

Administrative Procedure, Level 1 - Company Wide

CPCC-PRO-EN-40259

Engineering Calculations

Revision 1, Change 3

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Program: Engineering

Topic: Engineering Program

Technical Authority: Baker, Rachel K

Alternate Technical Authority: Fargo, Sean A

Functional Manager: Kujath, Brett A

Use Type: Administrative



USQ Facility	USQ Review	Screeners
105 KW Facility	Exclusion Reason: <i>N/A per CPCC-PRO-NS-53097</i>	
324 Building	Exclusion Reason: <i>N/A per CPCC-PRO-NS-53097</i>	
Below HazCat 3	Exclusion Reason: <i>N/A per CPCC-PRO-NS-53097</i>	
Canister Storage Building/Interim Storage Area	Exclusion Reason: <i>N/A per CPCC-PRO-NS-53097</i>	
Capsule Storage Area	Exclusion Reason: <i>N/A per CPCC-PRO-NS-53097</i>	
D4ES-Central Plateau	Exclusion Reason: <i>N/A per CPCC-PRO-NS-53097</i>	
Solid Waste Operations Complex	Exclusion Reason: <i>N/A per CPCC-PRO-NS-53097</i>	
Transportation	Exclusion Reason: <i>N/A per CPCC-PRO-NS-53097</i>	
Waste Encapsulation Storage Facility	Exclusion Reason: <i>N/A per CPCC-PRO-NS-53097</i>	
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Change Summary

Description of Change

Incorrect link to Hanford Document Numbering System.

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Engineering Calculations**Published Date: 12/31/25****Effective Date:12/31/25****1.0 INTRODUCTION****1.1 Purpose**

This procedure establishes the format and content requirements for engineering calculations prepared and revised in support of Central Plateau Cleanup Company (CPCC) engineering design activities.

1.2 Scope

This procedure describes the required format and content for engineering calculations. Requirements for review, approval, release, and change control for engineering calculations are described in CPCC-PRO-EN-440, *Engineering Documentation Preparation and Control*.

A calculation is defined as a document that assembles inputs, assumptions, bases, requirements, constraints, physical/chemical properties, and algorithms to analytically develop outputs based on physical laws.

1.3 Applicability

This procedure applies to engineering and nuclear safety calculation activities that meet the definition of a calculation described by this procedure. There are three types of calculations: Simple, Embedded, and Formal. Each calculation type is covered separately by this procedure.

This procedure may also be used for calculations performed by other functional areas not specifically related to engineering analysis or design activities. This may include Industrial Health and Safety, Radiological Protection, Transportation, Environmental Protection, etc.

Calculations developed for Package Specific Safety Documentation shall comply with DOE/RL 2001 36, *Hanford Sitewide Transportation Safety Document*.

1.4 Implementation

This procedure is effective upon publication.

2.0 PROCESS**2.1 Simple Calculations**

A Simple Calculation includes finite, observable inputs and produces simple results of fact (e.g., area, volume, flow, distance, unit conversion). It requires routine arithmetical operations and does not utilize complex relationships. It is normally used to support operations or to provide conservative estimates. Calculation correspondence including checking, approval, and results are provided via email or other agreed upon method. Simple Calculations do not have a document number and do not have a Calculation Cover Page. Use of a Simple Calculation as the appropriate method is approved by the Engineering Manager for the group performing the calculation.

