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2nd Edition

Environmental Management

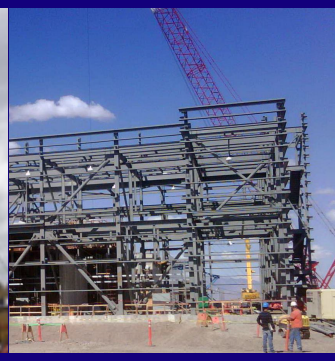
Safety ▪ Performance ▪ Cleanup ▪ Closure

Standard Review Plan (SRP)

Final Design Review Module







Corporate Critical Decision (CD) Review and Approval Framework Associated with Nuclear Facility Capital and Major Construction Projects

March 2010

Office of Environmental Management
U.S. Department of Energy
Washington D. C. 20585

OFFICE OF ENVIRONMENTAL MANAGEMENT

Standard Review Plan (SRP)

Final Design

Review Module

Critical Decision (CD) Applicability					
CD-0	**CD-1**	**CD-2**	**CD-3**	**CD-4**	**Post Operation**
			✓		

March 2010

[This Review Module was used to develop the Review Plan for 90% Design Review of SWPF in 2008 and for 60% Design Review of the OR U 233 Disposition Project in 2009. Lessons learned have been incorporated in the Review Module.]

FOREWORD

The Standard Review Plan (SRP)[1] provides a consistent, predictable corporate review framework to ensure that issues and risks that could challenge the success of Office of Environmental Management (EM) projects are identified early and addressed proactively. The internal EM project review process encompasses key milestones established by DOE O 413.3A, Change 1, *Program and Project Management for the Acquisition of Capital Assets*, DOE-STD-1189-2008, *Integration of Safety into the Design Process*, and EM's internal business management practices.

The SRP follows the Critical Decision (CD) process and consists of a series of Review Modules that address key functional areas of project management, engineering and design, safety, environment, security, and quality assurance, grouped by each specific CD phase.

This Review Module provides the starting point for a set of corporate Performance Expectations and Criteria. Review teams are expected to build on these and develop additional project-specific Lines of Inquiry, as needed. The criteria and the review process are intended to be used on an ongoing basis during the appropriate CD phase to ensure that issues are identified and resolved.

[1] *The entire EM SRP and individual Review Modules can be accessed on EM website at http://www.em.doe.gov/Pages/Safety.aspx , or on EM's internet Portal at https://edoe.doe.gov/portal/server.pt Please see under /Programmatic Folder/Project Management Subfolder.*

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ACRONYMS

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ALARA	AS Low as Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
CD-(N)	Critical Decision – (numbered)
DOE	Department of Energy
DSA	Documented Safety Analysis
EM	Office of Environmental Management
FD	Final Design
FPD	Federal Project Director
HVAC	Heating Ventilation and Air Conditioning
MEL	Master Equipment List
NFPA	National Fire Protection Association
NPH	Natural Phenomena Hazards
P&ID	Piping and Instrumentation Diagram
PDSA	Preliminary Documented Safety Analysis
PDSR	Preliminary Design Safety Report
PFHA	Preliminary Fire Hazards Analysis
QA	Quality Assurance

SDD	System Design Description
SDS	Safety Design Strategy
SQA	Software Quality Assurance
SRD	Systems Requirements Document
SSC	Structures, Systems and Components

I. INTRODUCTION

Design Reviews are an integral part of the contractor and federal project management process. As stated in DOE Order 413.3A, Change 1, *Program and Project Management for the Acquisition of Capital Assets:*

> *Beginning at CD-1 and continuing through the life of the project, as appropriate, Design Reviews are performed by individuals external to the project. Design Reviews are performed to determine if a product (drawings, analysis, or specifications) is correct and will perform its intended functions and meet requirements. Design Reviews must be conducted for all projects and must involve a formalized, structured approach to ensure the reviews are comprehensive, objective, and documented.*

Final design is the last phase of development prior to construction. The purpose of the final design phase in a project is to prepare final drawings, technical specifications, and contract documents required to obtain bids and quotes for procurement and construction. Final design review is typically conducted when the design is about 90% completion. However, final design review can be conducted anytime after preliminary design. For instance, an initial final design can be performed when the design is at 60% completion.

In preparation for Critical Decision (CD)-3 approval the Federal Project Director must ensure that the contractor is ready to proceed with construction. This involves verification that the final design is complete, such that is provides an adequate basis upon which to construct the facility. The Final Design (FD) review supports this goal by evaluating the technical adequacy of the engineering design and ensuring that safety and quality assurance related activities and products are up to date.

II. PURPOSE

The Final Design (FD) Review Module (RM) is a tool that assists Department of Energy (DOE) federal project review teams in evaluating the technical sufficiency of the final design prior to CD-3 approval. The FD RM focuses on the engineering design, technology, safety, and quality assurance to determine whether it meets overall design commitments, technical and safety requirements. It also evaluates whether the design supports performance of the established facility functions. A FD review principal focus is on the effectiveness of the design in meeting safety, health, and engineering standards, addressing technical risks, and ensuring successful constructability. Additionally, a FD review should concentrate, as appropriate, on the design aspects associated with interfaces that rely on existing site infrastructure. FD reviews may include project quality assurance program effectiveness in addressing a project's design and configuration management needs as well as effectively implementing requirements established in 10CFR830, Subpart A and DOE O 414.1C.

This module does not explicitly target other project areas such as cost and schedule, security, and environmental protection. Also, the safety basis review in the FD review is focused on the interface between safety basis development and design. Safety basis review guidance is established by DOE directives, including DOE-STD-1104. It is expected that the FD review will

be performed in conjunction with other reviews for items such as security and environmental protection and that the Federal Project Director (FPD) will use input from all of these reviews to determine if the project is ready to proceed to the next phase and begin construction.

The performance objectives and criteria presented in Appendix A of this FD RM are focused largely on the quality, the operability and the constructability of the design. Other elements of the final design review process are addressed in other Office of Environmental Management (EM) SRP RM's.

III. ROLES AND RESPONSIBILITIES

A successful FD review depends on an experienced and qualified team. The team should be augmented with appropriate subject matter experts selected to complement the specific technical concerns of the project being reviewed (e.g., Structural, Seismic, Mechanical Engineering, Quality Assurance, etc.). The specific types of expertise needed will be dependent on the type of facility being reviewed, as well as other factors such as complexity and hazards or risks.

It is preferred that personnel selected to participate in a design review have design experience. This is particularly relevant for reviewers who evaluate engineering design elements against industry standards or other regulatory design requirements. It may not be practical or necessary for some other subject matter experts, such as various safety disciplines, to have this experience.

It is strongly recommended that the team leader should either be a project or systems engineer experienced in the management of a multi-disciplined review team (e.g. mechanical, electrical chemical, industrial, nuclear) that matches to the extent practicable the contractors design team. The review team should be augmented with subject matter experts as appropriate to review specialty matters such as structural analysis, seismic design criteria, criticality, and energetic reactions.

Management support is another necessary component to a successful FD review. Field element managers, as well as the FPD, must recognize the importance of the FD review and facilitate the resources necessary for its execution. This also requires appropriate interfaces with EM headquarters personnel who may direct or participate in the FD review process.

The roles and responsibilities for all involved in the FD review must be clear and consistent with various requirements of DOE O 413.3A. The table below provides a compilation of design review roles and responsibilities.

