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Environmental Management

Safety ▪ Performance ▪ Cleanup ▪ Closure

Standard Review Plan (SRP)

Preliminary 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
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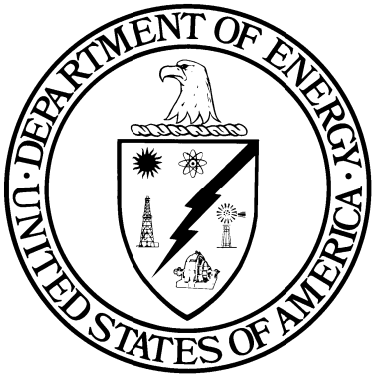
OFFICE OF ENVIRONMENTAL MANAGEMENT

Standard Review Plan (SRP)

Preliminary Design

Review Module

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



March 2010

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

ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CD	Critical Decision
EM	Environmental Management
FRAM	Functions, Responsibilities, and Authorities Manual
HVAC	Heating, Ventilation, and Air Conditioning Conditions
IPT	Integrated Project Team
NFPA	National Fire Protection Association
NPH	Natural Phenomena Hazards
PD	Preliminary Design
P&ID	Piping and Instrumentation Diagram
PDRI	Project Definition Rating Index
PSDR	Preliminary Safety Design Report
QA	Quality Assurance
SDD	System Design Description
SDS	Safety Design Strategy
SSC	Structures, Systems and Components
SQA	Software Quality Assurance

I. INTRODUCTION

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

> Beginning at Critical Decision (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.

The preliminary design stage is of special interest because it is the first step in the project execution phase, when the conceptual design is evolved to a depth and level of detail that supports establishment of a Performance Baseline. This is an important stage in the project that has large cost implications associated with technical decisions, and the potential impacts of revising these decisions later in the project can be significant[2].

DOE G 413.3-3-5 defines preliminary design for CD-2 approval is:

> Approximately 25-30 percent of the total project design complete (with a clear understanding of actions needed to complete final design)... This range is typical for many DOE project types, but values can vary on individual projects. Some projects may develop an adequate design with a lower percentage of the overall design while other projects may require a much higher percentage.

Also, DOE- STD-1189 indicates that:

> Typically, about 30 to 40 percent of the design activity is completed during the preliminary design phase, and the remainder of the design is completed during the final design phase.

In preparation for the CD-2 approval, the Federal Project Director must ensure that the contractor is ready to proceed with final design. This involves verification that the preliminary design is sufficiently mature, such that it provides an adequate basis for safety, cost, and schedule decisions/estimates. The Preliminary Design (PD) review supports this goal by evaluating the technical adequacy of the engineering design, as well as safety and quality assurance related activities[3].

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[2] *Decisions at other stages of design can have similar impacts and also warrant a technical review. These activities are addressed in DOE-EM review modules for conceptual and final design.*

[3] *The PD review does not include safety evaluations performed in support of DOE-STD-1189-2008, though it does consider interfaces and outputs from facility safety basis activities.*

II. PURPOSE

The PD Review Module (RM) is a tool that assists DOE federal project review teams in evaluating the technical sufficiency of the PD prior to CD-2 approval. This PD RM can be applied anytime during the design prior to CD-2 approval. However, in practice, the design is typically review at the 30% design stage, which is corresponding to the end of the PD before initiation of final design. The PD RM focuses on the maturity of engineering design, safety, and quality assurance to determine whether it meets overall design commitments, and technical/safety requirements. It also evaluates whether the design supports performance of the established facility functions. A PD review's 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 PD review should concentrate, as appropriate on the design aspects associated with interfaces that rely on existing site infrastructure. PD 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 PD RM does not explicitly target other project areas, including cost and schedule, high performance sustainable design, security, and environmental protection. The safety basis review in the PD review is focused on the interface between safety basis development and design at the preliminary design stage. Safety basis review guidance is established by DOE directives, including DOE-STD-1104.

III. ROLES AND RESPONSIBILITIES

A successful PD 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/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.

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

The roles and responsibilities for all involved in the PD review must be clear and consistent with various requirements of DOE O 413.3A and the DOE Functions, Responsibilities, and

Authorities Manual (FRAM). The table below provides a compilation of preliminary design review roles and responsibilities.

