

Administrative Procedure, Level 1 - Company Wide

CPCC-PRO-EN-40264

Formal Design Review Standard

Revision 0, Change 5

Published: 12/29/2025

Effective: 12/29/2025

Periodic Review Due Date: 08/22/2027

Program: Engineering

Topic: Engineering Program

Technical Authority: Baker, Rachel K

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>	
JHA: Administrative		
Periodic Review Due Date:08/22/2027		
Rev. 0, Chg. 5		

Change Summary

Description of Change

Added directions on who can be a committee reviewer in sections 3.1.
Added guidance on essential design methods to Appendix B Section 3.1

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

TABLE OF CONTENTS

1.0 INTRODUCTION2
1.1 Purpose.....2
1.2 Scope2
1.3 Applicability2
1.4 Implementation2
2.0 RESPONSIBILITIES.....3
2.1 CPCCo Project Engineering Manager3
2.2 Project Engineer / Design Authority3
2.3 CPCCo Central Engineering3
2.4 Design Review Chairman3
3.0 PROCESS5
3.1 Design Review Team.....5
3.2 Formal Design Review Execution6
3.3 Formal Design Review Report8
4.0 FORMS9
5.0 RECORD IDENTIFICATION.....9
6.0 SOURCES10
6.1 Requirements.....10
6.2 References.....10

List of Appendixes

Appendix A - Formal Design Review Report Outline.....11
Appendix B - Formal Design Review General and Specific Design Criteria Considerations
.....21
Appendix C - FDC Design Verification Matrix.....34

Published Date: 12/29/25

Effective Date: 12/29/25

1.0 INTRODUCTION

1.1 Purpose

This procedure establishes the performance of Formal Design Reviews for a conceptual, preliminary, or definitive design as described in CPCC-RD-EN-1819, *Engineering Requirements*, and CPCC-PRO-EN-40271, *Engineering Design Process*. This procedure also establishes the expectations for documenting the output of the review – the Formal Design Review Report.

1.2 Scope

All engineering efforts supporting Engineering, Projects, and Construction (EPC) projects, including subcontracted design services, shall be subject to a Formal Design Review at the conceptual, preliminary, and definitive design stages. It is recommended that projects requiring engineering design beyond that required for a Facility Modification Package (FMP) also utilize this procedure. See CPCC-MP-PM-53011, *CPCCo Project Management Plan*, for specific definitions of subprojects and routing operations activities.

This procedure establishes the requirements for performance of Formal Design Reviews as described in CPCC-PRO-EN-8336, *Design Verification*. Tailoring these requirements to meet the unique needs of individual projects shall be performed by Project Management and the responsible Project Engineering Manager.

1.3 Applicability

Formal design reviews at the conceptual, preliminary, and definitive design stages shall be performed for:

- All EPC projects managed by the Central Plateau Cleanup Company (CPCCo)
- Projects requiring large-scale design efforts in compliance with DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, and DOE-STD-1189-2008, *Integration of Safety into the Design Process*
- Projects for new CPCCo-managed facilities
- Major modifications to Configuration Managed systems, structures, and components (CM SSC) at nuclear facilities

Projects categorized as General Plant Projects (GPP)

1.4 Implementation

This procedure is effective upon publication.

Published Date: 12/29/25

Effective Date: 12/29/25

2.0 RESPONSIBILITIES

2.1 CPCCo Project Engineering Manager

- Ensures formal design reviews are performed as required by this procedure.
 - Performs appropriate tailoring of the requirements to ensure adequacy of the content and rigor of the review.
 - Obtains the project and external review resources necessary to perform and complete the formal design review, including the Design Review Chairman.
 - Ensures all comments received are collected, documented, categorized, and dispositioned.
- Ensures all comment dispositions are concurred with by the originator.

2.2 Project Engineer / Design Authority

- Supports the design review.

Disposition comments received per the direction of the CPCCo Project Engineering Manager.

2.3 CPCCo Central Engineering

Provides subject matter experts (SME), including the Design Review Chairman if needed, to the formal design reviews at the direction of the Project Engineering Manager. SME support may include:

- Contact with other CPCCo and Department of Energy (DOE) complex projects to ensure consistency in design inputs/outputs.
- Assisting with codes and standards applicability and interpretations.
- Overall technical and administrative reviews of the documents and processes to assist the CPCCo Project Engineering Manager.

2.4 Design Review Chairman

- Ensures that the extent of the review is adequate and appropriate for each reviewer and collectively for the overall review.
- Oversees the design team during the review process.
- Holds a design review briefing to begin the Formal Design Review.
- Discusses functions and requirements, design philosophy, and the basic configuration of the equipment, hardware, or software, etc. during the design review briefing.
- Documents the meeting proceedings in meeting minutes, which will become part of the Formal Design Review Report.
- Verifies that all comments received via Review Comment Record (RCR), or equivalent, are appropriately dispositioned.

Prepares the Formal Design Review Report by summarizing the design review results including documentation of all comments with final dispositions and concurrence of the originators.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

The Design Review Chairman, in conjunction with the CPCCo Chief Engineer, has the final authority on dispute resolution regarding dissenting technical opinions that arise during the formal design review in accordance with CPCC-PRO-EN-14616, *Resolving Dissenting Technical Opinions*.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

3.0 PROCESS

The specific sequence, content, and responsibilities applied to perform Formal Design Reviews vary with the size, complexity, and other project-specific factors.

The primary focal point of a Formal Design Review is to verify that the design meets all functional design criteria listed in the Functional Design Criteria (FDC), as documented in the FDC Design Verification Matrix, and all other project-defined requirements.

Other aspects of the review include:

- Evaluation of potential design options.
- Checking the analysis and rationale used to validate the design choices.
- Verification that designs details will support the completion of the engineering design and facilitate long-lead procurements for specialty equipment.
- Identification of areas for further investigation and/or research.

Risk minimization activities needed during construction, startup, and operations.

3.1 Design Review Team

The Design Review Team shall be comprised of the Design Review Chairman and Design Review Committee. The Design Review Committee is composed of representatives from the following functions (when affected by the design) whom have not been directly involved in the production of the design:

- Civil/Structural
- Electrical Systems
- Heating, Ventilation, and Air-Conditioning (HVAC)
- Instrumentation and Controls
- Mechanical Systems
- Piping
- Process
- Fire Protection
- Nuclear Safety
- Criticality Safety
- Radiological Protection
- Safeguards and Security
- Emergency Preparedness
- Quality Assurance
- Environmental
- Worker Safety & Health
- Facility Interface
- Transportation
- Testing
- Operations
- Maintenance

Members of the Design Review Committee shall be selected based on the necessary expertise to ensure that an in-depth review can be performed, dependent upon the size and complexity of the design.