Position	Responsibility
Field Element Manager	Provides support and resources to the Federal Project Director and Review Team Leader in carrying out the design review.
	Facilitates the conduct of the design review. Assigns office space, computer equipment, and support personnel to the team as necessary to accomplish the review in the scheduled time frame

Position	Responsibility
Federal Project Director	Identifies the need for a FD review and determines the scope of the review effort.
	In conjunction with the Contractor Project Manager, develops the briefing materials and schedule for the review activities.
	Coordinates the review team pre-visit activities and follows up review team requests for personnel to interview or material to review.
	Coordinates the necessary training and orientation activities to enable the review team members to access the facility and perform the review.
	Unless other personnel are assigned, acts as the site liaison with the review team. Tracks the status of requests for additional information.
	Coordinates the Federal site staff factual accuracy review of the draft report.
	Leads the development of the corrective action plan if required. Tracks the completion of corrective actions resulting from the review.
Review Team Leader	In coordination with the Federal Project Director and the Acquisition Executive, selects the areas to be reviewed.
	Based on the areas selected for review, project complexity and hazards involved, selects the members of the review team.
	Verifies the qualifications: technical knowledge; process knowledge; facility specific information; and independence of the Team Members.
	Leads the design review pre-visit.
	Leads the review team in completing the Review Criteria for the various areas to be reviewed.
	Coordinates the development of the data call and forwards to the Federal Project Director, a list of documents, briefings, interviews, and presentations needed to support the review.
	Forwards the final review plan to the Acquisition Executive for approval.
	Leads the on-site portion of the review.
	Ensures the review team members complete and document their portions of the review and characterizes the findings.
	Coordinates incorporation of factual accuracy comments by Federal and Contractor personnel on the draft report.
	Forwards the final review report to the Acquisition Executive for consideration in making the decision to authorize start of construction.
	Participates, as necessary in the closure verification of the findings from the review report.
Review Team Member	Refines and finalizes the criteria for assigned area of the review.
	Develops and provides the data call of documents, briefings, interviews, and presentations needed for his or her area of the review.
	Completes training and orientation activities necessary for the review. Conducts any necessary pre-visit document review.
	Participates in the on-site review activities, conducts interviews, document reviews, walk downs, and observations as necessary.
	Based on the criteria and review approaches in the Review Plan, assesses whether his or her assigned criteria have been met.
	Documents the results of the review for his or her areas. Prepares input to the review report.
	Makes recommendations to the Review Team Leader for characterization of findings in his or her area of review.

Position	Responsibility
	Resolves applicable Federal and Contractor factual accuracy comments on the draft review report.
	Prepares the final review report for his or her area of review.

IV. REVIEW SCOPE AND CRITERIA

This FD RM provides a set of review criteria that are organized into several technical/safety areas and engineering disciplines. These review areas are summarized below and include general requirements, radiation protection, criticality safety, fire protection, safety basis, integrated safety management, quality assurance (including software quality assurance), civil/structural, engineering design (process design/layout, mechanical and piping, electrical, instrumentation and control, Heating Ventilation and Air Conditioning (HVAC), and configuration management. For each review area, Appendix A of this Module provides overall performance objectives and then a subset of review criteria that satisfy each performance objective. These performance objectives and review criteria will provide consistent guidance to project-specific design review teams to develop their Lines of Inquiry.

General Requirements

This area of the review is intended to ensure that the final design meets the operational and functional objectives of the project and that project documentation is adequate for approval of CD-3.

Radiation Protection

This area is focused on ensuring that the final design supports safety of operations and activities involving radiological material through engineered controls and barriers. A major emphasis of the review is concerned with 10 CFR 835 Subpart K – Design and Control elements and with physical design elements (e.g., confinement, shielding) rather than overall radiological control program requirements. Other aspects of 10 CFR 835, as well as DOE-STD-1098-99, *Radiological Control*, and the contractor's AS Low as Reasonably Achievable (ALARA) Program also require verification within the final design.

Criticality Safety

The intent of this review area is to ensure that the final design adequately considers the potential for criticality in planned activities and that the design implements the necessary and appropriate controls consistent with DOE O 420.1B and related American National Standards Institute (ANSI) / American Nuclear Society (ANS) Standards. The FD review is focused on the physical design elements rather than the overall criticality safety program

Fire Protection

The purpose of this review area is to ensure that the final design adequately considers fire safety in the planned activities and the design implements the necessary and appropriate controls consistent with DOE O 420.1B, DOE-STD-1066-99, National Fire Protection Association (NFPA) standards, and other applicable regulatory requirements. The areas of review are derived from these requirements as related to physical design elements rather than the overall the fire protection program.

Safety Integration

Two primary aspects of safety integration are evaluated in the FD review. The first is on the overall management philosophy and approach to integrating safety into design. This review area establishes whether an Integrated Safety Management Description Document has been prepared and updated to address the final design activities. A major component of this review area is also to establish that workplace hazards have been identified and incorporated into the facility design.

The second aspect is related to the Safety Basis review area for Hazard Category 1, 2 or 3 nuclear facilities. This review area is not intended to include or conflict with other ongoing reviews of the Safety Basis Documents, which are conducted in accordance with DOE-STD-1189. Rather, this review area is focused on verifying that controls derived from the safety basis are adequately captured in the final design. This includes verification that appropriate safety classifications are assigned to Structures, Systems and Components (SSCs) within design documentation and that design commitments are consistent with DOE O 420.1B. The DOE review of the contractor's safety basis programs and activities is covered in DOE-STD-1104. This should include consideration of site characterization, including Natural Phenomena Hazards (NPH) elements (e.g., seismic, wind, flood), and appropriate performance criteria, integrated with the Civil/Structural elements below.

Quality Assurance

This review is primarily derived from the requirements of American Society of Mechanical Engineers (ASME) NQA-1- 2000 or later edition and 10 CFR 830 Subpart A and focuses on the design elements rather than the overall Quality Assurance (QA) program. The primary objectives are to ensure that (1) design inputs are correctly selected and translated into design documents in a timely manner; (2) design methods are appropriate; (3) organizational and physical interfaces are identified and controlled; (4) suitable materials, parts processes, and inspections and testing criteria have been specified; (5) changes to design are controlled in a manner commensurate with the original design; (6) the design is independently verified to be adequate; and (7) documentation and records of the design and design verification processes are maintained in accordance with the QA program. A software quality assurance (SQA) review should also be conducted as part of the overall QA review. This includes any software used to classify, design, or analyze structures, systems and components relied on to protect workers, the public and environment.

The requirements identified in 10 CFR830.122, Criterion 6 addresses QA for the design process and form the primary basis for the performance objectives. Also included are requirements from DOE Order O 414.1C, Quality Assurance, and the contractor's project specific Quality Assurance Plan.

Civil/Structural/Seismic

The purpose of this review area is to ensure that the geotechnical/seismic studies, structural design and associated calculations, drawings and specifications are complete for the final design. Requirements from DOE O 420.1B and the DOE standard 1020 series related to NPH design form a major emphasis for the FD Review. Validation associated with design calculations should be performed as part of the final design review process. Proper use of national standards, such as those promulgated by the American Concrete Institute (ACI), American Institute of Steel Construction (AISC), American Welding Society (AWS), etc. throughout project civil/structural specifications, will be confirmed.

Engineering Design

A major emphasis of the FD review is on the engineering functions that relate to facility systems necessary for confining hazardous and radioactive materials, either as a direct barrier or supporting a critical function of a safety system. The FD RM addresses performance objectives and criteria according to process design/layout, mechanical and piping, electrical, instrumentation and control, and HVAC. A number of DOE directives and industry standards provide good engineering principles, as well as functional design requirements, that form the basis for the FD review. Some examples are as follows:

- DOE Order O 420.1B, Facility Safety
- DOE-STD-3024-98, Content of System Design Descriptions (SDD)
- DOE-HDBK-1169-2003, Nuclear Air Cleaning Handbook
- DOE-STD-1189-2008, Integration of Safety into the Design Process
- DOE-HDBK-1132-99, Design Considerations
- DOE-HDBK-1092-2004, Handbook on Electrical Safety

Configuration Management

Although Configuration Management is normally managed from within the Engineering Organization, its application to a construction project begins very early in the project planning and continues throughout the life of the project. For this reason, as well as for its importance in satisfying facility safety requirements it should be reviewed as a separate area. The review focuses on configuration management requirements found in DOE Order O 420.1B, *Facility Safety*; DOE STD-1073-2003, *Configuration Management Program*; and the Site/Contractor Configuration Management Program

V. REVIEW PLANS AND DOCUMENTATION

The results of a FD review will be used by the DOE Federal Project Director and ultimately the Acquisition Executive to help determine whether project funds may be authorized to authorize construction. It is important to clearly document the methods, assumptions and results of the FD review. The overall SRP provides guidelines for preparing a Review Plan and a final report.