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<i>Actionee</i>	<i>Step</i>	<i>Action</i>
Originator	1.	Simple calculation shall NOT be utilized for the following: <ol style="list-style-type: none"> a. In support of design. b. To determine the operability of Safety Class (SC)/Safety System (SS) structures, systems, and components (SSCs). c. To meet regulatory requirement(s). d. In situations where a formal record needs to be maintained.
	2.	PREPARE the calculation in a manner that produces a legible, reproducible document of sufficient contrast.
	3.	ENSURE calculations are orderly, complete, <u>AND</u> are sufficiently detailed to support review and checking.
	4.	ENSURE the calculation includes, at a minimum, the following: <ol style="list-style-type: none"> a. A concise statement of the purpose for the calculation. b. All input data including source and source revision number/effective date, as applicable. c. Clear results and conclusions.
	5.	TRANSMIT the calculation to the Engineering Manager
Engineering Manger	6.	REVEIW the calculation for appropriate, inputs, method, completeness, <u>AND</u> accuracy.
<p>NOTE: <i>Additional reviews and approvals are at the discretion of the Engineering Manager.</i></p>		
	7.	RETURN the calculation to the Originator with any comments
Originator	8.	RESOLVE any comments with the Engineering Manager
	9.	TRANSMIT the calculation to the requester/project, a simple calculation is not required to be formally submitted as an official record.

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2.2 Embedded Calculations

Embedded Calculations are issued as part of another document (e.g., Operations Evaluation [OE], Technical Evaluation [TE], Path Forward Plan, Chemical Compatibility Evaluation, Documented Safety Analysis [DSA], Fire Hazard Analysis [FHA], Specification, Report). It is checked, reviewed, approved, and issued as part of the document in which it is embedded. Embedded Calculations do not have a separate document number and do not have a Calculation Cover Page. Use of an Embedded Calculation as the appropriate method is approved by the Engineering Manager from the organization performing the calculation.

Actionee	Step	Action
Originator	1.	Calculations may be embedded if the following criteria are met: <ol style="list-style-type: none"> a. Does NOT contain unverified assumptions. 2. PREPARE the calculation in a manner that produces a legible, reproducible document sufficient contrast. 3. ENSURE calculations are orderly, complete, and are sufficiently detailed to support review and checking. 4. Calculations using electronic worksheets (e.g., Mathcad, Excel) shall have all inputs, formulas, and outputs visible and easily accessible to facilitate checking and verification 5. ENSURE the calculation includes, at a minimum, the following: <ol style="list-style-type: none"> a. A concise statement of the purpose for the calculation. b. All input data including source and source revision number/effective date, as applicable. c. Assumptions individually listed and clearly stated with a basis. d. Equations individually listed and clearly stated. e. Numerical calculations including identification of the units used. f. Concise statements addressing the calculation results, recommendations, limitations, and conclusions.
Checker	6.	Calculation checking shall be done in accordance with Section 2.4 Calculation Checking.
Checker	7.	Additional reviews and approval of the Embedded Calculation are driven by the those required by the document in which the calculation is embedded

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Actionee	Step	Action
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NOTE: After checking the calculation, approval of the document in which it is embedded also approves the calculation. The calculation does not require separate approval.

2.3 Formal Calculations

A Formal Calculation is a standalone document that contains sufficient detail, including basis and references, such that a person technically qualified in the subject can review and understand the analyses and verify the adequacy of the results without requiring help or clarification from the originator. A formal calculation is used to support development of drawings, specifications, reports, design documents, Safety Basis documents, and other engineering products used to construct, modify, or operate a facility.

Formal Calculations shall comply with the following requirements:

- Each calculation shall have a unique calculation number and cover sheet (see Section 2.4).
- Each calculation shall have the calculation number identified on each page. Each page shall contain the page number and shall be marked as "Page X of Y" or "Sheet X of Y".
- Calculations shall be neat and legible, laid out in a logical manner, and shall contain sufficient detail to allow a technically qualified person to understand, check, and review the calculation.
- The level of detail required for a calculation shall be that necessary to permit the design activity to be carried out correctly, provide a consistent basis for making design decisions, support design verification measures, and support evaluation of design changes. A subject matter expert (SME) or knowledgeable individual should be able to understand the analysis and verify the adequacy of the result without recourse to the original preparer.
- Inputs shall be obtained from controlled, verified, and/or standard reference sources whenever possible. Uncontrolled or unapproved design input shall be documented, referenced, and verified. Inputs shall be clearly identifiable at the point of use within the calculation.
- Assumptions shall be justified or shall have their basis provided. Assumptions that require later verification shall be identified and tracked for resolution in the iCAS system per CPCC-PRO-QA-052, *Issues Management*.
- Outputs shall be clearly traceable to inputs. Actual computations shall be included in the calculation.
- Documentation of inputs, assumptions, and calculation methods or algorithms obtained from literature or references shall be included in the design calculation.
- Calculations using electronic worksheets (e.g., Mathcad, Excel) shall have all inputs, formulas, and outputs visible and easily accessible to facilitate checking and verification.
- Software used in the preparation of a calculation shall comply with the requirements of CPCC-PRO-IRM-309, *Controlled Software Management*.
- **OCRWM Only:** Calculations prepared to support Office of Civilian Radioactive Waste Management (OCRWM) activities shall be prepared as Formal Calculations.
- Formal Calculations are prepared and issued per Section 3.1.3, Calculations of CPCC-PRO-EN-440, *Engineering Documentation Preparation and Control*.