Position	Responsibility
Field Element Manager	Provides support and resources to the Federal Project Director (FPD) 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
Federal Project Director	Identifies the need for a PD 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 FPD and the Acquisition Executive, selects the preliminary design areas to review.
	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 FPD, 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 approval.
	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/her area of the review.
	Completes training and orientation activities necessary for the review. Conducts any necessary pre visit document review.

Position	Responsibility
	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.
	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

A primary objective of the preliminary design is to provide sufficient information to support development of the project's Performance Baseline for CD-2 approval. The FPD will have to determine whether the preliminary design is at the appropriate level of maturity to proceed with a design review. This typically occurs at some point after the design contractor declared that certain milestones described in the project schedule have been achieved.

Specific objectives of the PD review that may be appropriate depending on the project include:

- Ensure that the design will meet program requirements as defined in the contract
- Ensure that the design is compliant with the requirements of DOE Order 420.1B, or applicable exemptions have been initiated and accepted by the appropriate approval authority.
- Ensure that the design is compliant with applicable codes and standards, and
- Ensure that the design incorporates the approach to minimize or remove hazards, or if that cannot be achieved, to provide a robust engineered controls, relying on administrative controls as a last resort.

Establishing whether the preliminary design milestone has been achieved is to some degree subjective and judgment based. On the one hand, expected safety decisions and supporting analyses/documentation appropriate at the preliminary design stage are well described in DOE-STD-1189-2008. Likewise, project cost and schedule related items expected to be completed at this stage are described in DOE O 413.3A. Maturity of the engineering design is not as straightforward in terms of explicitly completed deliverables.

The status of the engineering design is the main determining factor as to whether a preliminary design review should be conducted. One approach to evaluating progress is to examine specific engineering disciplines and the design actions/documents that are completed. Collectively, this will give an approximation of whether the project has achieved adequate progress in the range of 30% completion. Guidelines that support this approach are provided in the following table and are meant to be rough approximations.

Engineering Discipline	Preliminary Design Goals
Process Engineering	All process equipment identified and sized
	Layouts and flow diagrams complete
	Effluents qualified
	Safety systems identified
Architectural	Plans at 85%, except for notes, dimensions, and sections
	Sections-70% completion
	Elevations-70% completion
	Details-40% completion
	Schedules -80%
Civil	Grading Plan-50% completion
	Site Plan with utilities -90%
	Calculations -75%
Structural	Calculations-85% to match architectural progress
	Drawings show basic framing system
Piping	Calculations-70% completion
	Schematics showing major components; general arrangements and flow patterns of each system-90% completion
	Brief tabulation of major equipment data: equipment size, capacity, physical data, etc; materials of construction; brief functional requirements;
Electrical	Initial start of one-line diagram, legend, notes
	Basic power and lighting plan
	General layout of electrical distribution, both interior and exterior
	Locations of substation feeders, switchgear, panel boards
	Preliminary typical layout of lighting and receptacle arrangements, location of control devices, motors, fire alarm devices
Instrumentation	Instrumentation system diagram and tabulation
	Control room layout and general instrumentation system field layout
	Design calculations

Another tool that is helpful in evaluating progress is the Environmental Management Project Definition Rating Index (PDRI). This evaluation is used by the Integrated Project Team (IPT) in evaluating the progress of the project at each critical decision established in DOE O 413.3A. Although PDRI scores are not used as a "go/no-go" requirement for CD approval, the scores are an important factor in the decision to proceed to the next project phase. PDRI scores can provide insight on preliminary design progress. Additional information on the PDRI can be found in http://www.em.doe.gov/Pages/pdri.aspx

Once it has been determined that the design is sufficiently mature for the review, the scope of a PD review is determined by factors such as the types and magnitude of hazards, the complexity

of the facility or process, current stage of the design, and the project mission. These influences are considered when the PD review is commissioned, and they are reflected in the final review criteria selected by the review team. Once selected, the review criteria define the planned scope of the PD review.

This PD 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 Conditions (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 provide consistent guidance to project-specific design review teams to tailor to their respective review areas. In some cases, review criteria may not be applicable to a particular project for a valid reason (e.g., conscious decision to accept immature design because of complex technical issues still to be evaluated). In these cases, the review team member should document the rationale supporting such assertions in order to provide completeness in the review process.