The following activities should be conducted as part of the Review Plan development and documentation/closure of the review:

- Subsequent to the selection, formation and chartering of the review team and receipt and review of the prerequisite documents, assignment of responsibilities for the development of specific lines of inquiry should be made.
- The review team members should develop specific lines of inquiry utilizing the topics and areas listed in the respective appendices of this module.
- The individual lines of inquiry should be compiled and submitted to the manager authorizing the review for concurrence prior to starting the review.
- The project-specific review plan should be compiled with a consistent and uniform numbering scheme that provided for a unique identifier for each line of inquiry, arranged by subject area (e.g. Management-Personnel and Qualifications, Management-Processes and Systems, Technical-Civil, etc.) such that the results of each line of inquiry can be documented and tracked to closure.
- The lines of inquiry should be satisfied via document review and personnel interviews and any combination of these methods. The method used the basis for closure/comment/finding and the result of the inquiry should all be documented and tracked.

The Review Plan should be broken down to provide coverage of the following topics.

Review Coverage

The physical areas of the facility operations that are subject to the PDR should be presented, along with subject areas that are being reviewed. Any areas that are excluded from the review should be discussed, along with the rationale for exclusion.

Design Assumptions

Design assumptions include any process decisions that frame the scope of the design effort and must be considered by reviewers when validating performance. This may include assumptions such as final product forms or performance characteristics related to operational steps or processes. Any explicit expectations imposed on the contractor by DOE, above and beyond those requirements and standards contained in the design contract, are also important assumptions that should be conveyed so that actions to modify the contract can be initiated to support document submittal/approval.

Performance Baseline Documents

The primary documents that form the project technical requirements and that are the basis for review criteria should be referenced in this section. At a minimum this should list the DOE contract that commissions the design, Facility and Design Description Documents, and DOE Order 420.1B and associated review guides/standards.

Design Documents

Design documents include facility documents expected to be provided to the Review Team. A detailed inventory list of all documentation is not necessary in this section. Rather, it should focus on document types expected. Where applicable, this includes the following types of documents: Facility and Design Description Documents; process flow diagrams; Preliminary Safety Design Report; structural drawings, calculations and specification; electrical drawings, calculations and specifications; instrumentation and controls drawings, calculations and specifications; mechanical drawings, calculations and specification; process system drawings, calculations, and specifications.

Performance Objectives and Criteria

The performance objectives and criteria that apply to the review process will be selected and presented in this section, or attached as an appendix to the Review Plan. These should be based on Appendix A of this RM, as applicable based on specific project characteristics. The rationale for selection should be presented.

VI. REFERENCE MATERIAL

- DOE Order DOE O 413.3A, Change 1, *Program and Project Management for the Acquisition of Capital Assets*
- DOE Manual DOE M 413.3-1, *Project Management for the Acquisition of Capital Assets*
- DOE Standard DOE-STD-1189-2008, *Integration of Safety into the Design Process*.
- DOE Order DOE O 420.1B, *Facility Safety*
- DOE Guide DOE G 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives*
- DOE G 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide for use with DOE O 420.1, Facility Safety*
- DOE G 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*
- DOE Order DOE O 430.1B, *Real Property Asset Management*
- DOE Guide DOE G 430.1-1, Chapter 3, *Stages of Project Development*
- DOE Standard DOE STD -3024-98, *Content of System Design Descriptions*
- DOE-STD-3009, Change Notice No. 3, March 2006, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*
- DOE-STD-1020-2002, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*

- DOE-STD-1021-93, *Natural Phenomena Hazards Performance Categorization Criteria for Structures, Systems, and Components*
- DOE-STD-1022-94, *Natural Phenomena Hazards Site Characterization Criteria*
- DOE-STD-1023-95, *Natural Phenomena Hazards Assessment Criteria*
- ANSI/ANS 2.26-2004, *Categorization of Nuclear Facility Structures, Systems and Components for Seismic Design*
- ASCE/SEI 43-05, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*
- ANSI/ANS-2.27-2008, *Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments*
- ANSI/ANS-2.29-2008, *Probabilistic Seismic Hazard Analysis*
- DOE Standard DOE-STD-3006-2003, *Handbook for the Conduct of Operational Readiness Reviews*
- DOE Handbook DOE-HDBK-1132-99, *Design Considerations*
- DOE O 414.1C, *Quality Assurance*
- DOE G 414.1-4, *Safety Software Guide for Use with 10 CFR 830 Subpart A, Quality Assurance Requirements and DOE O 414.1C, Quality Assurance*
- DOE G 413.3-5, *Performance Baseline*
- SPD-SWPF-217, *Salt Waste Processing Facility Independent Technical Review*
- U-233 Material Downblending and Disposition Project 60% Design Review Report, January 2008, Revision 0
- NUREG-1718, *Standard Review Plan for the Review of a Mixed Oxide (MOX) Fuel Fabrication Facility*
- DOE Order O 6430.1A, *General Design Criteria* [Archived]

APPENDIX A – PERFORMANCE OBJECTIVES AND CRITERIA

Legend of Final Design Review Topics

Review Topical Area	Identifier
General Requirements	GR
Radiation Protection	RP
Criticality Safety	CS
Fire Protection	FP
Safety Integration	SB
Quality Assurance	QA
Civil/Structural/Seismic	NPH
Engineering Design	ED
-Process Design/Layout	ED-1
-Mechanical and Piping	ED-2
-Electrical, Instrumentation and Control	ED-3
-HVAC	ED-4
Configuration Management	CM

ID #	Performance Objectives and Criteria[2]	Met?
General Requirements		
GR-1	Are the management documents associated with the project sufficiently complete and contain enough detail to support proceeding to the construction phase?	
	Has the final design address the safety and health standards, technical risks, and construction or operability requirements? **(GR-1.1)**	
	Has the project satisfied the requirements and commitments identified during the preliminary design phase? **(GR-1.2)**	
	Are the Project Execution Plan schedule, milestones and completion date achievable in agreement with the design submittals? **(GR-1.3)**	
GR-2	Does the design meet the final design expectations, as defined in site procedures and meets Performance Requirements developed in the Design Requirements Document?	
	Is there a clear and complete system for tracking design assumptions to assure their resolution prior to construction and operations? **(GR-2.1)**	
	Has the design incorporated adequate provisions for the safe removal, treatment, and disposition of secondary waste and other byproducts of the process? **(GR-2.2)**	
	Is the process equipment expected to survive the environment long enough to fulfill its mission where the equipment will be exposed to demanding environmental conditions? **(GR-2.3)**	
	Does the design incorporate construction and process materials suitable for the site and process environment? **(GR-2.4)**	

[2] *The site should provide the technical bases and assumptions that support the answers provided to each Line of Inquiry. If possible, the review teams should independently verify the technical bases and assumptions.*