The committee may include reviewer(s) from another project, program, department, or division or an outside consultant. The reviewer(s) may be the responsible DA if the individual did not perform the original design. The reviewer(s) may be the originator's manager, if the manager did

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

not specify a singular design approach or rule out certain design considerations and did not establish the design inputs used in the design.

The reviewer(s) may be the originator's supervisor manager provided:

- The supervisor / Manager is the only individual in the organization competent to perform the verification.
- The verification is not hastily and superficially done.

The determination to use the supervisor / manager is documented and approved, in advance, with concurrence of the QA organization.

The Design Review Chairman or his designee shall facilitate the review. Each committee member may designate an alternate or alternates with the concurrence of the chairman. It is recommended, but not required, that the Design Review Chairman and Design Review Committee members be the same individuals for all design reviews conducted for a project.

3.2 Formal Design Review Execution

The following actions shall be performed when performing a Formal Design Review for conceptual, preliminary, and definitive design phases of a project.

Actionee	Step	Action
Project Engineering Manager	1.	ESTABLISH the expectations, roles, responsibilities, and scope of work required for the formal design review. The depth and rigor of a formal design review will vary based on the size and complexity of the project design.
Design Review Chairman	2.	SELECT a Design Review Chairman for the design review.
Design Review Chairman	3.	IDENTIFY the Design Review Committee members and alternates.
Design Review Chairman	4.	PREPARE the schedule for performing the design review.
Design Review Chairman	5.	IDENTIFY <u>AND</u> OBTAIN the design media to be reviewed.
Design Review Chairman	6.	DEVELOP expectations, general, and specific review criteria for the design review relevant for the design (see Appendix B) <u>AND</u> DOCUMENT in a preliminary Formal Design Review Report (see Appendix A).
Design Review Chairman	7.	<u>IF</u> not previously prepared, <u>THEN</u> COMPLETE columns 1, 2, and 3 of a FDC Design Verification Matrix (Appendix C).
Design Review Chairman	8.	PREPARE a Design Review Package containing the design media, preliminary Formal Design Review Report, FDC Design Verification Matrix, and other relevant documentation as needed.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

<i>Actionee</i>	<i>Step</i>	<i>Action</i>
Design Review Committee	9.	DISTRIBUTE Design Review Package to the Design Review Committee members.
	10.	REVIEW the Design Review Package prior to the kickoff meeting.
	11.	Hold design review kickoff meeting with Design Review Committee. Explain requirements for the design review.
Design Review Team	12.	REVIEW design media, discuss issues, and record comments on an RCR (A-6004-835) or equivalent form.
	13.	COMPLETE columns 4, 5, and 6 of the FDC Design Verification Matrix for items verified by the design review.
Design Review Chairman	14.	ENSURE meeting minutes for each design review meeting are recorded.
	15.	ENSURE all relevant questions and functional area concerns or issues are addressed by the Design Review Team. Ensure all issues are documented on an RCR or equivalent.
	16.	ORGANIZE RCR comments as follows: Type A: 1) Inadequate or missing requirement or assumption. or 2) Requirement/assumption inadequately incorporated at conceptual design.

NOTE: *All type A comments must be resolved or incorporated into the Design Report before it is issued.*

Type B:

- 1) Deficiencies that can be incorporated during preliminary / definitive design.
- 2) Suggestion for a better way to design systems or items that should be considered during preliminary or definitive design.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

<i>Actionee</i>	<i>Step</i>	<i>Action</i>
<p>NOTE:</p> <ul style="list-style-type: none"> • <i>Type B comments may be resolved with a statement of commitment to resolve prior to completion of design.</i> • <i>Comments received outside of the formal review process shall also be addressed in a similar manner to comments received from the Design Review Team.</i> 		
Design Review Chairman	17.	PROVIDE RCR comments and issues to the Design Authority for disposition.
Design Authority	18.	WORK with the Design Agent and Design Review Team to disposition the design review comments. Comments which are not accepted must be justified.
	19.	CONFIRM proper incorporation of the comment with the comment originator (member of the Design Review Team) <u>AND</u> OBTAIN the reviewers acceptance by initialing the RCR or equivalent form. Provide completed RCR forms to the Design Review Chairman.
Design Review Chairman	20.	FINALIZE the Formal Design Review Report by providing the results of the general and specific criteria evaluations, the completed RCR forms, attendance lists, design conclusions, etc. into the report. The report shall be prepared, issued, and released in accordance with CPCC-PRO-EN-440, <i>Engineering Documentation Preparation and Control</i> .

3.3 Formal Design Review Report

Appendix A provides the format and content of a Formal Design Review Report. Appendix A is typical for a large-scale design review, consistent with the requirements of DOE Order 413.3B, and DOE-STD-1189-2008. Depending on the scope and complexity of the project, some sections may not be applicable and can be removed from the report. The overall goal is to provide a technically justifiable review to verify the design elements from each of the engineering and functional disciplines, including operations.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

4.0 FORMSA-6004-835 or equivalent, *Review Comment Record (RCR)***5.0 RECORD IDENTIFICATION**

All records are generated, processed, and maintained in accordance with CPCC-PRO-IRM-10588, *Records Management Processes*.

Records created during the performance of Office of Civilian Radioactive Waste Management (OCRWM) activities shall be managed and additionally submitted to the OCRWM Records Coordinator, in accordance with CPCC-PRO-QA-19579, *OCRWM Records Management*.

Records Capture Table

Name of Record	Submittal Responsibility	Retention Responsibility
Formal Design Review Report	Design Review Chairman	IRM Service Provider
Formal Design Review Report (OCRWM)	Design Review Chairman	OCRWM Records Coordinator
Review Comment Records or equivalent	Design Review Chairman/ RCR Author	IRM Service Provider
Review Comment Records or equivalent (OCWRM)	Design Review Chairman/ RCR Author	OCRWM Records Coordinator