General Requirements

This area of the review is intended to capture the overall progress with respect to completion of design documents and deliverables associated with the preliminary design stage. This includes various management documents, progress of required technical studies, design criteria, design reports, system descriptions, and other higher tier planning documents. The focus of the PD review is to ensure that the design supports safe operation in all disciplines and that engineered control features are included in the design where appropriate. The review should also verify that the project has a mechanism to capture and manage important assumptions that could result in design changes if not supported through later stages of design. Subsequent evaluation of the process used to validate assumptions may be included in follow-on reviews.

Radiation Protection

This area is focused on ensuring that the preliminary 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 preliminary design.

Criticality Safety

The intent of this review area is to ensure that the preliminary 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 ANSI/ANS Standards. The PD 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 preliminary 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, and 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 PD 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 preliminary 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 Safety Basis review area for Hazard Category 1, 2 or 3 nuclear facilities. This review area is not intended to conflict with other ongoing reviews of the Preliminary Safety Design Report, which is prepared in accordance with DOE-STD-1189. Rather, it focuses on verifying that controls derived from the safety basis are adequately captured in the preliminary 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 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 of relevance to the preliminary deign are requirements from DOE Order O 414.1C, Quality Assurance, and the contractor's project specific Quality Assurance Plan.

Civil, Structural, and Seismic

The purpose of this review area is to ensure that progress of the geotechnical/seismic studies, structural design and associated calculations, drawings and specifications are on track with the preliminary design stage. Requirements from DOE O 420.1B and the DOE standard 1020 series related to NPH design form a major emphasis for the PD review. Some level of validation associated with design calculations (depending on availability) will be involved, though not to the extent 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 PD 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 PD 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 PD 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 PD 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 conduct final design activities. It is important to clearly document the methods, assumptions and results of the PD 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 PD review 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 O 420.1B and associated review guides and 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 the EM Preliminary Design Review Module, Appendix A, as applicable based on specific project characteristics. The rationale for selection should be presented.

VI. REFERENCE MATERIAL

- DOE Order DOE O 413.3A, *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 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 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 Preliminary Design Review Topics

Review Topical Area	Identifier
General Requirements	GR
Radiation Protection	RP
Criticality Safety	CS
Fire Protection	FP
Safety Integration	SI
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[4]	Met?
General Requirements		
GR-1	Does the design progress meet preliminary design expectations, as defined in site procedures, and meet Performance Requirements developed in the Design Requirements Document?	
	Does the preliminary design address safety and health standards, technical risks, construction and operability requirements? **(GR-1.1)**	
	Is there a clear and complete system for tracking design assumptions and to assure their resolution prior to issue of final design? **(GR-1.2)**	
	Does the design incorporate adequate provisions for the safe removal, treatment, and disposition of secondary waste and other byproducts of the process? **(GR-1.3)**	
	Where process equipment will be exposed to demanding environmental conditions, is the design of the equipment expected to survive the environment long enough to fulfill its mission? **(GR-1.4)**	
	Has the project identified all assumptions and requirements that are required to be carried forward to ensure that the final design, construction, and administrative controls are developed? **(GR-1.5)**	
GR-2	Has the System Description documentation properly integrated the Facility design with the Process design?	
	Has 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-2.1)**	
	Has the System Design Descriptions prepared for safety related systems and meet the requirements of DOE Order O 420.1B and	

[4] *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[4]	Met?
	DOE Standard DOE-STD-3024-98, *Content of System Design Descriptions*? **(GR-2.2)**	
	Does the facility envelope contain adequate space to accommodate alternative process technology decisions? **(GR-2.3)**	
GR-3	Is there a process in place to resolve any remaining technical uncertainties and to validate design assumptions and calculations?	
	Are all elements of the process demonstrated at full scale and production throughput verified by demonstration or calculation? **(GR-3.1)**	
	Are prototypes being acquired for any machine or process which has not previously been used in this application? Does the testing schedule provide confidence that the project schedule can be met? **(GR-3.2)**	
	Are design assumptions identified? Is there a process in place to verify them with actual field measurement or modeling? **(GR-3.3)**	
	Are new fluid systems being tested with mock-ups or with surrogate material to verify flow rates, hold up issues, or capacity? **(GR-3.4)**	
Radiation Protection		
RP-1	Does the preliminary design meet the requirements of 10 CFR 835 Subpart K on Design and Control?	
	Are 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)**	
	Are 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)**	
	Are optimization methods used to assure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls? **(RP-1.4)**	
	Are design objectives for controlling personnel exposure from external sources of radiation in areas of continuous occupancy (2000 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 confinement and ventilation design features 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 design or modification of a facility and the selection of materials including features that facilitate operations, maintenance, decontamination, and decommissioning? **(RP-1.7)**	