ID #	Performance Objectives and Criteria[2]	Met?
	Do the test results demonstrate the facility process effectiveness? **(GR-2.5)**	
	Have any additional reasonable measures been identified that could be implemented to facilitate the replacement of key pieces of equipment that are susceptible to degradation? **(GR-2.6)**	
	Has the project identified all assumptions and requirements that are required to be carried forward to ensure that appropriate requirements for construction and administrative controls are developed? **(GR-2.7)**	
GR-3	Has the System Description documentation properly integrated the Facility design with the Process design?	
	Is the structural design for the facility been coordinated with the process design effort to ensure adequate space is available for installation and operation of all the equipment that is designated to be installed? **(GR-3.1)**	
	Has the System Design Descriptions been prepared for safety related systems and do they meet the requirements of DOE Order O 420.1B and DOE Standard DOE STD -3024-98, *Content of System Design Descriptions*? **(GR-3.2)**	
GR-4	Is there a process in place to resolve any remaining technical uncertainties and to validate design assumptions?	
	Are all elements of the process demonstrated at full scale and production throughput verified by demonstration or calculation? **(GR-4.1)**	
	Are prototypes being acquired for any machine or process which not previously was used in this application? Does the testing schedule provide confidence that the project schedule can be met? **(GR-4.2)**	
	Has design assumptions been identified and there is there process in place to verify them with actual field measurement or modeling? **(GR-4.3)**	
	Are new fluid systems being tested with mock-ups or with surrogate material to verify flow rates, hold up issues, or capacity? **(GR-4.4)**	
Radiation Protection		
RP-1	Does the facility design meet the requirements of 10 CFR 835 Subpart K – Design and Control?	
	Has the primary measures taken to maintain radiation exposure in controlled areas ALARA accomplished through physical design features (e.g., confinement, ventilation, remote handling, and shielding)? **(RP-1.1)**	
	Are Design features adequate to meet design objectives for controlling personnel exposure (concrete walls of sufficient thickness; penetrations and galleries adequately designed)? **(RP-1.2)**	
	Administrative controls employed only as supplemental method to control radiation exposure where use of physical design features is demonstrated to be impractical? **(RP-1.3)**	
	Have optimization methods been used to assure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls? **(RP-1.4)**	
	Is the Design objectives for controlling personnel exposure from external sources of radiation in areas of continuous occupancy (2000	

ID #	Performance Objectives and Criteria[2]	Met?
	hours per year) to maintain exposure levels below an average of 0.5 mrem (5 microsieverts) per hour and as far below this average as is reasonably achievable? The design objectives for exposure rates for potential exposure to a radiological worker where occupancy differs from the above shall be ALARA and shall not exceed 20 percent of the applicable standards in Sec. 835.202. **(RP-1.5)**	
	Are the confinement and ventilation design features are relied on for control of airborne radioactive material, consistent with a design objective to avoid releases to the workplace atmosphere and in any situation, and then to control the inhalation of such material by workers? **(RP-1.6)**	
	Is the design or modification of a facility and the selection of materials including features that facilitate operations, maintenance, decontamination, and decommissioning? **(RP-1.7)**	
RP-2	Does the facility design meet the requirements of 10 CFR 835 Subpart E, Monitoring of Individuals and Areas?	
	Does it provide for : • Adequately documenting radiological conditions. • Detecting changes in radiological conditions. • Detecting gradual buildup of radiological material. • Verifying the effectiveness of engineering and process controls in containing radioactive materials and reducing radiation and/or radioactive material • Identifying and controlling potential sources of individual exposure to radiation and/or radioactive material? **(RP-2.1)**	
	Does the facility Identify instruments that are: • Appropriate for the type(s), levels, and energies of the radiation(s) encountered • Appropriate for existing environmental conditions? **(RP-2.2)**	
RP-3	Is the facility design inconsistent with the requirements of 10 CFR 835 Subpart F – Entry Control Program?	
	Facility design provides for entry control commensurate with the existing and potential radiological hazards within the area including one or more of the following methods: • Signs and barricades • Control devices on entrances; • Conspicuous visual and/or audible alarms; • Locked entrance ways; or • Administrative controls? **(RP-3.1)**	
	Are control(s) installed at any radiological area exit that would prevent rapid evacuation of personnel under emergency conditions? **(RP-3.2)**	
	Does the facility design provide for entry control for high and very high radiation areas? Such areas shall be monitored as necessary during access to determine the exposure rates to which the individuals are exposed? **(RP-3.3)**	
	Is one or more of the following features used for each entrance or access point to a high radiation area where radiation levels exist such that an individual could exceed a deep dose equivalent to the whole	

ID #	Performance Objectives and Criteria[2]	Met?
	body of 1 rem (0.01 sievert) in any one hour at 30 centimeters from the source or from any surface that the radiation penetrates: • A control device that prevents entry to the area when high radiation levels exist or upon entry causes the radiation level to be reduced below that level defining a high radiation area; • A device that functions automatically to prevent use or operation of the radiation source or field while individuals are in the area; • A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; • Entryways that are locked. During periods when access to the area is required, positive control over each entry is maintained; • Continuous direct or electronic surveillance that is capable of preventing unauthorized entry; • A control device that will automatically generate audible and visual alarm signals to alert personnel in the area before use or operation of the radiation source and in sufficient time to permit evacuation of the area or activation of a secondary control device that will prevent use or operation of the source. • Very high radiation area physical controls. In addition to the above requirements, additional measures shall be implemented to ensure individuals are not able to gain unauthorized or inadvertent access to very high radiation areas. • No control(s) shall be established in a high or very high radiation area that would prevent rapid evacuation of personnel? **(RP-3.4)**	
Criticality Safety		
CS-1	Does the final design ensure that operations with fissionable material remain subcritical under all normal and credible abnormal conditions?	
	Does the design satisfy the requirements of revisions to the consensus nuclear criticality safety standards of American National Standards Institute (ANSI)/American Nuclear Society (ANS) 8 in effect at the time of the approval of DOE O 420.1B? **(CS-1.1)**	
	Is the final design in such a way that no single credible event or failure can result in a criticality (DOE O 420.1B)? **(CS-1.2)**	
	Have criticality safety evaluations for fissionable materials operations been performed in accordance with DOE-STD-3007-2007, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities***,** or they are approved by DOE (e.g., parameters, limits and controls required to maintain sub-criticality for all normal and credible abnormal conditions)? (DOE O 420.1B)? **(CS-1.3)**	
	Does the final design include controls that are derived from the criticality safety evaluation in the preferred order of passive engineered controls, active engineered controls, or lastly administrative controls? (DOE 420.1B)? **(CS-1.4)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Does the final design implements the double contingency principle defined in ANSI/ANS 8.1, *Nuclear Criticality Safety in Operations with Fissionable Material outside Reactors*? **(CS-1.5)**	
	Does the final design provide an explanation whenever an ANSI/ANS standard or other DOE O 420.1B requirement is not planned to be implemented? **(CS-1.6)**	
CS-2	Does the final design ensure that nuclear criticality safety is controlled by one or more parameters of the system(s) within sub critical limits and by allowances for process contingencies?	
	Has the final design demonstrated controls through one or more of the following as appropriate*:* • Physical constraints • Use of instrumentation • Chemical means • Reliance on natural or credible course of events • Administrative procedures • Other means? **(CS-2.1)**	
	Have all controlled parameters and their limits are specified and the influence of variations of these parameters on the k_{eff} is understood and documented in the final design supporting documents? **(CS-2.2)**	
	Does the final design rely upon equipment design, where practicable, in which dimensions are limited rather than administrative controls? **(CS-2.3)**	
	Does the final design rely upon the use of neutron absorbers, if such reliance is consistent with the requirements of section 4.2.4 of ANSI/ANS 8.1, 8.5 (rashig rings) and 8.14 soluble neutron absorbers? **(CS-2.4)**	
	Have subcritical limits derived from experiments or calculations in accordance with the requirements of sections 4.2.5 and 4.3 of ANSI/ANS 8.1? **(CS-2.5)**	
CS-3	Is the design and use of a criticality alarm system(s) is in accordance with the requirements of ANSI/ANS 8.3?	
	Does the alarm system coverage meet the requirements of section 4.2 of ANSI/ANS 8.3? **(CS-3.1)**	
	Does the criticality alarm system design supports the requirements of section 4.3 of ANSI/ANS 8.3? **(CS-3.2)**	
	Is the dependability of the final design for a criticality alarm system consistent with the requirements of ANSI/ANS 8.3 section 4.4? **(CS-3.3)**	
	Do the criticality alarm system(s) meet the criteria identified in ANSI/ANS 8.3 section 5? **(CS-3.4)**	
	Does the system supports testing and maintenance as identified in ANSI/ANS 8.3, Section 6? **(CS-3.5)**	
Fire Protection		
FP-1	Does the final design ensure that it provides a level of safety sufficient to meet DOE goals and objectives?	
	Has it fulfilled its requirement of highly protected risk (HPR) (DOE O 420.1B)? **(FP-1.1)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Does the final design prevents loss of safety functions and safety systems as determined in the hazards analysis and provides defense in depth (DOE O 420.1B)? **(FP-1.2)**	
	Does the final design prevent fires and related effects that cause an unacceptable release of hazardous or radiological materials? **(FP-1.3)**	
	Does the final design prevent fires and related effects that cause vital DOE program to suffer an unacceptable interruption? **(FP-1.4)**	
	Does the final design prevent fires and related effects that result in the loss of critical process controls? **(FP-1.5)**	
FP-2	Does the design meets or exceeds applicable fire protection and emergency response provisions of the governing local building code (the International Building Code if no local code applies), applicable regulations, DOE fire safety criteria, and industry standards, such as those promulgated by the NFPA?	
	Does the design identifies and reflects the full spectrum of applicable facility related fire protection and emergency response criteria as delineated by DOE and as adopted when the design criteria are/were approved? **(FP-2.1)**	
	Does the design reflect and conform to the provisions of the following chapters/sections of the local building code (International Building Code (IBC) if no local code applies): • Use and Occupancy Classification • Special Fire Safety Design Requirements for Unique Structures • Height and Area Limitations • Types of Construction • Fire-resistance Design Requirements • Combustibility of Interior Finishes • Fire Protection Systems • Means of Egress • Access for Emergency Vehicles • Fire resistance of Exterior Walls and Roofs • Protection of Structural Steel • Fire Protection and Emergency Services During Construction? **(FP-2.2)**	
	Does the design reflect and conform to the provisions of the following chapters/ sections of the local fire code (International Fire Code if the IBC applies): • Fire Service Features • Building Services and Systems • Fire-resistance Rated Construction • Fire Protection Systems, Including Fire Water Supply • Means of Egress • Fire Exposures, including Wild Land Fire Risk • Flammable and Combustible Liquids and Gases • Hazardous Materials • Emergency Vehicle Accessibility to Facilities? **(FP-2.3)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Does the design reflect and conform to the facility specific provisions of Section 2 *Fire Protection* of Appendix A to 10 CFR Part 851? **(FP-2.4)**	
	Does the design reflect and conform to the following facility specific provisions of 29 CFR 1926, *Construction Industry Regulations*: • Subpart C, *General safety and Health Provisions* (Fire Safety and Emergency Services) • Subpart D, *Occupational Health and Environmental Controls* (Emergency Medical-related) • Subpart F, *Fire Protection and Prevention* • Subpart Z, *Toxic and Hazardous Substances?* **(FP-2.5)**	
	Does the design reflect and conform to the facility specific provisions of Chapter II, *Fire Protection*; Section 3.c. *Fire Protection Design* of DOE O 420.1B, *Facility Safety*. (Specific review elements are delineated in P.O. 3.)? **(FP-2.6)**	
	Does the design reflect and conform to the following facility specific provisions of DOE G 420.1-3, *Implementation Guide for DOE Fire protection and Emergency Services Programs:* • Section 4.2, *Highly Protected Risk Status* • Section 4.5, *Program Documentation* (construction-related) • Section 4.6, *Fire Hazards Analysis* • Section 4.9, *Baseline Needs Assessment* (emergency services) • Section 4.15, *Exemptions, Variances, Equivalencies* • Section 4.17, *Fire Protection Design* • Section 4.20, *Fire Suppression System Confinement or Containment* • Section 4.21, *Fire Protection System Classification?* **(FP-2.7)**	
	Does the design reflect and conform to the following facility specific provisions of DOE-STD-1066-99, *Fire Protection Design Criteria*: • Chapter 5, *General Criteria* • Chapter 6, *Water Supply and Distribution System Criteria* • Chapter 7, *Automatic Sprinkler System Criteria* • Chapter 8, *Fire Alarm Systems* • Chapter 10, *Life Safety Criteria* • Chapter 11, *Electrical Equipment Criteria* • Chapter 12, *Protection Criteria for General Process Hazards* • Chapter 13, *Protection Criteria for Special Hazards* • Chapter 14, *Nuclear Filter Plenum Fire Protection* • Chapter 15, *Glovebox Fire Protection* (if included in scope)? **(FP-2.8)**	
	Does the design reflect and conform to the following facility specific provisions of NFPA-801, *Standard for Fire Protection for Facilities Handling Radioactive Waste*: • Nuclear Safety Considerations • Identification of Hazards • General Plant Design • Life Safety Design Features	