Published Date: 12/29/25

Effective Date: 12/29/25

6.0 SOURCES**6.1 Requirements**

CPCC-RD-EN-1819, *Engineering Requirements*

6.2 References

10 CFR 830, *Nuclear Safety Management*

10 CFR 835, *Occupational Radiation Protection*

10 CFR 851, *Worker Safety and Health Program*

CPCC-MP-PM-53011, *CPCCo Project Management Plan*

CPCC-MP-QA-599, *Quality Assurance Program*

CPCC-PRO-EN-14616, *Resolving Dissenting Technical Opinions*

CPCC-PRO-EN-40271, *Engineering Design Process*

CPCC-PRO-EN-440, *Engineering Document Preparation and Control*

CPCC-PRO-EN-8336, *Design Verification*

CPCC-PRO-IRM-10588, *Records Management Processes*

CPCC-PRO-QA-19579, *OCRWM Records Management*

CPCC-PRO-RP-1622, *Radiological Design Review Process*

CPCC-RD-IRM-210, *Records Management Program*

CPCC-STD-EN-40255, *Functional Design Criteria*

CRD O 151.1D, *Comprehensive Emergency Management System*

CRD O 414.1D, *Quality Assurance*

DOE G 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria Guide for Use with DOE O 420.1, Facility Safety*

DOE G 420.1-3, *Implementation Guide for DOE Fire Protection and Emergency Services Programs for Use with DOE O 420.1C, Facility Safety*

DOE G 441.1-1B, *Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations*

DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*

DOE O 440.1B, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees*

DOE O 450.1A, *Environmental Protection Program*

DOE-HDBK-1139/2-2006, *Chemical Management (Volume 2 of 3) Chemical Safety and Lifecycle Management*

DOE-STD-1066-99, *Fire Protection Design Criteria*

DOE-STD-1189-2008, *Integration of Safety into the Design Process*

DOE-STD-3009-94, *Change Notice 3, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - Formal Design Review Report Outline

This appendix establishes the content and format of a Formal Design Review Report. The content presented here is typically for a large-scale design project. Depending on the scope and complexity of the project sections that will do not apply or add value may be omitted.

Prior to the Design Review Kickoff meeting, the Design Review Chairman should prepare a preliminary version of the Formal Design Report to establish the design review scope, schedule, documentation requirements, and design media to be reviewed. It is suggested the following sections be completed in the preliminary report:

1. Purpose
2. Scope
3. Design Media to be Reviewed
4. Design Review Team
5. Design Review Schedule
6. Design Review Documentation
7. General Design Review Criteria (**NOTE:** *Criteria section only*)
8. Specific Design Review Criteria (**NOTE:** *Criteria section of each area only*)

The preliminary Formal Design Report should be provided to the Design Review Team as a part of the Design Review Package.

=====

TABLE OF CONTENTS

Provide a Table of Contents for the report.

1.0 PURPOSE

Identify the purpose of the Report. Suggested wording is:

“This report documents the performance and results of the [Conceptual | Preliminary | Definitive] formal design review for EPC Project [Unique Project Identifier].

This Formal Design Review consists of a systematic overall review and evaluation of the design by the Design Review Committee identified in Section 4.0. The Design Review Committee represents all affected disciplines and functions.

This Formal Design Review Report serves as CPCCo’s verification of design and documentation of completion of this formal design review.”

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - (Cont.) Formal Design Review Report Outline**2.0 SCOPE**

Identify the scope of the formal design review. Suggested wording is:

“This formal design review was performed for the [Conceptual | Preliminary | Definitive] design phase of EPC Project [Unique Project Identifier]. The review was performed on the design media identified in Section 3.0 below.”

3.0 DESIGN MEDIA TO BE REVIEWED

Provide inventory and description of design documents to be reviewed, along with the FDC Design Verification Matrix information.

4.0 DESIGN REVIEW TEAM

Identify the Design Review Chairman and list the Design Review Committee team members by assignment / function / discipline. Identify alternates for each if identified.

5.0 DESIGN REVIEW SCHEDULE

The Design Review Chairman establishes the schedule for the Design Review. The schedule should include the pre-design review activities and the Formal Design Review tasks. The DRC should schedule the review meetings far enough in advance to allow team members to review the design package and prepare for the meeting.

A formal design review briefing (i.e., Kick-off Meeting) is scheduled to begin the Formal Design Review.

6.0 DESIGN REVIEW DOCUMENTATION

Describe the Design Review Documentation requirements. Discrepancies, issues, or comments are itemized in RCR forms or equivalent. All issues and comments raised and documented by the reviewers shall be dispositioned with the disposition documented on the RCR or equivalent as stated in Section 3.2. If the issue or comment is not accepted, a justification must be provided on the documentation form. The reviewer must initial his acceptance of the disposition of each of his/her comment. The documented comments shall be categorized as follows:

- Type A:
- 1) Inadequate or missing requirement or assumption or
 - 2) requirement/assumption inadequately incorporated at conceptual design.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - (Cont.) Formal Design Review Report Outline

NOTE: *All type A comments must be resolved or incorporated into the Conceptual Design Report before it is issued.*

- Type B:
- 1) Deficiencies that can be incorporated during preliminary/definitive design.
 - 2) Suggestion for a better way to design system or items that should be considered during preliminary or definitive design.

NOTE: *Type B comments may be resolved with a statement of commitment to resolve during preliminary/ definitive design.*

An RCR or equivalent form should be included as an attachment to the Formal Design Review Report. Attendance is documented for each design review meeting and meeting minutes recorded. These are included as attachments to the report.

7.0 DESIGN REVIEW RESULTS**7.1 General Design Review Criteria**

Criteria: Identify the General Design Criteria to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of General Design Criteria to be evaluated. This should include the following:

- Design Input Verification
- Assumptions
- Design Methodology
- Design Output

Acceptance Criteria

Results: Describe the results of the review for each general criterion identified.

Conclusions: Provide a statement regarding the overall status of the general design criteria reviewed. Identify any open issues needing to be resolved.

7.2 Specific Design Review Criteria**7.2.1 Quality Assurance**

Criteria: Identify the Specific Design Criteria for Quality Assurance to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Quality Assurance. This should include the following:

- Assessment of documentation quality and consistency
- Design Review Team member independence

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - (Cont.) Formal Design Review Report Outline

- Performance of issue identification, root cause analysis, and timely corrective action
- Document control process

Tracking and verification of assumptions and design requirements

Results: Describe the results of the review for each QA criterion identified.

Conclusions: Provide a statement regarding the overall status of the QA design criteria reviewed. Identify any open issues needing to be resolved.

7.2.2 Worker Safety and Health

Criteria: Identify the Specific Design Criteria for Worker Health and Safety to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Worker Health and Safety. This should include the following:

- Assessment of documentation quality and consistency
- Design Review Team member independence
- Performance of issue identification, root cause analysis, and timely corrective action
- Document control process

Tracking and verification of assumptions and design requirements

Results: Describe the results of the review for each QA criterion identified.

Conclusions: Provide a statement regarding the overall status of the QA design criteria reviewed. Identify any open issues needing to be resolved.