ID #	Performance Objectives and Criteria[4]	Met?
RP-2	Does the preliminary design meet the requirements of 10 CFR 835 Subpart E, Monitoring of Individuals and Areas?	
	Does the preliminary design provide for : (1) Adequately documenting radiological conditions. (2) Detecting changes in radiological conditions. (3) Detecting gradual buildup of radiological material. (4) Verifying the effectiveness of engineering and process controls in containing radioactive materials and reducing radiation and/or radioactive material (5) Identifying and controlling potential sources of individual exposure to radiation and/or radioactive material? **(RP-2.1)**	
	Does the preliminary design identify instruments that are: (1) Appropriate for the type(s), levels, and energies of the radiation(s) encountered (2) Appropriate for existing environmental conditions. **(RP-2.2)**	
RP-3	Is the preliminary design consistent with the requirements of 10 CFR 835 Subpart F – Entry Control Program?	
	Does the preliminary design provide for entry control commensurate with the existing and potential radiological hazards within the area including one or more of the following methods: a. Signs and barricades b. Control devices on entrances; c. Conspicuous visual and/or audible alarms; d. Locked entrance ways; or e. Administrative controls? **(RP-3.1)**	
	Are there control(s) installed at any radiological area exit that would prevent rapid evacuation of personnel under emergency conditions? Note: no controlled should be installed. **(RP-3.2)**	
	Does the preliminary 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)**	
	Are 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 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: f. 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; g. A device that functions automatically to prevent use or operation of the radiation source or field while individuals are in the area; h. 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;	

ID #	Performance Objectives and Criteria[4]	Met?
	i. Entryways that are locked. During periods when access to the area is required, positive control over each entry is maintained; j. Continuous direct or electronic surveillance that is capable of preventing unauthorized entry; k. 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. l. 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. m. 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 preliminary design ensure that operations with fissionable material remain sub critical under all normal and credible abnormal conditions?	
	Does the preliminary design satisfy the requirements of revisions to the consensus nuclear criticality safety standards of ANSI/ANS 8 in effect at the time of the approval of DOE O 420.1B? **(CS-1.1)**	
	Is the preliminary design addressed that no single credible event or failure can result in a criticality (DOE O 420.1B)? **(CS-1.2)**	
	Are the preliminary criticality safety evaluations for fissionable materials operations performed in accordance with DOE-STD-3007-2007, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities?* Are they 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 preliminary 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)**	
	Does the preliminary design implement 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 preliminary 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 preliminary 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?	
	Does the preliminary design demonstrate controls through one or more of the following as appropriate*:*	

ID #	Performance Objectives and Criteria[4]	Met?
	• Physical constraints • Use of instrumentation • Chemical means • Reliance on natural or credible course of events • Administrative procedures • Other means? **(CS-2.1)**	
	Are all controlled parameters and their limits specified and the influence of variations of these parameters on the k_{eff} is understood and documented in the preliminary design supporting documents? **(CS-2.2)**	
	Does the preliminary design rely upon equipment design, where practicable, in which dimensions are limited rather than administrative controls? **(CS-2.3)**	
	Does the preliminary 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)**	
	Are the sub critical 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) 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 support the requirements of section 4.3 of ANSI/ANS 8.3? **(CS-3.2)**	
	Is the dependability of the preliminary design for a criticality alarm system consistent with the requirements of ANSI/ANS 8.3 section 4.4? **(CS-3.3)**	
	Does the criticality alarm system(s) meet the criteria identified in ANSI/ANS 8.3 section 5? **(CS-3.4)**	
	Does the system support testing and maintenance as identified in ANSI/ANS 8.3, Section 6? **(CS-3.5)**	
Fire Protection		
FP-1	Does the preliminary design ensure that it provides a level of safety sufficient to meet DOE goals and objectives?	
	Does the preliminary design fulfill requirement of highly protected risk? (HPR) (DOE O 420.1B) **(FP-1.1)**	
	Does the preliminary designs prevent loss of safety functions and safety systems as determined in the preliminary hazards analysis and provides defense in depth? (DOE O 420.1B) **(FP-1.2)**	
	Does the preliminary design prevent fires and related effects that cause an unacceptable release of hazardous or radiological materials? **(FP-1.3)**	
	Does the preliminary design prevent fires and related effects that cause vital DOE program to suffer an unacceptable interruption? **(FP-1.4)**	