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- Upon issue and release of calculations using HISI listed software, the calculation shall be identified in HISI Usage Log for the subject software.

2.3.1 Calculation Number and Cover Sheet

Calculation numbers shall be obtained and assigned as follows:

- For formal calculations, obtain a calculation number from the [Hanford Document Numbering System \(HDNS\)](#). Calculation numbers can be CPCC company-specific (e.g., CPCC-XXXXX) or organization specific (e.g., D&D-XXXXX, SGW-XXXXX, CPCC-STP-CN--Topic-XXXXX).
- Each calculation shall have a cover sheet prepared using the *CPCC Calculation Cover Sheet* (A-6004-793) or equivalent. The CPCC Calculation Cover Sheet may be completed per the instructions in Appendix A, *Calculation Cover Sheet*.

2.3.2 Formal Calculation Contents

Appendix B, Formal Calculation Format provides a template of how the calculation shall be formatted. Each calculation shall include the following sections:

- **Title Page:** Each Formal calculation shall have a title page that lists the title of the calculation, the calculation number, and approvals for the Calculation Author and Checker. Use the Calculation Cover Sheet (A 6004 793) or equivalent.
- **Technical Check:** This section is required only when the calculation is prepared to support OCRWM activities but may be included if required by the Calculation Author. This section shall contain the check documentation described in Section 2.4
- **Table of Contents:** A structured outline of the contents of the calculation.
- **References:** List all references to literature searches, technical citations, and other background data used to make assumptions and perform the calculation. For rigorous calculations, this may include copies of references with pertinent information clearly marked. These are the sources of the design input information.
 - Examples of references include drawings, reports, manuals, publications, codes, and standards. Each reference will contain the document name and if applicable, a document number. The revision number or publication date will be provided, if available.
- **Purpose:** Provide a section that clearly and concisely describes the purpose of the calculation, any alternatives examined, and the expected objective.

NOTE: *Software shall be approved for use within Hanford Information Systems Inventory (HISI) prior to issue and release of the calculation. The HISI entry contains the Verification and Validation documentation for software as required in CPCC-PRO-IRM-309, Controlled Software Management. The HISI listing also includes the list of Authorized Users for the software and Usage Log.*