7.2.3 Fire Protection

Criteria: Identify the Specific Design Criteria for Fire Protection to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Fire Protection. This should include the following:

- Adequate Fire Protection strategy
- Separation of SSCs
- Life Safety-Egress considerations (approach)
- Identification of Fire Areas
- Preliminary Functional Classification

Identification of design codes and standards and requirements

Results: Describe the results of the review for each Fire Protection criterion identified.

Conclusions: Provide a statement regarding the overall status of the Fire Protection design criteria reviewed. Identify any open issues needing to be resolved.

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - (Cont.) Formal Design Review Report Outline**7.2.4 Infrastructure and System Interface**

Criteria: Identify the Specific Design Criteria for Infrastructure and System Interface to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Infrastructure and System Interface. This should include the following:

- Supporting utilities (e.g., water, steam, power, industrial gases)
- Surrounding or collocated facilities
- Supporting organizations and SMPs

Facility interface and modifications

Results: Describe the results of the review for each Infrastructure and System Interface criterion identified.

Conclusions: Provide a statement regarding the overall status of the Infrastructure and System Interface design criteria reviewed. Identify any open issues needing to be resolved.

7.2.5 Criticality Safety

Criteria: Identify the Specific Design Criteria for Nuclear and Criticality Safety to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Nuclear and Criticality Safety. This should include the following:

- Identification of the presence of fissionable material and need for criticality safety designs.
- Are design features employed to prevent criticalities as a result of natural phenomena hazards?
- Does the criticality safety design consider the effects of activation of a fire suppression system?

Is the use of engineered controls maximized in the criticality safety design?

Results: Describe the results of the review for each Nuclear and Criticality Safety criterion identified.

Conclusions: Provide a statement regarding the overall status of the Nuclear and Criticality Safety design criteria reviewed. Identify any open issues needing to be resolved.

7.2.6 Radiological Protection

Criteria: Identify the Specific Design Criteria for Radiological Protection to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Radiological Protection. This should include the following:

- ALARA considerations and strategy
- Radiological dose considerations for installation, operations, and maintenance

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - (Cont.) Formal Design Review Report Outline

- Identification of personnel radiation protection requirements
- Decommissioning considerations

Results: Describe the results of the review for each Radiological Protection criterion identified.

Conclusions: Provide a statement regarding the overall status of the Radiological Protection design criteria reviewed. Identify any open issues needing to be resolved.

7.2.7 Human Factors

Criteria: Identify the Specific Design Criteria for Human Factors to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Human Factors. This should include the following:

- Does design consider human factors for construction, testing, operations, and maintenance?
Has human reliability and error been adequately evaluated?

Results: Describe the results of the review for each Human Factors criterion identified.

Conclusions: Provide a statement regarding the overall status of the Human Factors design criteria reviewed. Identify any open issues needing to be resolved.

7.2.8 Safeguards and Security

Criteria: Identify the Specific Design Criteria for Safeguards and Security to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Safeguards and Security. This should include the following:

- Designed in structural protection for key resource or materials
- Adversary deterrence and delay
- Intrusion detection systems

Protective force resources

Results: Describe the results of the review for each Safeguards and Security criterion identified.

Conclusions: Provide a statement regarding the overall status of the Safeguards and Security design criteria reviewed. Identify any open issues needing to be resolved.

7.2.9 Environmental Protection

Criteria: Identify the Specific Design Criteria for Environmental Protection to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Environmental Protection. This should include the following:

- Identification of all environmental regulatory requirements applicable to the design

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - (Cont.) Formal Design Review Report Outline

- Identification of environmental protection practices
- Incorporation of environmental requirements in the design

Results: Describe the results of the review for each Environmental Protection criterion identified.

Conclusions: Provide a statement regarding the overall status of the Environmental Protection design criteria reviewed. Identify any open issues needing to be resolved.

7.2.10 Hazardous Material

Criteria: Identify the Specific Design Criteria for Hazardous Material to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Hazardous Material. This should include the following:

- Does design reduce incidents involving hazardous material?
- Does design minimize generation of hazardous waste?
- Are protection strategies incorporated in the design?

Are hazardous materials identified?

Results: Describe the results of the review for each Hazardous Material criterion identified.

Conclusions: Provide a statement regarding the overall status of the Hazardous Material design criteria reviewed. Identify any open issues needing to be resolved.

7.2.11 Radiological and Hazardous Waste Management

Criteria: Identify the Specific Design Criteria for Radiological and Hazardous Waste Management to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Radiological and Hazardous Waste Management. This should include the following:

- Have hazardous waste streams been identified?
- Can less hazardous materials be substituted?
- Storage and/or treatment of hazardous waste needed?

Have provisions for accidental released been addressed?

Results: Describe the results of the review for each Radiological and Hazardous Waste Management criterion identified.

Conclusions: Provide a statement regarding the overall status of the Radiological and Hazardous Waste Management design criteria reviewed. Identify any open issues needing to be resolved.

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - (Cont.) Formal Design Review Report Outline**7.2.12 Emergency Preparedness**

Criteria: Identify the Specific Design Criteria for Emergency Preparedness to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Emergency Preparedness. This should include the following:

- Have hazards been identified?
- Have less hazardous options been considered?

Does design allow for detection of emergency situations?

Results: Describe the results of the review for each Emergency Preparedness criterion identified.

Conclusions: Provide a statement regarding the overall status of the Emergency Preparedness design criteria reviewed. Identify any open issues needing to be resolved.

7.2.13 Piping and Instrumentation Diagram (P&ID) Review

Criteria: Identify the Specific Design Criteria for P&IDs to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for P&IDs. This should include the following:

- Are the P&IDs, PFDs, System Description, Equipment List, and Equipment Data sheets in sync and under configuration control?
- Is the operation of the system adequately explained?

Are there ambiguities in the design?

Results: Describe the results of the review for each P&IDs criterion identified.

Conclusions: Provide a statement regarding the overall status of the P&IDs design criteria reviewed. Identify any open issues needing to be resolved.

7.2.14 System Engineer Review

Criteria: Identify the Specific Design Criteria for System Engineer Review to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for System Engineer Review. This should include the following:

- Does the SSC have a System Engineer assigned?
- Has the System Engineer been involved in the design and analysis?

Is the System Engineer familiar with the design?

Results: Describe the results of the review for each System Engineer Review criterion identified.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - (Cont.) Formal Design Review Report Outline

Conclusions: Provide a statement regarding the overall status of the System Engineer Review design criteria reviewed. Identify any open issues needing to be resolved.