ID #	Performance Objectives and Criteria[2]	Met?
	• Fire Protection and Notification Systems • Equivalencies? **(FP-2.9)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-1, *Uniform Fire Code* (Construction and Emergency Services Provisions)? **(FP-2.10)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-70, *National Electrical Code?* **(FP-2.11)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-72, *National Fire Alarm Code?* **(FP-2.12)**	
	Does the design reflect and conform to the following facility specific provisions of NFPA-80, S*tandard for Fire Doors and Fire Windows?* **(FP-2.13)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-90A, *Standard for the Installation of air Conditioning and Ventilating Systems?* **(FP-2.14)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-101, *Life Safety Code?* **(FP-2.15)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-241, *Standard for Safeguarding Construction, Alteration and Demolition Operations?* **(FP-2.16)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-780, *Standard for the Installation of Lightning Protection Systems?* **(FP-2.17)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-1144, *Standard for Protection of Life and Property from Wildfire?* **(FP-2.18)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-1141, *Standard for Fire Protection in Planned Building Groups?* **(FP-2.19)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-1221, *Standard for the Installation, Maintenance and Use of Emergency Services Communications Systems?* **(FP-2.20)**	
	Does the design reflect and conform to the facility specific provisions of NFPA-1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments?* **(FP-2.21)**	
FP-3	Does the final design for the facility and supporting systems meets or exceed the following overarching facility-specific fire protection design criteria?	
	Is there a reliable and adequate supply of water for fire suppression? Is there documentation (text and / or drawings) that must include a commitment to conform to applicable criteria, as delineated above, and should also include a design description that encompasses; fire water storage (quantity and duration), pumps, distribution piping, materials, and other available details? **(FP-3.1)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Are there noncombustible construction materials for facilities exceeding the size limits established by DOE (see DOE-STD-1066-99, *Fire Protection Design Criteria)*. Documentation must include a commitment to conform to applicable criteria, as delineated above, and should also include the type(s) of construction that will be featured for each facility and reference to the listed structural assemblies that are intended to meet the construction classifications? **(FP3.2)**	
	Is there complete fire-rated construction and barriers, commensurate with the applicable codes and fire hazards, to isolate hazardous areas and minimize fire spread and loss potential consistent with limits as defined by DOE? Are there design documents that should describe in general terms the subdivision of each facility into fire areas, as defined in DOE-STD-1066-99? Is the description should include a summary of how penetrations of fire area boundary construction will be protected. This description should address doorways, ventilation penetrations, cable and conduit penetrations and any anticipated unprotected openings in fire area walls and floor/ceiling assemblies? **(FP-3.3)**	
	Does the fire protection design address: • Automatic fire extinguishing systems throughout all significant facilities and in all facilities and areas with potential loss of safety class systems (other than fire protection systems), • significant life safety hazards, • unacceptable program interruption, • Or, fire loss potential in excess of limits defined by DOE? **(FP-3.4)**	
	Is there redundant fire protection systems in areas where • Safety class systems are vulnerable to fire damage, and no redundant safety capability exists outside of the fire area of interest, or • The maximum possible fire loss (MPFL) exceeds limits established by DOE. An initial Maximum Possible Fire Loss (MPFL) calculation is provided to support the need for redundant systems? **(FP-3.5)**	
	In new facilities, are redundant safety class systems (other than fire protection systems) located in separate areas and design documents identify those fire areas (such as a control room or automatic electric power transfer area) where redundant safety systems may be located. The description should include the nature and extent of redundant fire protection in these areas? **(FP-3.6)**	
	Is there means to notify emergency responders and building occupants of a fire (e.g., fire alarm or signaling system). The design should provide a description of a fire alarm / signaling system? **(FP-3.7)**	
	Is there emergency egress and illumination for safe facility evacuation in the event of fire as required by applicable codes or fire standards? Does the design demonstrate that two remote exits are available from all occupied areas, except where permitted by the Life safety Code? Do the design documents provide an overview of the egress concept, including lighting and signage? Are there issues that might affect	