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- **Software Verification and Validation (V&V) (For Software Use Only):** With the exception of Flat File as defined in CPCC-PRO-IRM-309, when software is used in the performance of the calculation, the following information shall be provided:
 1. Title and version of the approved software used.
 2. HISI Identification number and acronym of software used.
 3. Workstation type and property number on which the software was run
 4. A copy of the Installation and Checkout Form or equivalent for the software on the Workstation identified in the above bullet. Use a Software Installation and Checkout Form (A-6005-149) or equivalent.
 5. Identification of the Authorized User performing the software calculation.
 6. Statement confirming the application of the software to the problem being solved was correct and the software was used within its limitations.
- **Inputs:** Identify all the relevant data inputs used in the calculations, including values, measurements, or any other information required for the analysis. Inputs should be numbered and tied back to references.
- **Assumptions:** Detail any assumptions made during the calculation process, including basis and sensitivity. Assumptions should be numbered to provide tracking purposes.
- **Analytical Methods and Calculations:** Each calculation shall provide the following:
 1. A brief narrative of the calculation to be performed and the solution to be provided. Diagrams are encouraged to illustrate the problem to be solved.
 2. Identification of units used.
 3. Clearly marked end results
 4. Clearly marked revisions.
 5. For manual or hand calculations, provide the following:
 6. Identification of the source or derivation of all equations that are not common usage.
 7. Listing of appropriate equations and algorithms
 8. The actual calculation depicting the calculation steps.
 9. For calculation performed with Engineering Analysis and Design software, provide a brief description of the software and how it was used to perform the calculation. If available, provide the equations or analytical methods use by the Software.
 10. For calculations using software (e.g., MathCAD, Excel), describe the equations used or provide a printout of the equations used in an appendix. To facilitate checking, identify the coding, background logic, and/or formulas used in the calculation.
 11. The explanation of the calculation method and computations themselves should be concise yet detailed enough to permit a qualified Checker to perform the Calculation Check with minimal interpretation of the information presented.

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- **Results:** Provide a description of the results obtained.
- **Conclusions:** Describe the context or qualifying information required to explain and/or interpret the end result of the calculation. Discuss the degree to which the purpose and objectives of the calculation have been met and the appropriateness and completeness of the results for the intended purpose.
- **Attachments and Appendices:** Include additional information, as needed, such as copies of references, memos, or pages of manuals, computer code output sheets, computations spreadsheets, worksheets showing/explaining equations used, input transmittals, etc.

2.4 Calculation Checking

Formal and Embedded Calculations shall be checked by a qualified checker as determined by the engineering manager of the group performing the calculation. Checking Simple Calculation is addressed in Section 2.1 Simple Calculations. The calculation check shall ensure the calculation meets the following:

- Contents and format adhere to this procedure
- The overall approach, assumptions, and end results are reasonable
- Inputs are correctly selected and incorporated into the calculation
- Assumptions are adequate and documented
- The calculation method used is appropriate
- All mathematical operations performed in the calculation are correct or checked using an alternative calculation
- Applicable operating experience has been considered
- Results are valid and technically sound
- When software programs are used, inputs and outputs appear to be feasible
- References are cited
- Conclusions are supported by the results
- When using software, ensure the software is Operational in HISI and that the software was used within its approved grade level and limitations defined in the applicable Software Management Plan or other Software Quality Assurance documentation.
- When performing a calculation check on a flat file as defined in CPCC-PRO-IRM-309, then utilize one of the following methods, in preferred order as approved by the engineering manager:
 1. Alternate Calculation.
 2. Manually checking the entire calculation for accuracy.
 3. Manually checking samples of the calculation for accuracy.
 4. Peer reviewing inputs, functions, and outputs.
- The calculation check may be documented using one of the following methods:

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1. A marked up copy of the calculation
 2. A documented list of comments
 3. A *Review Comment Record (RCR)* (A-6004-835)
 4. *CPCCo Engineering Review Checklist* (A-6004-797)
- For OCRWM, the calculation check shall be documented using one of the following methods:
 1. A marked up copy of the calculation with each page initialed by the checker along with a completed and signed *CPCCo Engineering Review Checklist* (A-6004-797).
 2. A *Review Comment Record (RCR)* (A-6004-835) along with a completed and signed *CPCCo Engineering Review Checklist* (A-6004-797).
 - Documentation of the check, resolution of all comments, and acceptance by the Checker is indicated by the Checkers approval on the Title Page of the calculation. For Embedded Calculations this is indicated by approval of the document in which the calculation is embedded.

2.5 Calculation Revision

Revisions to Formal calculations shall be made using the following methods as appropriate:

- Handwritten calculations shall have correction or changes made on a copy of the original and issued as the next revision and have a new calculation coversheet created. Electronic Calculations shall be revised by electronically editing the native file(s) and creating a new calculation coversheet. If the native file is not available, the calculation can be recreated.

Each calculation revision requires a calculation check as described in Section 2.4.