7.2.15 Nuclear Safety Hazards Analysis and Associated Controls

Criteria: Identify the Specific Design Criteria for Nuclear Safety Hazards Analysis and Associated Controls to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Nuclear Safety Hazards Analysis and Associated Controls. This should include the following:

- Are safety controls identified and incorporated at a level consistent with the current phase of design?
- Does the design should SSC functional classifications, performance categories, and seismic design criteria for natural phenomenon hazard (NPH) protection?
- Does the design address the approach to be taken to further develop and document the safety basis through the remaining project phases?

Has a confinement strategy been developed?

Results: Describe the results of the review for each Nuclear Safety Hazards Analysis and Associated Controls criterion identified.

Conclusions: Provide a statement regarding the overall status of the Nuclear Safety Hazards Analysis and Associated Controls design criteria reviewed. Identify any open issues needing to be resolved.

7.2.16 Transportation

Criteria: Identify the Specific Design Criteria for Transportation to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Transportation. This should include the following:

- Has the design identified the nuclear and hazardous material, which will be transported on-site?
- Has the design identified the methods and equipment (casks, over packs, etc.) for receiving/shipping materials (e.g., rail, truck, air, marine)?

Has the design addressed the applicable requirements for transportation of nuclear and hazardous material?

Results: Describe the results of the review for each Transportation criterion identified.

Conclusions: Provide a statement regarding the overall status of the Transportation design criteria reviewed. Identify any open issues needing to be resolved.

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix A - (Cont.) Formal Design Review Report Outline**7.2.17 Software**

Criteria: Identify the Specific Design Criteria for Software to be evaluated by the Design Review Team. Refer to Appendix B for a discussion of Specific Design Criteria for Software. This should include the following:

- Has the need for software been established?
- Has the software functional and design requirements been established?
- Has software deliverables and documentation requirements been identified?

Are the software requirements traceable to SSC functional and design requirements?

Results: Describe the results of the review for each Software criterion identified.

Conclusions: Provide a statement regarding the overall status of the Software design criteria reviewed. Identify any open issues needing to be resolved.

8.0 REFERENCES

List all documents referenced in the report.

9.0 ATTACHMENTS**9.1 Completed Review Comment Forms (RCRs or equivalent)**

Include all completed and dispositioned RCRs.

9.2 FDC Design Verification Matrix

Include the most current version of the FDC Design Verification Matrix.

9.3 Attendance Lists

Include the attendance lists form all Design Review meetings.

9.4 Meeting Minutes

Include the meeting minutes from all Design Review meetings.

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - Formal Design Review General and Specific Design Criteria Considerations

This appendix lists general and specific questions and criteria to be reviewed and evaluated during a typical design review.

1.0 GENERAL DESIGN REVIEW CRITERIA

The team conducts a review to verify/answer the following questions per CPCC-PRO-EN-8336, *Design Verification*:

1.1 Design Input Verification

Verification of design inputs is verification that the requirements listed in the FDC are sufficient for this design at the level of a conceptual design. The design inputs or requirements are identified in the FDC Design Verification Matrix (see Appendix C).

The following questions should be addressed:

- Were the design inputs correctly selected?

Have engineering standards and criteria been specified properly in the design and are the applicable codes, standards, and requirements, including revisions, properly identified?

1.2 Assumptions

Assumptions are listed in the FDC Design Verification Matrix. Verification is performed by determining if the assumptions listed in the FDC Design Verification Matrix are sufficient for this design at the current stage (conceptual, preliminary, or definitive) of design and that the assumptions that require re-verification (after conceptual) are identified.

The following questions should be addressed:

- Are assumptions necessary to perform the design activity adequately described and reasonable?

Where necessary, have assumptions been identified for re-verification when the design task is completed?

1.3 Design Method

Was an appropriate design method used? This can be determined by review of the media and interviews with the design team.

Essential design methods, materials, parts, equipment, and processes shall be chosen and assessed to ensure they are fit for their intended purpose. Information gained from past experiences, documented in reports or other formats, shall be accessible to the design personnel.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations**1.4 Design Output**

A review of the design media should answer the following questions:

- Does the design meet functional requirements? This can be determined by review of the FDC Design Verification Matrix.
- Were the design inputs correctly incorporated into the design? The FDC Design Verification Matrix provides the link to where every requirement and assumption has been incorporated into the design.
- Is the design output reasonable compared to design inputs? This review is conducted by evaluating each of the design elements identified (credited) in the FDC Design Verification Matrix and determining, in the judgment of the Design Review Committee, whether they have been adequately incorporated (or that an N/A is appropriate) for the design at the current stage of design.

Are the necessary design input and verification requirements for interfacing organizations specified in the design documents or in supporting procedures or instructions? This review is an evaluation by each of the Design Review Team members that represents an interfacing organization (i.e., Systems Interface, Operations, Quality Assurance, Nuclear Safety, Industrial Safety, Environmental, Testing, and Radiological) that the design documents, company procedures, or project procedures provide necessary design input and verification requirements for the interfacing organization they represent. This consists of a review of the FDC Design Verification Matrix and, as necessary, company and/or project procedures and instructions to determine their adequacy. The Chairman represents the interface with the company Chief Engineer for this review.

1.5 Acceptance Criteria

Have adequate acceptance criteria been specified and are the verification methods stated appropriately in the FDC Design Verification Matrix?

1.6 Criteria Applicable to Preliminary and Definitive Designs

The following questions listed in CPCC-PRO-EN-8336 are not considered to be applicable at the level of Conceptual Design, but are applicable to Preliminary and Definitive Design:

- Have suitable materials, parts, processes, inspection, and testing criteria been specified?
- Has appropriate consideration been given to use of standardized parts, materials, and processes?
- Does the design represent the simplest design consistent with functional requirements and expected service conditions?
- Can the equipment be readily assembled / disassembled as designed?
- Are the specified materials/coatings compatible with each other and with the environmental conditions to which the material will be exposed?

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations

- Have modifications to commercial grade items and any associated verification operations or tests been appropriately documented?
- Have qualified and certified parts been specified?
- Do manufacturing, processing, and fabrication procedures minimize stress corrosion and fatigue?
- Do the clearances and tolerances take into account the effects of age and wear?
- Are assembly clearances adequate?
- Does the design avoid any materials unproven for use in the anticipated environment?
- Has the design appropriately considered maintenance, operations, and reliability, including maintenance procedures and techniques, unique maintenance requirements, and frequencies?
- Can the design and its parts be easily inspected for conformance to engineering specifications and to support in-service frequencies?

Can the hardware be adequately disposed of after use if it is radiologically or chemically contaminated?