ID #	Performance Objectives and Criteria[4]	Met?
	Does the preliminary design prevent fires and related effects that result in the loss of critical process controls? **(FP-1.5)**	
FP-2	Does the preliminary design meet or exceed 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 preliminary design identify and reflect 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 preliminary 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 preliminary 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)**	
	Does the preliminary 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)**	

ID #	Performance Objectives and Criteria[4]	Met?
	Does the preliminary 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)**	
	The design reflects and conforms 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 preliminary 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* (preliminary design stage) • 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 preliminary 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 preliminary 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	

ID #	Performance Objectives and Criteria[4]	Met?
	• Life Safety Design Features • Fire Protection and Notification Systems • Equivalencies? **(FP-2.9)**	
	Does the preliminary 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 preliminary design reflect and conform to the facility specific provisions of NFPA-70, *National Electrical Code?* **(FP-2.11)**	
	Does the preliminary design reflect and conform to the facility specific provisions of NFPA-72, *National Fire Alarm Code?* **(FP-2.12)**	
	Does the preliminary design reflect and conform to the following facility specific provisions of NFPA-80, *Standard for Fire Doors and Fire Windows?* **(FP-2.13)**	
	Does the preliminary 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 preliminary design reflect and conform to the facility specific provisions of NFPA-101, *Life Safety Code?* **(FP-2.15)**	
	Does the preliminary 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 preliminary 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 preliminary 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 preliminary 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 preliminary 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 preliminary 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 preliminary design for the facility and supporting systems meet or exceed the following overarching facility-specific fire protection design criteria:	

ID #	Performance Objectives and Criteria[4]	Met?
	A reliable and adequate supply of water for fire suppression. For preliminary design purposes, documentation (text and/or drawings) must include a commitment to conform to applicable criteria, as delineated above, and should also include a conceptual design description that encompasses; fire water storage (quantity and duration), pumps, distribution piping, materials, and other available details? **(FP-3.1)**	
	Noncombustible construction material for facilities exceeding the size limits established by DOE (see DOE-STD-1066-99, *Fire Protection Design Criteria)*. For preliminary design purposes, 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)**	
	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. Design documents should describe in general terms the subdivision of each facility into fire areas, as defined in DOE-STD-1066-99. 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)**	
	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. For preliminary design purposes, documentation (text and drawings) should describe which fire areas will be protected by fire extinguishing systems, the extent of protection, the governing NFPA Standards and relevant DOE criteria, and any anticipated design issues (such as high vaulted ceilings or areas with high ventilation rates). There must be a firm commitment to use listed materials which must be encompassed by a QA/QC program? **(FP-3.4)**	
	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)**	

ID #	Performance Objectives and Criteria[4]	Met?
	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)**	
	Are there means to notify emergency responders and building occupants of a fire (e.g., fire alarm or signaling system)? Does the preliminary design provide a description of a fire alarm/signaling system, with a commitment to conform to applicable criteria, to use listed components, and to subject the components to a QA/QC program? **(FP-3.7)**	
	Does the preliminary design address emergency egress and illumination for safe facility evacuation in the event of fire as required by applicable codes or fire standards? Does the preliminary design demonstrate that two remote exits are available from all occupied areas, except where permitted by the Life Safety Code? Does the preliminary design provide an overview of the egress concept, including lighting and signage? Are issues that might affect egress, such as security measures, identified without mentioning specific provisions? **(FP-3.8)**	
	Does the preliminary design address 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)? Do preliminary 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)**	
	Does the preliminary design address the 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 dikes? Such features would only be necessary if required by the preliminary FHA or preliminary safety analysis in conjunction with other facility or site environmental protection measures. Does the preliminary design provide a description of confinement and containment issues and their mitigation? **(FP-3.10)**	
	Does the preliminary design address fire and related hazards that are unique to DOE and not addressed by industry codes and standards? Does the preliminary design address 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 preliminary FHA? Does the preliminary design identify atypical fire hazards (such as chemicals or processes) and does the fire protection means intended to mitigate their corresponding fire risk? **(FP-3.11)**	