Calculation checking requirements are the same as for a new calculation. The person making the revision is the author of the calculation.

The same process used to generate Simple and Embedded Calculations is used to revise those calculations.

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3.0 FORMS

Calculation Cover Sheet, A-6004-793

CPCCo Engineering Review Checklist, A-6004-797

Review Comment Record (RCR), A-6004-835

Software Installation and Checkout Form, A-6005-149

4.0 RECORD IDENTIFICATION

None

5.0 SOURCES

5.1 Requirements

[CPCC-RD-EN-1819](#), *CPCC Engineering Requirements*

5.2 References

[DOE/RL-2001-36](#), *Hanford Sitewide Transportation Safety Document*

[CPCC-PRO-EN-2001](#), *Facility Modification Package Process*

[CPCC-PRO-EN-20050](#), *Engineering Configuration Management.*

[CPCC-PRO-EN-440](#), *Engineering Documentation Preparation and Control*

[CPCC-PRO-IRM-10588](#), *Records Management Processes*

[CPCC-PRO-IRM-309](#), *Controlled Software Management*

[CPCC-MP-QA-599](#), *Quality Assurance Program*

[CPCC-PRO-QA-19579](#), *OCRWM Records Management*

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A CPCC Calculation Cover Sheet (A-6004-793) is prepared in accordance with the following instructions for each revision to an engineering calculation.

Appendix A - Calculation Cover Sheet			
Section	Block Number	Block Title	Instructions
1: Identification	1	Calculation Number	Enter the Number of the Engineering Document. See Section 2.2.
	2	Revision	Enter the revision number of the revised calculation. The revision number for the initial issue of a calculation is Rev. 0. Page Changes use the current revision number plus alpha characters (e.g., Rev. 0A, Rev. 1B, etc.). Direct Revision uses the next numerical number in the sequence (e.g., Rev. 1).
	3	Calculation Title	Enter the title of the calculation.
	4	Purpose	Briefly describe the purpose of the calculation.
	5	Project/Program/Activity	If the calculation supports a Project, Program, or Activity, provide a number or title.
2: Approval	6	Author	Print Name of the Calculation Author, Obtain Signature, and Date. This if for the author of the current revision. Revision history is captured in the Summary of Revisions section.
	7	Checker	Print Name of the Calculation Checker, Obtain Signature, and Date. This if for the checker of the current revision. Revision history is captured in the Summary of Revisions section.
	8	Title/Print/Signature/Date	If required add additional spaces for approval. Identify the Title of the approver, print the approvers name and have the approver sign and date.
3: Summary of Revisions	9	Rev. No.	Identify the revision number for each revision. Revision numbers are listed in ascending order. List all previous revision and the current revision in the summary.
	10	Description of Change	Provide a brief description of the change(s) made to the calculation for each revision listed.
	11	Affected Pages	Identify the pages affected by the change(s) for each revision listed.
	12	Author	For the current revision, obtain the Calculation Authors signature. For the previous revisions,

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Appendix A - Calculation Cover Sheet

Section	Block Number	Block Title	Instructions
			print the name of the Author.
	13	Checker	For the current revision, obtain the Calculation Checkers signature. For the previous revisions, print the name of the Checker.

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Appendix B - Formal Calculation Format**1.0 TABLE OF CONTENTS:**

This section provides a structured outline of the contents of the document.

2.0 REFERENCES:

List all the sources, documents, or references that were consulted or cited in the appendix. References should be numbered to refer to later in the document.

3.0 PURPOSE

The introduction provides an overview of the calculations to be presented in the appendix, outlining the purpose and scope of the analysis.

4.0 INTRODUCTION/BACKGROUND

Provide any background information needed to understand the calculation purpose.