2.0 SPECIFIC DESIGN REVIEW CRITERIA**2.1 Quality Assurance (QA)**

DOE O 413.3A, *Program and Project Management for the Acquisition of Capital Assets*, requires that QA begins at project inception and continues throughout the project's life cycle. In addition, the QA requirements of 10 CFR 830, *Nuclear Safety Management* applies to nuclear facilities and CPCC-MP-QA-599, *Quality Assurance Program* applies to all DOE facilities and activities. 10 CFR 830, Subpart A, *Quality Assurance Requirements* establishes QA requirements for contractors conducting activities, including providing items or services, that affect, or may affect, nuclear safety of DOE nuclear facilities.

Consistent with that requirement, DOE O 413.3B also requires that a Quality Assurance Program (QAP), compliant with 10 CFR 830, Subpart A, and CPCC-MP-QA-599, is approved in Critical Decision 1 (CD-1) and updated and continuously applied throughout the project's life cycle.

The QA design review includes determining whether the project is using the CPCCo QAP. This specifically includes activities in the design phases of a project because quality of the design is integral to the safe operation of the facility. Inclusion of a robust QA program in the design phases strengthens the ability to achieve the goals of Safety-in-Design by identifying and correcting problems early in the design phase (when it is more cost-effective to make corrections).

In particular, the following QA activities help keep the design process on track and are subject to this review using the following criteria:

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations

The project is:

- Performing periodic assessments of the documentation, including drawing reviews, to ensure that the drawings, design calculations, and other documents are in agreement.
- Verifying that the design review team members are independent.
- Identifying problems that occur in the design process, determining the root cause, and taking timely corrective actions, both immediate and long term.
- Verifying that the design media under review are being controlled with an approved process.
- Tracking and verifying assumptions from the safety analysis or design through the Operational Readiness Review (ORR).

Tracking design requirements through inspection and testing for verification that safety SSCs meets all requirements (e.g., is the project identifying critical characteristics).

2.2 Worker Safety and Health

The focus of the Worker Safety and Health Program Rule (i.e., 10 CFR 851, *Worker Safety and Health Program*) for design review is as follows:

- Provide a place of employment that is free from recognized hazards that are causing or have the potential to cause death or serious physical harm to workers; and

Ensure that work is performed in accordance with (i) all applicable requirements of this rule; and (ii) with the worker safety and health program for that workplace.

This commitment to providing a workplace that is free of recognized hazards adds a layer of attention to the hazard analysis and facility controls that goes beyond that required for the Nuclear Safety Controls.

The 10 CFR 851 rule requires establishing a worker safety and health program that is approved by the Department. Two required areas of this rule that are of particular relevance to Safety-in-Design are fire protection and pressure safety. The rule invokes National Fire Protection Association (NFPA) requirements for fire protection and American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel code (BPV). These consensus standards are also typically invoked by DOE G 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosive Safety Criteria Guide for Use with DOE O 420.1, Facility Safety*, for safety-significant and safety-class systems and components, as well as DOE G 420.1-3, *Implementation Guide for DOE Fire Protection and Emergency Services Programs for Use with DOE O 420.1C, Facility Safety*, for all fire protection systems, regardless of safety designation. These standards represent design input into any new construction and potentially to major modifications.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations

Applicability of worker safety-related national consensus codes and standards should be recognized at the earliest stages of conceptual design and captured in appropriate requirements documents. As the design evolves into preliminary and definitive design, these codes and standards will drive certain areas of design. The Industrial Safety representative on the design review team verifies that appropriate worker safety codes & standards have been incorporated into the conceptual design.

2.3 Fire Protection (FP)

A key interface during the early design phases is identifying the potential fire hazards and scenarios that drive safety functional classification of fire protection SSCs (e.g., detection and suppression).

Fire protection design includes the following elements:

- reliable water supply
- noncombustible construction
- fire-related barriers
- detection systems
- building contents
- ventilation control

automatic suppression systems

Design is developed through a competent and thorough Fire Hazard Analysis (FHA) and interactions between the design team and Fire Protection SMEs. Design guidance for fire protection can be found in DOE G 420.1-3 and in DOE-STD-1066-99, *Fire Protection Design Criteria*. Safety Fire Protection SSCs can represent a significant cost to the overall project and present special interface challenges between Fire Protection SMEs and safety analysis disciplines. A full understanding of the implications of fire protection selection is necessary to effectively implement a strategy during definitive design. For example, selecting a confinement ventilation system that uses High Efficiency Particulate Air (HEPA) filtration necessitates considering potential particulate loading of the filters due to fire scenarios.

The Fire Protection representative provides design review of the Fire Protection aspects of design including the following:

- Separation of SSC's
- Life Safety-Egress considerations (approach)
- Identify Fire Areas
- Preliminary Functional Classification

Define design codes and standards

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations

This specifically includes the application at the conceptual level of the following FP codes and standards:

- 10 CFR 851, Worker Safety and Health Program
- DOE O 420.1C, Facility Safety
- DOE O 440.1B, Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees
- DOE-STD-1066, Fire Protection Design Criteria

DOE G 420.1-3, Implementation Guide for DOE Fire Protection and Emergency Services Programs for use with DOE O 420.1 Facility Safety

2.4 Infrastructure and System Interface

Infrastructure considerations are critical to a project. It is important to identify infrastructure needs and existing capabilities or constraints as early as practicable in the design process. In this discussion, infrastructure includes all existing facilities and utilities that will interface or that may coexist with the new facility or modification to an existing facility. The infrastructure considerations include, but are not limited to the following:

- Supporting utilities (e.g., water, steam, power, industrial gases)
- Surrounding or collocated facilities
- Supporting organizations and SMPs

Facility interface and modifications

Of particular importance is the identification of any constraints that may hinder project planning and execution. Equipment compatibility (e.g., electrical) constraints can arise when interfaces with an aged infrastructure are possible. Gas systems should be investigated to fully understand interconnections with surrounding facilities and for features relevant to the hazard analysis. Utility interfaces should be identified in both pre-conceptual and conceptual design. An important consideration is the ability of the utilities to support Safety Class (SC) and Safety Significant (SS) systems such as fire sprinkler systems. In preliminary design, specific needs should be reconciled with the existing systems capabilities and capacities to support baseline cost estimation.

