E, and N/A	
<input checked="" type="checkbox"/>	- No SDD exists for this spreadsheet and the spreadsheet documentation is provided in section 8 of this SVF.
<b>8a. Alternatives Analysis:</b> Excel <sup>®</sup> was chosen for this application because it is the site standard utility calculation software and will perform the necessary functions.	
<b>8b. Software Management Plan:</b> This SVF serves as the software management plan for the spreadsheet identified in section 2c above. .	
<b>8c. Risk Management Plan:</b> The project risk inherent in the development of utility calculation software applications in grades D (single-use), E, or N/A is small and does not require specific risk management measures.	
<b>8d. Software Configuration Management Plan:</b> The configuration items include this SVF (identified in section 1 above and at the top of each page) and the spreadsheet file named in section 2c on the first page of this SVF. Upon issuance of the completed SVF and the spreadsheet file, they become configuration items that must be controlled. The configuration items will be controlled by requiring the approval of changes before revising the spreadsheet and by documenting the verification of changes using an updated SVF. The configuration status of all approved non-safety spreadsheets is tracked and documented in HISI and in DMCS. Reviews of the status of documentation and spreadsheet file versions may be obtained from either system. Configuration audits and reviews will be accomplished by the verification of the spreadsheet, by a Quality Assurance (QA) review of the spreadsheet documentation, and by the review and approval of the HISI VDD tab. The verification of the spreadsheet determines whether the spreadsheet meets the stated requirements and satisfies the requirement for a functional configuration audit. The QA review of the SVF along with the HISI VDD tab review and approval determines whether the spreadsheet is acceptable for use and satisfies the requirements for a physical configuration audit.	
<b>8e. Purchase Order/Statement of Work:</b>	
<input checked="" type="checkbox"/> N/A	- No third party add-ins or modules were used in this spreadsheet. Excel <sup>®</sup> is available as a site standard from software distribution and no procurement documentation is required.
<input type="checkbox"/> Third Party Software Used?	Purchase Order/SOW Reference:
<b>8f. Software Requirements Specification:</b>	

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The specific requirements that the spreadsheet shall meet are provided in this section.

**1. Unique Spreadsheet Requirements:**

- 1.1. The output of the spreadsheet must obtain conservative estimate for Plutonium 241 in C-farm soil from the years 2008-2011 by using Best Basis Inventory liquid and solid template values to calculate a conservative range of isotopic ratios for Plutonium 241 using the ratio of Pu-241 to Pu-239/Pu-240.

**8g. Requirements Traceability Matrix:** The requirements traceability matrix is provided in Section 9 of this SVF and provides a cross walk between the software requirements, associated test cases, and test results.

**8h. Spreadsheet Design Description:** An overall description of the spreadsheet design is provided below:

To develop a series of isotopic ratio tables that can be used to conservatively estimate the amount of Pu-241 in C-Farm soil between the years 2008-2011. The process history found in the Hanford Defined Waste (HDW) Model was used to estimate the waste types expected to reside in C-Farm and these waste types were compared against liquid and solid BBI template values to develop series of isotopic ratio tables for Pu-241 in C-Farm soil. This spreadsheet will be used as a reference.

All template values were taken from SVF-1261 and SVF-1262 and these tables are included in the final spreadsheet as well as a list describing the waste types found in C-Farm. An isotopic ratio for Pu-241 has been calculated from these template values, and a series of Pu-241 isotopic ratios have been provided and appropriately decayed to each sample year in a separate table using half-lives taken from the Sixteenth Edition of the Chart of the Nuclides; five tables are provided to the user. The following worksheets are found within this spreadsheet.

Pu241 Isotopic Ratio worksheet: Includes a table of extracted BBI template values from waste types in C-Farm. A series of isotopic ratios are calculated from the template values, separated by liquid or solid waste type, and are provided in their own column. A Maximum Ratio is provided that is calculated from the MAX function, A 90<sup>th</sup> % is provided that is calculated from the PERCENTILE function, and a Median Ratio is provided from the MEDIAN function.

Maximum Ratio	5.69E+00
90th %	3.73E+00
Median Ratio	7.34E-01

Equation for estimation of <sup>241</sup>Pu:

$$^{241}\text{Pu}_{\text{conservative}} = \frac{^{238}\text{Pu}_{\text{sample}} \times [^{241}\text{Pu} / (^{238}\text{Pu} + ^{240}\text{Pu})]_{\text{template}}}{1}$$