ID #	Performance Objectives and Criteria[2]	Met?
	egress, such as security measures, should be identified without mentioning specific provisions? **(FP-3.8)**	
	Is there physical access and appropriate equipment that is accessible for effective fire department intervention (e.g., interior standpipe systems in multi-story or large, complex facilities)?Does the design documents show access roads, location of fire hydrants, standpipe systems and fire department connections, entryways into facilities, and other design features (congested areas) that might adversely affect emergency services? **(FP-3.9)**	
	Is there means to prevent the accidental release of significant quantities of contaminated products of combustion and fire fighting water to the environment, such as ventilation control and filter systems and curbs and dike?. Are there such features would only be necessary if required by the FHA or safety analysis in conjunction with other facility or site environmental protection measures? **(FP-3.10)**	
	Are there means to address fire and related hazards that are unique to DOE and not addressed by industry codes and standards? Does Mitigation features consist of isolation, segregation or the use of special fire control systems (water mist, clean agent, or other special suppression systems) as determined by the FHA? Does the design identifies atypical fire hazards (such as chemicals or processes) and the fire protection means intended to mitigate their corresponding fire risk? **(FP-3.11)**	
	Are the fire protection systems designed such that their inadvertent operation, inactivation, or failure of structural stability that will not result in the loss of vital safety functions or inoperability of safety class systems as determined by the safety analysis or Documented Safety Analysis (DSA)? Is there a description of processes provided that will be used to evaluate for such risk and the possible means (physical safeguards such as shielding or barriers) that would likely be used to minimize the threat from inadvertent operation, inactivation, or other failure? (FP-3.12)	
FP-4	Does the design identify conditions for which literal compliance with the above-referenced criteria cannot be met in a cost-effect manner and where alternative (equivalent) fire safety and emergency response features will be proffered?	
	Does the design documentation (text) manifests a process for identifying conditions for which literal conformance is not feasible or cost-effective? Does this description include a requirement for an engineering analysis by qualified fire protection engineers, review and approval by engineers, review and approval by appropriate contractor management, and a commitment to submit all such equivalency determinations to the DOE Authority Having Jurisdiction (AHJ)? **(FP-4.1)**	
	Does the design documentation (text) manifest a system for identifying, tracking, and record keeping of all pending decisions regarding fire safety and emergency services equivalencies? **(FP-4.2)**	
	Does the design documentation (text) manifest a commitment to implement a design that conforms to governing fire safety criteria	

ID #	Performance Objectives and Criteria[2]	Met?
	when there is no agreement with the DOE AHJ regarding a pending equivalency? (Default decisions regarding design are to literal conformance.) **(FP-4.3)**	
	Where required by Paragraph 3.b. (5) of DOE O 420.1B a Preliminary Fire Hazards Analysis (PFHA), has it been documented and updated from the preliminary design stage? **(FP-4.4)**	
	Has the PFHA been completed under the supervision of a qualified (as defined by DOE) or (as defined in DOE STD-1066-99) fire protection engineer? **(FP-4.5)**	
	Has the scope and content of the PFHA are in conformance with the guidelines delineated in Section 4.6 of DOE G 420.1-3 (September 27, 2007 or current equivalent)? **(FP-4.6)**	
	Are the conclusions of the PFHA incorporated into Preliminary Documented Safety Analysis (PDSA) and integrated into design basis and beyond design basis accident conditions? **(FP-4.7)**	
	Do provisions exist for updating the PFHA over time as significant changes occur? **(FP-4.8)**	
Safety Integration		
SI-1	Are Safety Basis Documents prepared and consistent with preliminary design documents?	
	Is a Preliminary Safety Design Report (PDSA) prepared by the SDIT? **(SI-1.1)**	
	Has the PDSA been reviewed by DOE and verified to meet expectations of DOE-STD-1189-2008, or where deficient, explicit conditions of approval established? **(SI-1.2)**	
SI-2	Does the final design incorporate sufficient defense in depth consistent with preliminary safety analysis?	
	Does the design include multiple layers of protection to prevent or mitigate the unintended release of radioactive materials to the environment (e.g., isolation, confinement, successive physical barriers, minimizing material at risk, etc)? (DOE O 420.1B)? **(SI-2.1)**	
SI-3	Has the final design meet the requirements and objectives of DOE O 420.1B? This includes:	
	Does the final design ensure that safety SSCs are designed commensurate with the importance of the safety functional requirements? **(SB-3.1**	
	Has the Safety Class electrical systems been designed to preclude single point failure? **(SB-3.2)**	
	Has the process systems, as identified in the preliminary design, been designed to minimize waste production and mixing of radioactive and non-radioactive wastes? **(SB-3.3)**	
SI-4	Has the Integrated Safety Management Description been prepared and incorporates final design activities?	
	Are the requirements, methodology, and responsibility for ES&H activities clearly identified and communicated? **(SI-4.1)**	
	Does the final design incorporates an analysis of potential workplace hazards (industrial safety/hygiene) and establishes appropriate controls? **(SI-4.2)**	

ID #	Performance Objectives and Criteria[2]	Met?
Quality Assurance		
QA-1	Are the design inputs correctly translated into design documents in a timely manner	
	Are the design inputs for interfacing organizations specified in the design documents or in supporting procedures? **(QA-1.1)**	
	Does the design incorporate applicable requirements and design bases? **(QA-1.2)**	
	Are the design inputs specified to the level of detail necessary to permit design activities to be correctly carried out and to provide a consistent basis for making design decisions, accomplishing design verification activities, and evaluating design changes? **(QA-1.3)**	
	Are the design inputs based upon contractual requirements and customer expectations and are technically correct and complete. (DOE G 414.1-2A)? **(QA-1.4)**	
QA-2	Are the design methods used appropriate?	
	Has the design been developed using sound engineering/scientific principles and appropriate standards? **(QA-2.1)**	
	Are the design assumptions, if necessary, adequately described and reasonable? **(QA-2.2)**	
	Do the design output compare reasonably to the design inputs? **(QA-2.3)**	
QA-3	Are the organizational and physical design interfaces identified and controlled?	
	Are the organizational responsibilities described for preparing, reviewing, approving, and verifying design documents related to an item or its processes, such as system descriptions, design input and criteria, design drawings, design analyses, computer programs, specifications, and procedures? **(QA-3.1)**	
	Do the internal and external design interface controls, procedures, and lines of communication among participating design organizations and across technical disciplines are established and described for the review, approval, release, distribution, and revision of documents involving design interfaces? **(QA-3.2)**	
QA-4	Are the suitable materials, parts, processes, and inspections and testing criteria specified?	
	Does the design provide for appropriate acceptance, inspection, testing, and maintenance criteria to ensure continuing reliability and safety of designed items? (DOE G 414.1-2A)? **(QA-4.1)**	
QA-5	Are the changes to design controlled in a manner commensurate with the original design?	
	Are the design and specification changes, including field changes, subject to the same design controls that were applicable to the original design? **(QA-5.1)**	
	Has Configuration Management been referenced for additional review criteria? **(QA-5.2)**	
QA-6	Is the design independently verified adequate?	
	Does the design procedure identify the responsibilities of personnel verifying the design, the areas and features that require design	