ID #	Performance Objectives and Criteria[4]	Met?
	Are the fire protection systems designed such that their inadvertent operation, inactivation, or failure of structural stability will not result in the loss of vital safety functions or inoperability of safety class systems as determined by the Preliminary Safety Design Report? Is 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 preliminary 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 preliminary design documentation manifest a process for identifying conditions for which literal conformance is not feasible or cost-effective? Does the documentation 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 preliminary design documentation 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 preliminary design documentation manifest a commitment to implement a design that conforms to governing fire safety criteria when there is no agreement with the DOE AHJ regarding a pending equivalency? (Default decisions regarding design are to literal conformance.)? **(FP-4.3)**	
FP-5	Where required by Paragraph 3.b. (5) of DOE O 420.1B, has a (Preliminary) Fire Hazards Analysis (FHA) been completed and documented?	
	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-5.1)**	
	Are the scope and content of the PFHA in conformance with the guidelines delineated in Section 4.6 of DOE G 420.1-3 (September 27, 2007 or current equivalent)? **(FP-5.2)**	
	Are the conclusions of the PFHA incorporated into safety analyses documentation and integrated into design basis and beyond design basis accident conditions? **(FP-5.3)**	
	Are there provisions exist for updating the PFHA over time as significant changes occur? **(FP-5.4)**	
Safety Integration		
SI-1	Is the Preliminary Safety Design Report (PSDR) prepared and consistent with preliminary design documents?	
	Is the Safety Design Strategy prepared by the Safety Design Integration Team (SDIT)? **(SI-1.1)**	
	Is the PSDR prepared by the SDIT? **(SI-1.2)**	

ID #	Performance Objectives and Criteria[4]	Met?
	Has the PSDR been reviewed by DOE and verified to meet expectations of DOE-STD-1189-2008, Appendix I, or where deficient, explicit conditions of approval established? Has DOE prepared a Preliminary Safety Validation Report on its review? **(SI-1.3)**	
	Has the Safety Design Strategy (SDS) been reviewed by DOE and verified to meet expectations of DOE-STD-1189-2008, Appendix E, or where deficient explicit conditions of approval established? **(SI-1.4)**	
	Are the Design criteria consistent with design commitments and requirements identified in the SDS? **(SI-1.5)**	
SI-2	Does the preliminary design incorporate sufficient defense in depth consistent with preliminary safety analysis?	
	Does the preliminary 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	Does the preliminary design meet the requirements and objectives of DOE O 420.1B?	
	Does the preliminary design ensure that the facility is sited and designed in a manner to ensure adequate protection to health and safety of the public, workers, and the environment from the effects of accidents involving radioactive materials release? **(SI-3.1)**	
	Does the preliminary design ensure that safety SSCs are designed commensurate with the importance of the safety functional requirements? **(SB-3.2)**	
	Is the safety class electrical systems designed to preclude single point failure? **(SB-3.3)**	
	Are the process systems designed to minimize waste production and mixing of radioactive and non-radioactive wastes? **(SB-3.4)**	
SI-4	Has the Integrated Safety Management Description been prepared and incorporated into preliminary design activities?	
	Are the requirements, methodology, and responsibility for ES&H activities clearly identified and communicated? **(SI-4.1)**	
	Does the preliminary design incorporate an analysis of potential workplace hazards (industrial safety/hygiene) and establishes appropriate controls? **(SI-4.2)**	
Quality Assurance (Additional Lines of Inquiry are contained in the QA Review Module and Software QA RM)		
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)**	
	Has the design incorporated applicable requirements and design base? **(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)**	

ID #	Performance Objectives and Criteria[4]	Met?
	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 responsible design organization prescribe and document the design activities to the level of detail necessary to permit the design process to be carried out in a correct manner, and to permit verification that the design meets requirements? (NQA-1 300) **(QA-2.1)** This should include the integration function when multiple organizations, design efforts and systems are included in the total system design.	
	Are the design analyses sufficiently detailed such that a person technically qualified in the subject can review and understand the analyses and verify the adequacy of the results without recourse to the originator? (NQA-1 400) **(QA-2.2)**	
	Has the design been developed using sound engineering/scientific principles and appropriate standards? **(QA-2.3)**	
	Are the design assumptions, if necessary, are adequately described and reasonable? **(QA-2.4)**	
	Is the design output compare reasonably to the design inputs? **(QA-2.4)**	
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)**	
	Are the internal and external design interface controls, procedures, and lines of communication among participating design organizations and across technical disciplines established and described for the review, approval, release, distribution, and revision of documents involving design interfaces? **(QA-3.2)**	
QA-4	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? (See CM, *Configuration Management*, for additional review criteria)	
	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)**	
QA-6	Is the design independently verified to be adequate?	