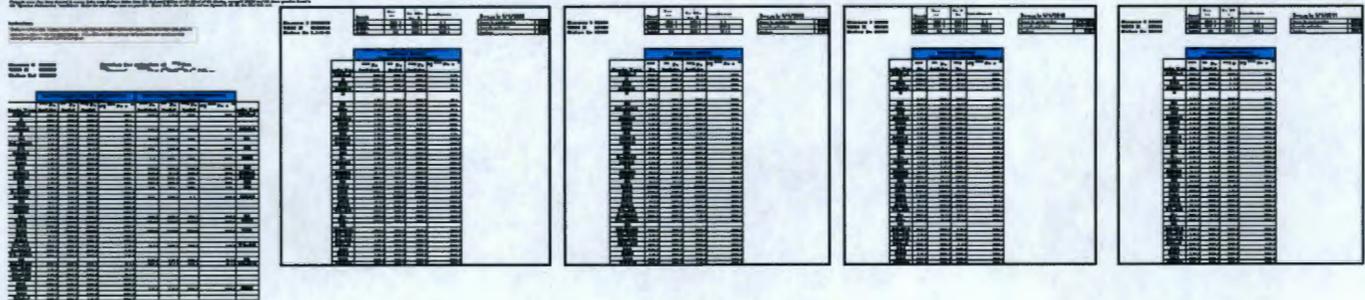
Waste Type	Liquid Template Values (Ranked by Isotopic Ratio) Decayed to 1/1/2001				Solid Template Values (Ranked by Isotopic Ratio) Decayed to 1/1/2001				Waste Type
	<sup>239</sup> Pu (µCi/ml)	<sup>240</sup> Pu (µCi/ml)	<sup>241</sup> Pu (µCi/ml)	<sup>241</sup> Pu / ( <sup>239</sup> Pu + <sup>240</sup> Pu)	<sup>239</sup> Pu (µCi/g)	<sup>240</sup> Pu (µCi/g)	<sup>241</sup> Pu (µCi/g)	<sup>241</sup> Pu / ( <sup>239</sup> Pu + <sup>240</sup> Pu)	
CWZr1	4.84E-03	1.87E-03	3.82E-02	5.69E+00	5.22E-01	2.02E-01	4.12E+00	5.69E+00	CWZr1
B	4.89E-03	1.71E-03	3.23E-02	4.90E+00	-	-	-	-	
PL1	4.89E-03	1.71E-03	3.23E-02	4.90E+00	-	-	-	-	
OWW3	4.89E-03	1.71E-03	3.23E-02	4.90E+00	8.24E-02	2.88E-02	5.45E-01	4.90E+00	OWW3
Z	5.04E-03	1.26E-03	2.03E-02	3.22E+00	-	-	-	-	
BL	5.90E-03	1.51E-03	1.69E-02	2.29E+00	8.97E-01	2.29E-01	2.58E+00	2.29E+00	BL
BY-Sitck	5.04E-03	1.21E-03	1.14E-02	1.82E+00	-	-	-	-	
P2	5.03E-03	1.23E-03	1.10E-02	1.75E+00	2.64E+00	6.48E-01	5.77E+00	1.75E+00	P2
OWW2	5.03E-03	1.23E-03	1.10E-02	1.75E+00	-	-	-	-	
SRR	5.05E-03	1.17E-03	9.92E-03	1.59E+00	5.00E+00	1.16E+00	9.81E+00	1.59E+00	SRR
CSR	5.05E-03	1.17E-03	9.75E-03	1.57E+00	-	-	-	-	
R2	5.05E-03	1.18E-03	8.95E-03	1.44E+00	4.24E-01	9.94E-02	7.53E-01	1.44E+00	R2
CWP2	5.05E-03	1.19E-03	8.61E-03	1.38E+00	3.26E-02	7.70E-03	5.56E-02	1.38E+00	CWP2
CWR2	5.07E-03	1.11E-03	7.20E-03	1.16E+00	8.97E-01	1.97E-01	1.27E+00	1.16E+00	CWR2

This portion of the sheet is copied for each of the sample years between 2008-2011 and placed in a 'box' to distinguish between sample years.

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Each 'box' includes all previous calculations, but with all values decayed to the appropriate sample year using the first order decay equation that is included in the "Equation Information" worksheet. An example for format of decay information is provided below:

Analyte	Half-life (years)	$\lambda$ (Lambda) (day <sup>-1</sup> )	Decay Factor (e <sup>-<math>\lambda</math>t</sup> )	Decay to 1/1/2008	
239Pu	2.41E+04	7.87E-08	1.00E+00	Decay from Template Effective Date (t <sub>0</sub> )	1/1/2001
240Pu	6.56E+03	2.89E-07	9.99E-01	Decay to Sample Analysis Date (t <sub>i</sub> )	1/1/2008
241Pu	14.4	1.32E-04	7.14E-01	Days of Decay (t)	2556

An equation is provided to calculate a conservative estimate of Pu-241 (The calcs are already done, the user will decide which date is appropriate). A table for solid template values is provided as an error check for ratio calculation. The isotopic ratios should be the same in both tables.

Waste Types worksheet: A descriptive list of C-Farm waste types determined through process history.

Equation Information worksheet: This worksheet includes a reference for half-life values and the equation for first order decay.

Liquids\_Template worksheet: SVF-1262

Solids\_Template worksheet: SVF-1261

**8i. Test Plan and Cases:** The test plan and specific test cases are provided in Section 9 of this SVF

**8j. Acceptance Test Report:** The Acceptance Test results are provided in Section 9 of this SVF.

**8k. Installation Plan:** The minimum installation plan for all utility calculation software (spreadsheets) is to release the completed SVF and its associated spreadsheet through the Hanford site document control system. Any spreadsheet-specific or unique installation requirements are provided immediately below.