ID #	Performance Objectives and Criteria[2]	Met?
	verification, the pertinent considerations to be verified, and the extent of documentation required to document verification? **(QA-6.1)**	
	Are guidelines or criteria established and described for determining the method of design verification (design review, alternate calculations, or tests)? **(QA-6.2)**	
	Has the design has been verified or validated by individuals or groups other than those who performed the design work? **(QA-6.3)**	
	Has the design been verified or validated before approval and implementation of the design? **(QA-6.4)**	
QA-7	Is the documentation and records maintained in accordance with the QA program?	
	Does the design documentation include a list of approved and controlled computer codes? (DOE G 414.1-2A) **(QA-7.1)**	
	Do the design records include documentation such as design inputs, calculations, and analyses; engineering reports; design outputs; design changes; design verification activities; and other documents that provide evidence that the design process is adequately controlled in a timely manner? (DOE G 414.1-2A) **(QA-7.2)**	
	Are procedures established and described requiring documented verification of the dimensional accuracy and completeness of design drawings and specifications? **(QA-7.3)**	
QA-8	Has acquired software for safety-related calculations been pre-verified or the results of the calculations performed verified for each application of the software to ensure it produces the correct solutions within the defined limits of its intended use?	
	Has software acquired from a third party or from corporate inventories been used in design calculations been identified? **(QA-8.1)**	
	Has the test cases that exercise the defined limits and physical problem being solved been performed and the results verified to ensure acceptable results were generated from the software? **(QA-8.2)**	
QA-9	Is there controlled for software used to classify, analyze and design of SSCs relied on for workers, public or environmental protection?	
	Has software, including spreadsheets, databases and their associated support tools (e.g., Excel, MS Access, Windows O/S) been identified and the specific versions used in the design calculation noted? **(QA-9.1)**	
	Is software identified stored in a location that is easily retrieval and access is restricted to authorized individuals? **(QA-9.2)**	
	Are the updates to the software identified created from this stored software? **(QA-9.3)**	
QA-10	Are spreadsheets and other software specifically created for use in the engineering design developed using software quality and engineering practices appropriate for the impact on the engineering design?	
	Are the requirements for the spreadsheets and software clearly described and documented in a manner that can be easily tested. Are the requirements reviewed and approved? **(QA-10.1)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Is the structure, mathematical algorithms, control and logic flow, data structures applicable to the development of the spreadsheets and software documented in enough detail for review by independent technical individual? Is the independent review documented? **(QA-10.2)**	
	Are the spreadsheets and other software created for use in the engineering design tested to ensure the documented requirements meet and produce the correct results for the problem being analyzed? Are the tests results documented and evaluated by a responsible authority to ensure the test requirements met? **(QA-10.3)**	
QA-11	Are the software configuration items identified and controlled?	
	Are products of the software development activities that need to be retained identified and assigned a unique identifier? Do these products include the software requirements, software design, test cases and results, and records of reviews? **(QA-11.1)**	
	Are the items identified stored in a location that is easily retrieval and access is restricted to authorized individuals? **(QA-11.2)**	
	Are updates to the items identified created from these stored versions? **(QA-11.3)**	
Civil/Structural/Seismic		
NPH-1	Do design calculations address major structures and SSCs; and are they complete and consistent with known conditions and facility layout?	
	Do calculations evaluate the capacity of connections between structural members? **(NPH-1.1)**	
	Do calculations address all anticipated load cases? **(NPH-1.2)**	
	Do calculations provide sufficient documentation of assumed inputs and outputs? **(NPH-1.3)**	
	Do calculations consider structural behavior of the material to be used in construction? **(NPH-1.4)**	
	Do calculations tie directly to the design documentation? **(NPH-1.5)**	
	Are assumptions requiring verification clearly identified as open items to be resolved before the calculation is released as Revision 0? **(NPH 1.6)**	
	Is anchorage of SSCs described and anchorage loads provided to the design entity responsible for the anchorage design? **(NPH-1.7)**	
	Do the calculations for all SSCs effectively evaluate demand versus capacity for structural members and list the demand to capacity ratios? **(NPH-1.8)**	
	Are the connections between structural members designed to transfer all applicable loads? DO PC-1 and PC-2 design the IBC factors for collector elements, if applicable shall be used to increase connection loads? **(NPH-1.9)**	
	Do the calculations identify all applicable loads address all appropriate load cases? Are special or unique load cases, such as flooding or accident temperatures clearly identified and described? **(NPH-1.10)**	
	Are significant secondary effects, such as p-delta for structures, dynamic interactions between equipment and structures addressed? **(NPH-1.11)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Do the calculations provide adequate documentation of both inputs and outputs into design and effectively identify and justify the design assumptions? **(NPH-1.12)**	
	If finite element analyses are used, is there justification for the element types and meshing density to be provided in the calculations or via reference? **(NPH-1.13)**	
	For SSCs that cannot be qualified by calculation alone, is there a program to qualify by testing or similarity that is in accordance with DOE and National Consensus Standards? **(NPH-1.14)**	
	Does documentation show that the structure meets its functional requirement, for example, limitations on displacements, deflections, nozzle loads or fatigue included in the calculation as applicable? **(NPH-1.15)**	
	Are the calculations sufficiently complete to allow for an independent review without recourse to the originating entity? **(NPH-1.16)**	
	Do the calculations correctly consider the material properties to be used in construction? **(NPH-1.17)**	
	Is the anchorage of SSCs described and anchorage loads provided to the design entity responsible for the anchorage design? **(NPH-1.18)**	
NPH-2	Has the final design of the structure been developed, as required by DOE O 413.3A, Section 5.d. (4) and ASCE/SEI 43-05, Sections 3 and 4?	
	Has a final "seismic equipment list" of safety-related SSCs, listing functions, SDCs, and acceptable limit states been developed, as recommended by DOE-STD-1189-2008 Section 3.4 and Appendix A, and DOE-STD-1021-93 Section 3.10? (The final version should include piping and instrumentation diagrams indicating SSC boundaries.) **(NPH-2.1)**	
	Has the seismic qualification of safety-related equipment been completed, as required by ASCE/SEI 43-05, Section 8? **(NPH-2.2)**	
	Have acceptance criteria documents been updated to reflect changes to the facility layout and/or changes to the SDC or limit state of the individual facility SSCs? **(NPH-2.3)**	
	Are the design calculations being reviewed in-process by DOE reviewers? **(NPH-2.4)**	
	Have the final in-structure floor spectra been developed, as required by ASCE/SEI 43-05, Section 2.3? **(NPH-2.5)**	
	Has a final peer review report of the geotechnical, seismic, and structural design, as well as component qualification, been completed, as required by ASCE/SEI 43-05, Section 9.1? **(NPH-2.6)**	
	Does the finite element model reflect the latest design drawings? **(NPH-2.7)**	
	Has the structural load path been refined, and is the shear distribution in the structure, calculated per ASCE/SEI 43-05, Sections 3 and 4, reasonable? **(NPH-2.8)**	
	Are design calculations, per ASCE/SEI 43-05, Sections 3 and 4, consistent with the latest changes to the SDC or limit state of individual facility SSCs? **(NPH-2.9)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Are the current estimates of the piping and equipment size and weight used in the design? **(NPH-2.10)**	
	Is Seismic loading evaluated consistent with site-specific design response spectra? **(NPH-2.11)**	
	Does the seismic design of systems and components accounts for adverse interactions from non-seismic structures, systems, and components (spatial interactions, spray interactions, and system interactions)? **(NPH-2.12)**	
NPH - 3	Has a Mechanical and Electrical Equipment List (MEL) has been developed that identifies all safety related SSCs?	
	Does the MEL specify the systems and equipment safety classification, performance category, and required function during and following a design basis event? **(NPH-3.1)**	
	Is the MEL updated as design changes are implemented? **(NPH-3.2)**	
Engineering Design - Process Design/Layout		
ED-1	Have the Facility Plans, Piping and Instrumentation Diagrams (P&ID), and detail drawings been coordinated with the Process Descriptions, Flow Diagrams, and Process Calculations and the facility layout supports the process requirements?	
	Has Facility and System drawings been submitted design package meet the expectations of the Site procedure or contract specification for completeness and format? **(ED-1.1)**	
	Has the System Design Descriptions (SDD) prepared for safety related systems and meet the requirements of DOE Order O 420.1B and DOE Standard DOE STD -3024-98, Content of System Design Descriptions? **(ED-1.2)**	
	Does SDDs describe the performance characteristics of the system which are important to safety and link the safety basis analysis to the selected controls? **(ED-1.3)**	
	Are the Structures, Systems and Components (SSC) of the safety related systems properly characterized as to their safety pedigree in accordance with DOE O 420.1B and DOE-STD-3009? Have the necessary documents to support procurement and control of safety related SSCs been developed? **(ED-1.4)**	
	Have the process equipment and system drawings meet the expectations of the Site procedure or contract specification for completeness and format? **(ED-1.5)**	
	Are the process equipment and system drawings in the submitted design package accompanied by appropriate flow diagrams; calculations; and control parameters and set points? **(ED-1.6)**	
	Has a 3-D modeling system been applied to the design effort? Are the various engineering areas being closely integrated into the layout? (i.e. electrical cable trays, HVAC ductwork, piping and instrument penetrations/runs)? **(ED-1.7)**	
	Are layout drawings and floor plans coordinated with system drawings? Do the facility layout supports the process flow and facilitates movement of parts and tools to perform the facility mission? **(ED-1.8)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Does the facility design include adequate space for convenient access to major components (including piping, wiring, control tubing, etc.) during construction, testing, maintenance and inspection so that major disassembly is not required? **(ED-1.9)**	
	Have all engineering risks been identified and addressed? If not, what risks remain? Are plans in place to resolve these issues prior to final design? **(ED-1.10)**	
	Is there evidence that human factors principles are factored into the design (e.g., functional analysis, task analysis)? **(ED-1.11)**	
	Does the facility design addresses the good practices and guidance for layout, space allotment, hazards separation, and hazardous areas as identified in DOE-HDBK-1132-99? **(ED 1.12)**	
Engineering Design - Mechanical and Piping		
ED-2	Are the mechanical and piping drawings and supporting documentation adequate to accomplish the design mission?	
	Does the process equipment and system drawings in the submitted design package meet the expectations of the Site procedure or contract specification for completeness and format? **(ED-2.1)**	
	Does the piping and components meet the requirements of the designated Codes and Standards in the System Design Requirements document and materials are appropriate to the intended process? **(ED-2.2)**	
	Is the operating and design loads and load combinations correctly specified for each system and equipment? Do adequate calculations exist to support the selected design? **(ED-2.3)**	
	Are vessels and piping systems designed, sized, and qualified to the ASME Boiler and Pressure Vessel Code and ASME B31.3 code, including over-pressure protection? **(ED-2.4)**	
	Are equipment and systems in high radiation areas designed to minimize the need for repair or replacement? **(ED-2.5)**	
	Are provisions in place for periodic maintenance and inspection of systems and equipment to assure their continued integrity for the design life? **(ED-2.6)**	
	Is the design for shop fabrication and field erection of systems and components (joining, welding, non-destructive examination, testing) in accordance with the applicable codes and standards for each type of commodity? **(ED-2.7)**	
	Do the designs include the necessary strengthening, support, or restraints to meet the selected seismic performance criteria? **(ED-2.8)**	
	Does adequate capacity exist in material transport systems to handle expected volumes of radioactive/hazardous materials during normal operating and accident conditions? **(ED-2.9)**	
	Are tanks and piping systems of welded constructed to the fullest extent possible? **(ED-2.10)**	
	Are tank and piping systems designed to take advantage of gravity flow to reduce the potential for contamination associated with pumping and pressurization? **(ED-2.11)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Do all system components expect to be in contact with strong acids or caustics are corrosion resistant? **(ED-2.12)**	
	Has the use of traps been avoided, and the piping is designed to minimize entrapment and buildup of solids in the system? **(ED-2.13)**	
	Does the Facility design addresses the good practices and guidance for piping design and layout as identified in DOE-HDBK-1132-99. **(ED 2.14)**	
Engineering Design - Electrical, Instrumentation and Control		
ED-3	Are the electrical instrument drawings and supporting documentation adequate to accomplish the design mission?	
	Do the one-line diagrams and electrical distribution layout drawings in the submitted design package meet the expectations of the Site procedure or contract specification for completeness and format? **(ED-3.1)**	
	When selecting non-listed electrical materials and equipment, are there provisions for testing and labeling by a nationally recognized testing laboratory (international standards organization or recognized testing agency)? If not, has evaluation and approval by the authority having jurisdiction (AHJ) been performed? **(ED-3.2)**	
	Are panel schedules and control diagrams developed for the electrical systems? Are there load and fault calculations to support the design requirements? **(ED-3.3)**	
	Does the electrical portion of the design defines all major components (e.g., transformers, fuses and circuit breakers, and motors) as well as includes adequate excess electrical capacity to provide for future expansion? **(ED-3.4)**	
	Has the basic cable tray layout identify the layout interferences and material quantity needs? Has the cable tray designs have been integrated into a 3-D model? **(ED-3.5)**	
	When the facility includes a control room, do the design have considerations of DOE-HNDBK-1132-99, section 4.1, Control Centers/Control Rooms, have been taken into consideration? **(ED-3.6)**	
	Does the design incorporate provisions so that I&C system components can be tested periodically for operability and required functional performance? **(ED-3.7)**	
	Do instrument channels and associated logic ensure that I&C components fail in a safe failure mode? **(ED-3.8)**	
	Are instrumentation and control loop diagrams, instrument lists and data sheets developed to support the process design? **(ED-3.9)**	
Engineering Design - HVAC		
ED-4	Are the HVAC and Confinement System drawings and supporting documentation adequate to meet DOE requirements and accomplish the design mission?	
	Do the HVAC and Confinement System drawings in the submitted design package meet the expectations of the Site procedure or contract specification for completeness and format? **(ED-4.1)**	