Surrounding or co-located facilities need to be considered in the early stages of conceptual design. Nearby facilities may present hazards (e.g., toxic or explosive gases) that must be considered in design to protect from an external hazard. Provisions may be required within the planned facility to mitigate the effect of such events on personnel within the new facility. An analysis of the effects of nearby facilities should be completed in support of the Preliminary Safety Design Report (PSDR) and is not done at Conceptual. The System Interface representative verifies that the above considerations have been adequately addressed at the current design stage.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations**2.5 Criticality Safety**

The presence of fissionable material in quantities sufficient to sustain a critical reaction necessitates a criticality safety evaluation and inclusion of engineered controls in the design. These controls can result in a safety classification applied to some of the SSCs being designed. It becomes important to develop design criteria to address criticality concerns (e.g. safe geometry).

Criticality safety should rely on the use of engineered controls rather than administrative controls. Identification of criticality safety issues early in the process or facility design allows for increased methods to preclude criticality issues through engineered controls.

It is important to identify criticality safety design features which will prevent criticalities from being initiated by natural phenomena hazards such as seismic and wind. In addition, fire protection designs affect criticality safety. Where fire suppression systems are planned, the criticality evaluation must consider the introduction of water into the equation. This may make necessary further engineered controls to control water ingress into fissionable material containers or storage areas.

Designs should strive to make a criticality accident beyond an extremely unlikely event. If not practical, a Double Contingency Principle is used which requires control of two independent parameters.

The Criticality Safety member of the Design Review Team considers these elements when reviewing the design.

2.6 Radiological Protection

Radiological controls to achieve As Low as Reasonably Achievable (ALARA) represent a fundamental design philosophy that is used at the earliest stages of design and which is a requirement of 10 CFR 835, *Occupational Radiation Protection*. 10 CFR 835 Subpart K, *Design and Control and Facility Design and Modifications* provides key inputs into the design process. DOE G 441.1-1B, *Radiation Protection Programs Guide for Use with Title 10, Code of Federal Regulations, Part 835, Occupational Radiation Protection* Section 7.4 provides additional guidance for design. Radiological hazards are generally be considered candidates for confinement or shielding strategies to minimize worker exposure. These strategies will evolve to design requirements through the project life cycle. In addition, detection or monitoring equipment is generally required to protect workers, the public, and the environment.

The fundamental question to be answered for this design review element is: Have personnel radiation protection requirements/ ALARA been considered and properly addressed?

The Radiological/ALARA Independent Design Review will be conducted in accordance with CPCC-PRO-RP-1622, *Radiological Design Review Process*. The following elements are applicable to the Formal Design Review.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations**Independent Radiological Design Review Elements**

<i>Design Review Element</i>	<i>CPCC-PRO-RP-1622 Reference</i>	<i>Note</i>
Assignment of Radiological Protection SME to Design Review Team (by Decision Design Authority)	2.3.1	Completed by issue of this plan
Examine the design at defined steps during the development of design, particularly at major design review points.	2.3.2	Performed at CD-1, CD-2, and CD-3
Review the use of ALARA decision-making methods for the evaluation of ALARA alternatives, the presence of radiological design requirements and compliance with regulations.	2.3.3	Performed as part of the Formal Design Review.
Be implemented by Personnel who are competent in disciplines affected by the design including instillation and operational personnel, additionally the design team is expected to be familiar with ALARA design principles outlined by DOE. The radiological professional must have sufficient experience and access to resources to guide and evaluate the design.	2.3.4	Determined by DRC.
Include the use of reminder lists of radiological requirements and good practices and other written guidance.	2.3.5	Responsibility of the Design Review Team member(s).
Consider the radiological dose due to installation, maintenance, and operations.	2.3.6	Performed as part of the Formal Design Review.
Consider waste minimization from the earliest design stage.	2.3.7	Performed as part of the Formal Design Review.
Consider decommissioning from the earliest design stage.	2.3.8	Performed as part of the Formal Design Review.
Include a post-construction review of radiological design effectiveness.	2.3.9	Applicable to Definitive Design
Include written reports of findings and recommendations at each stage of the review.	2.3.10	Performed as part of the Formal Design Review.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations**2.7 Human Factors**

In the context of safety basis development, DOE-STD-3009-94, Change Notice 3, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, defines human factors to consist of the following:

- Human factors engineering that focuses on designing facilities, systems, equipment, and tools so they are sensitive to the capabilities, limitations, and needs of humans; and

Human reliability analysis that quantifies the contribution of human error to the facility risk.

These two factors apply to the design in (1) the layout and design of SSCs for operation, construction, maintenance, and testing or surveillance; and (2) in the evaluation of failure probability of human relied upon actions. In some instances, these factors overlap (e.g., control room operator action).

The connection to the safety analysis is, in many cases, indirect in that, by including this philosophy, inadvertent human errors can be minimized. This is specifically important to ensure that administrative controls can be implemented within the facility.

Within the project life cycle, the human potential for error is effectively addressed through the hazards analysis process and industrial or programmatic safety programs that identify other opportunities to avoid error potential. This is a normal part of design evolution and should be factored into the design process as those human factors reviews occur over the life cycle (particularly through preliminary and definitive design stages).

Human factors for design are established as a design philosophy early in the conceptual design phase. This philosophy will evolve to consider standard human interface issues. Many codes and standards reflect this approach, and it is inherent in the standards. The reviews by Operations and Testing representatives should ensure testability, operability, and Human Factors have been incorporated into the design.

2.8 Safeguards and Security

Some measure of security is required to be addressed for most DOE facilities. The following security issues should be considered for the project:

- Designed structural protection for key resource or materials
- Adversary deterrence and delay
- Intrusion detection systems

Protective force resources

Aspects of the security scheme must be coordinated with the structural design. However, security plans and security assessments are required in the security domain and these documents may influence the design. The operations representative to the design review team is expected to review security in design.

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations**2.9 Environmental Protection**

The design should address all applicable environmental regulatory requirements. These include regulations issued by the Environmental Protection Agency and by delegated states pursuant to statutes such as the Clean Air Act, the Clean Water Act, and the Resource Conservation and Recovery Act (RCRA). Other requirements (e.g., protection of endangered species, protection of historic and cultural resources) may also be apply.

DOE O 450.1A, *Environmental Protection Program* and associated guides provide further information relative to environmental protection practices. The environmental requirements applicable to design must be reflected in the design requirements.

The Environmental Design Review Team representative verifies that all environmental requirements have been identified and have been (or plan to be) incorporated into the design.