There are no spreadsheet-specific or unique installation requirements for this spreadsheet beyond the release of the spreadsheet and the SVF through the Hanford site document control system.

**8l. Contingency Plan:** In the event of hardware or software failure on an individual desktop computer running the spreadsheet, the MSA Contractor maintenance support is contacted for assistance in troubleshooting and resolving the failure. In the event that a hardware or software failure occurs during a critical period in the use of the spreadsheet, the use of the spreadsheet can be shifted to other computers (laptops) capable of running the spreadsheet. Issues with the spreadsheet are referred to the Spreadsheet Owner for resolution in accordance with Sections 4.4.10 and 4.4.11 of TFC-ENG-DESIGN-C-32. Any contingency plans or actions unique to this spreadsheet are provided immediately below.

There are no contingency plans or actions unique to this spreadsheet beyond those identified above.

**8m. Training Plan:** Users of this spreadsheet need to read this SVF and the documentation within the spreadsheet to familiarize themselves with the spreadsheet. Any additional training requirements for this spreadsheet are provided immediately below.

There are no additional training requirements for this spreadsheet..

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<p><b>8n. User Instructions:</b> The following instructions are provided to guide the use of the spreadsheet.</p> <p>This is a single use spreadsheet designed to be used as a table of template values with isotopic ratios of Pu-241. The isotopic ratios are ranked in descending order and are provided to conservatively estimate Pu-241. An equation for the conservative estimate of Pu-241 is provided.</p>	
<p><b>8o. Problem Reporting and Corrective Action:</b> if problems are identified during operation of this spreadsheet they shall be addressed, documented, and corrected as specified in TFC-ENG-DESIGN-C-32 for the software grade of the spreadsheet.</p>	
<p><b>8p. Retirement Plan:</b> In the event that this spreadsheet is no longer required, it shall be retired in accordance with section 4.6 of TFC-ENG-DESIGN-C-32.</p>	

**9. SPREADSHEET VERIFICATION AND VALIDATION**

**9a. Spreadsheet Test Plan:** A summary test plan is provided immediately below and detailed tests are provided in section 9b. Before the spreadsheet is verified, the Spreadsheet Owner or Developer needs to review the draft spreadsheet and any associated documentation with the Verifier as a code walkthrough of the spreadsheet.

The spreadsheet will be tested to ensure that all table values in "Pu241 Isotopic Ratio" sheet were correctly inputted using proper lookup functions. The only calculations in the sheet are those for the isotopic ratio and decay. It will be necessary to verify that the inputs for each ratio are correct. It will also be necessary to verify that the values are appropriately decayed and match the sample date in each table.

**9b. Spreadsheet Test Cases, Requirements Traceability Matrix, and Acceptance Test Report:**

Test Case ID	Test Case Description and Expected results	Requirement #	Test Results			
			Pass	Fail	NA	Comments
<i>Unique Spreadsheet Requirements Tests:</i>						
9.1.	Spreadsheet Owner provided overview.	1.1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.2.	<b>Verify that output for spreadsheet is correct.</b>	1.2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>See comments and ratio tests in Section 10.</b>
9.3.	Click here to enter text. <span style="color: red;">N/A Per email 9/22/14 TMP</span>	Click here	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.4.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.5.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.6.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.7.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.8.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.9.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.10.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**9c. General Comments:** The liquid and solid template values were tested using identical independent calculations and then checked using ratios. The decay testing was done in the same format. Ratios of 1.00 are equivalent to matching results, any ratios other than 1.00 can be attributed to zero divided by zero which also constitutes a positive match. Liquid and Solid template values were checked using independent checking of the reference an conditional formatting to check equal values.

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**10. GENERAL CONTINUATION SHEET.**

6.1 Internal Documents <span style="float: right;"><input type="checkbox"/> N/A</span>			
Type of Document	Document Number	Rev.	Title
SPREADSHEET VERIFICATION AND RELEASE FORM	SVF-1262	00	SPREADSHEET VERIFICATION RECORDS FOR SPREADSHEET LIQUID BBI TEMPLATE FY 2007.XLS

**9 CONTINUED. TEST CASES, REQUIREMENTS TRACEABILITY MATRIX, AND ACCEPTANCE TEST REPORT CONTINUATION.**

9b Continued. Spreadsheet Test Cases, Requirements Traceability Matrix, and Acceptance Test Report:						
Test Case ID	Test Case Description and Expected results	Requirement #	Test Results			
			Pass	Fail	NA	Comments
Specific Spreadsheet Requirement Tests:						
9.1.	N/A Per email 9/22/14 TMP		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.2.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.3.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.4.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.5.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.6.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.7.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.8.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.9.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.10.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.11.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.12.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.13.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.14.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.15.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.16.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.17.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9.18.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	