5.0 SOFTWARE VERIFICATION AND VALIDATION (V&V):

- This section is only included when software (not including Flat File) is used in the performance of the calculation and must contain the following:
 1. Title and version of the approved software used.
 2. HISI Identification number and acronym of software used.
 3. Workstation type and property number on which the software was run
 4. A copy of the Installation and Checkout Form or equivalent for the software on the Workstation identified in the above bullet. Use a Software Installation and Checkout Form (A-6005-149) or equivalent.
 5. Identification of the Authorized User performing the software calculation.
 6. Statement confirming the application of the software to the problem being solved was correct and the software was used within its limitations.

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Appendix B - (Cont.) Formal Calculation Format**6.0 INPUT DATA**

This section lists all the relevant data inputs used in the calculations, including values, measurements, or any other information required for the analysis. Inputs should be numbered and tied back to references.

Example:

Input #	Input	Value	Reference
1	Tank Volume	10,000 gallons	1
2	Maximum Tank Liquid Volume	9,850 gallons	1
3	Tank Heel	1,000 gallons	2
4	Operating Temperature	100°C	4
5	Standby Temperature	80°C	4

7.0 ASSUMPTIONS

Detail any assumptions made during the calculation process, including basis and sensitivity. Assumptions should be numbered to provide tracking purposes. This is important for transparency and to provide context for the results.

Example:

Assumption 1

- Assumption: The release rate of hydrogen from liquid is equal to its generation rate.
- Basis for this assumption: Excluding the possibility of trapped hydrogen, this is the conservative assumption. This assumption maximizes the rate of release of hydrogen into the vapor space and, therefore, leads to the minimum Recovery Times, maximum Purge Volumes, and maximum purge rates.
- Sensitivity to this Assumption: A reduction in the release rate would produce more favorable results.

8.0 ANALYTICAL METHODS AND CALCULATIONS:

Explain the methods and formulas used to perform the calculations including all variables and the step-by-step solution. This provides a step-by-step explanation of how the results were obtained. Refer to inputs/assumptions by number.

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Appendix B - (Cont.) Formal Calculation Format**9.0 RESULTS:**

This section presents the outcomes of the calculations, typically in the form of numerical values, tables, or graphs. It summarizes the key findings derived from the analysis.

10.0 CONCLUSIONS:

Present conclusions based on the results presented earlier and discuss the implications of the findings and may suggest recommendations or further actions.

11.0 APPENDICES:

This section includes any additional material that supplements the main content of the appendix. This could include detailed tables, charts, or supporting documents referenced in the calculations.

12.0 ATTACHMENTS:

Similar to the appendices, this section may contain supplementary material that is relevant to the calculations but not included in the main body of the document. This could include raw data, additional charts, or background information.

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Appendix C - Glossary

Term	Definition
Alternate Calculation	Alternate Calculations involves the use of one or more different methods of analysis to check and ensure the correctness and applicability of pertinent design calculations, both hand and computer calculations. Alternate calculations may consist of techniques, such as using simplified approximations to check lengthy or complicated methods, using more or less conservative assumptions in the analysis, using numerical analysis, or data extrapolations.
Controlled Inputs	Input values that are precisely known, measured, or specified with high certainty. For example: <ul style="list-style-type: none"> • Material properties obtained from certified suppliers with known manufacturing processes. • Design parameters explicitly defined in specifications or drawings. • Measured values from calibrated instruments.
Uncontrolled Inputs	Input values that are subject to variability or uncertainty that cannot be fully accounted for. May be influenced by environmental factors, manufacturing variations, or other unpredictable sources. For example: <ul style="list-style-type: none"> • Ambient temperature fluctuations. • Load variations on a structure. • Material property variations within a batch.
Verified Inputs	These are controlled inputs that have undergone a process of verification to ensure their accuracy and reliability. May involve independent measurements, cross-checks, or comparisons with known standards. <ul style="list-style-type: none"> • Calibrated instruments with traceable certifications. • Material test reports from accredited laboratories. • Peer reviews of design calculations
Unverified Inputs	These are inputs that have not been subjected to a formal verification process and may have higher levels of uncertainty or potential for error. <ul style="list-style-type: none"> • Assumed values based on engineering judgment. • Data from unverified sources. • Preliminary estimates that may require further refinement.