2.10 Hazardous Material

Similar to radiological hazards, DOE requirements invoke an ALARA concept for the protection of workers from hazardous materials. Design should support the primary objective of reducing the frequency, severity, and cost of incidents involving hazardous material, as well as the cost of hazardous operations. Prevention practices, such as substitution of less hazardous materials in a project or design of a process to reduce generation of hazardous waste, should be examined prior to consideration of protection strategies. Protection strategies will generally involve confinement strategies, such as gloveboxes, piped systems, and tanks, as well as administrative controls. The approach will typically be driven by the magnitude of the hazard and inventory. The design must incorporate the ALARA approach and make provision for hazardous material control and facility protection instrumentation, as needed.

Major hazardous materials, typically associated with process requirements, should be identified and considered within the design. The process design will identify and refine inventory or maximum anticipated quantities of hazardous material. Codes and standards to be applied should be specified for application in preliminary and definitive design. Provisions for facility monitoring and protection instrumentation for worker protection need to be considered during preliminary / definitive design.

Further guidance is available in the DOE-HDBK-1139/2-2006, *Chemical Management (Volume 2 of 3) Chemical Safety and Lifecycle Management*.

The Occupational Health and Safety Design Review Team representative is expected to review the design with respect to hazardous material.

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations**2.11 Radiological and Hazardous Waste Management**

CRD O 420.1C, *Facility Safety*, requires that facility process systems be designed to minimize waste production and mixing of radioactive and nonradioactive waste. Hazardous waste streams, including types, sources, and quantities should be identified early in the design and prevention practices, such as substitution of less hazardous materials in a project or design of a process to reduce generation of hazardous waste, should be examined to reduce management costs of these waste streams. These waste streams including storage and treatment and disposal systems are considered in design. Any potential for accidental releases from waste handling and treatment systems should be addressed during the hazard analysis process in the preliminary and definitive design phase.

2.12 Emergency Preparedness

CRD O 151.1D, *Comprehensive Emergency Management System*, and its accompanying guidance set, the DOE G 151.1-series, establishes specific requirements and methods for the Emergency Management Program (EMP). Early integration of EMP considerations into the safety design process can provide opportunities to minimize the hazardous nature of operations and to improve the ability to respond if an emergency occurs. The Emergency Planning Hazards Assessment (EPHA) for the EMP starts from the hazards analyses that support the safety design basis.

At the early stages in the project, only major hazards are likely to be known. The design team, and safety analysts work together to identify options that may be less hazardous. Incorporating instrumentation, hardware, and related requirements into the design can improve the ability to detect emergency situations during operations. Early recognition of an event is essential to enable potentially affected workers and the public to take actions to prevent or limit their exposure to hazardous materials. Provisions in the design may be appropriate to support recovery and reentry.

2.13 Piping and Instrumentation Diagram (P&ID) Review

A detailed review of the P&IDs is conducted by the Design Review Team. The Design Agent's engineering discipline lead engineers should be available to describe the system's design and operational control. A detailed line-by-line mark-off of every item on each P&ID should be performed as the Design Agent describes the equipment depicted. As a minimum, the Process Flow Diagram, System Description, Equipment List, and Equipment and Instrument Data Sheets are cross-checked for accuracy. The piping specification, narrative control philosophy, and functional requirements document should also be available for the review. The review serves to assure configuration control and confirm equipment consistency among the design media, explain the operation of the system, and address any ambiguities or misunderstandings of the design.

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations**2.14 System Engineer (SE) / Design Authority (DA) Review**

It is important to identify the System Engineer or Design Authority assigned to the SSC (when it becomes operational) and involve them in the design and hazards analysis process. In accordance with DOE-STD-1189-2008, "Ideally, this should begin in the definitive design phase so that they may become familiarized with the design in preparation for more direct involvement in the construction phase."

CRD O 420.1C requires application of a System Engineer (SE) program to "active safety class and safety significant SSCs as defined in the facility's DOE-approved safety basis, as well as to other active systems that perform important defense-in-depth functions, as designated by facility line management." An objective of the program is to ensure operational readiness of systems within scope.

2.15 Nuclear Safety Hazards Analysis and Associated Controls

The nuclear safety deliverables in support of design have been prepared and are integrated into the design. For CD-1, the deliverables include:

- A preliminary hazards analysis
- An accident analysis that establishes facility level design basis accidents
- A preliminary facility hazards classification
- A control decision document
- A risk and opportunity assessment
- An update to the project Safety Design Strategy (SDS)

A conceptual safety report

The reviewer verifies that each of these above has been prepared to the appropriate requirements of CPCCo procedures and the applicable standards, primarily DOE-STD-1189-2008.

The Nuclear Safety Design reviewer will verify that safety controls have been incorporated at a level consistent with the current phase of design. The media to be reviewed include, as a minimum, the General Arrangement Drawings, System Description, Control Philosophy, Process Flow Diagrams, and Piping and Instrumentation Diagrams.

Per DOE-STD-1189 Section 6.1, the design should address "SSC functional classifications, performance categories, and seismic design criteria for natural phenomenon hazard (NPH) protection."

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix B - (Cont.) Formal Design Review General and Specific Design Criteria Considerations

Also, per DOE-STD-1189, the design should address the “approach to be taken to further develop and document the safety basis through the remaining project phases.” The Nuclear Safety representative will verify that these requirements have been adequately met in during the Formal Design Review.

At the conceptual design phase, a confinement strategy should be complete and adequately described in the design.

2.16 Transportation

Review the requirements identified in the design requirements and determine if the project has:

- Identified and documented the applicable nuclear and hazardous material, which will be transported on-site.

Identified the methods and equipment (casks, over packs, etc.) for receiving/shipping materials (e.g., rail, truck, air, marine).

2.17 Software

For systems using software as part of their control scheme or data acquisition needs, design review activities specific to software are performed by the Design Review Team. These activities include:

- Adequate establishment of the need for software and required software deliverables (e.g., software specification, software design description, control system description, software testing approach)
- Adequate identification of the software functional requirements and design criteria
- technical adequacy of the software design approach
- completeness, consistency, clarity, and correctness of the software design

traceability of the design to the software requirements

Formal Design Review Standard

Published Date: 12/29/25

Effective Date: 12/29/25

Appendix C - FDC Design Verification Matrix

Refer to CPCC-STD-EN-40255, *Functional Design Criteria*, for more information regarding the FDC Design Verification.

1	2	3	4			5	6	7
Item No.	Requirement Basis (Source Document Number & Section / Paragraph)	Requirement Text (Use Quotes)	Were These Requirements Met?			How the requirements (or assumptions) were met with reference to where evidence is found in design output document OR explanation why the item is N/A	Verification Method	Verified By
			Yes	No	N/A			
Applicable Project Requirements:								
Design Assumptions: DSA Assumptions (if applicable); Project technical assumptions that would impact design or deployment.								