ID #	Performance Objectives and Criteria[2]	Met?
	Are the designs designations for seismic criteria of the safety related HVAC and Confinement Systems consistent with the Safety Design Strategy (SDS) and Preliminary Design Safety Report (PDSR) and are adequate to support procurement and cost decisions? **(ED-4.2)**	
	Do the HVAC Air Flow and Control drawings identify the seismic performance category of safety related SSCs and are adequate to support the performance requirements of the safety documentation? **(ED-4.3)**	
	Do the HVAC and Confinement System drawings comply with the requirements of DOE Order O 420.1B and meet the expectations of DOE-STD-1189-YR? **(ED-4.4)**	
	Do the confinement ventilation systems meet the performance criteria specified in DNFSB Recommendation 2004-2 Implementation Plan Document "Ventilation System Evaluation Guidance for Safety-Related and Non-Safety- Related Systems", Table 5-1, or later successor criteria? **(ED-4.5)**	
	Have the relationships between ventilation flows and pressures been evaluated to demonstrate that the flows and pressures can be maintained throughout normal, abnormal and accident conditions? Is there technical bases (i.e., calculations) developed to support performance requirements? (i.e., air flows, pressures, etc.) **(ED-4.6)**	
	Does the design of the secondary confinement system provide for continuous monitoring capability to detect loss of proper differential pressure with respect to the process area? **(ED-4.7)**	
	Are operating areas continuously monitored for hazardous release? Is consideration given to the use of redundant sensors and alarms? **(ED-4.8)**	
	Do the confinement systems address the design guidance in DOE-HDBK-1132-99, Section 1.1 and any applicable guidance in Section 1.2 (including the design guidance in DOE-HDBK-1169, DOE-STD-1066, ASME AG-1, and AGS-G001)? **(ED-4.9)**	
Configuration Management		
CM	Has the contractor established a Configuration Management program which meets the requirements of DOE Order O 420.1B?	
	Has the contractor developed local policies and procedures to implement an adequate Configuration Management Program? **(CM-1.1)**	
	Are roles and responsibilities for configuration management and change control clearly assigned and understood? **(CM-1.2)**	
	Are design changes and field changes being documented, reviewed and approved and effected documents are modified to reflect approved design changes? **(CM-1.3)**	
	Has a Master Equipment List (MEL) been developed and does it identify all safety related SSCs? Does the MEL specify systems and equipment safety classification, performance category and required function during and following a design basis event? The MEL is being updated as design changes are implemented? **(CM-1.4)**	