ID #	Performance Objectives and Criteria[4]	Met?
	Are the design procedures identify the responsibilities of personnel verifying the design, the areas and features that require design verification, the pertinent considerations to be verified, and the extent of documentation required to document verification? **(QA-6.1)**	
	Are the 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 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	Are 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 the procedures established and described requiring documented verification of the dimensional accuracy and completeness of design drawings and specifications? **(QA-7.3)**	
QA-8	Has the 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 the software acquired from a third party or from corporate inventories used in design calculations been identified? **(QA-8.1)**	
	Have 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 the software used for classification, analysis and design of SSCs relied on for worker, public or environmental protection controlled. **(QA-9.3)**	
	Have the software, including spreadsheets, databases and their associated support tools (e.g., Excel, MS Access, Windows O/S) been uniquely identified and the specific versions used in the design calculation noted? **(QA-9.4)**	
	Is the software identified stored in a location that is easily retrieval and access is restricted to authorized individuals? **(QA-9.5)**	
	Are the updates to the software identified created from this stored software? **(QA-9.6)**	
QA-10	Are the 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. The requirements are reviewed and approved? **(QA-10.1)**	

ID #	Performance Objectives and Criteria[4]	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? The independent review is documented? **(QA-10.2)**	
	Are the spreadsheets and other software created for use in the engineering design tested to ensure the documented requirements are met and produce the correct results for the problem being analyzed? Are the test results documented and evaluated by a responsible authority to ensure the test requirements are met? **(QA-10.3)**	
QA-11	Are the software configuration items identified and controlled?	
	Are the 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 the updates to the items identified created from these stored versions? **(QA-11.3)**	
Civil/Structural/Seismic		
NPH-1	Do the design calculations address major structures and SSCs and are complete and consistent with known conditions and facility layout at the preliminary design stage?	
	Do the calculations evaluate the capacity of connections between structural members? **(NPH-1.1)**	
	Do the calculations address all anticipated load cases? **(NPH-1.2)**	
	Do the calculations provide sufficient documentation of assumed inputs and outputs? **(NPH-1.3)**	
	Do the calculations consider structural behavior of the material to be used in construction? **(NPH-1.4)**	
NPH-2	Have the following seismic design expectations been addressed during preliminary design prior to CD-2 approval?	
	Has any remaining site geotechnical investigation work been completed as required by ANSI/ANS-2.27-2008, Section 4.3.2? **(NPH-2.1)**	
	Have any necessary NPH update assessments been completed, as required by DOE O 420.1B, Chapter IV? **(NPH-2.2)**	
	Have all appropriate NPH design inputs been identified, including ground motion design spectra, wind speeds, and flooding levels, as required by ASCE/SEI 43-05, Section 3.1 and DOE-STD-1020-2002? **(NPH-2.3)**	
	Have the structural design plan and seismic analysis plan been properly revised, if necessary? **(NPH-2.4)**	
	Has a revised, essentially final, "seismic equipment list" of safety-related SSCs, listing functions, SDCs, and acceptable limit states been developed in coordination with preliminary design safety basis work, as recommended by DOE-STD-1189-2008, Section 3.3 and Appendix A, and DOE-STD-1021-93, Section 3.10? **(NPH-2.1.5)**	

ID #	Performance Objectives and Criteria[4]	Met?
	Has the seismic qualification plan for safety-related equipment been finalized, as required by ASCE/SEI 43-05, Section 8? (NPH-2.6)	
	Have acceptance criteria documents for structural design, piping design, and equipment design/evaluation been completed? **(NPH-2.7)**	
	Are the acceptance criteria appropriate for the SDC and limit state of the individual facility SSCs, as required by ASCE/SEI 43-05, Section 5.2? **(NPH-2.8)**	
	Are the acceptance criteria documents appropriately linked to one another? **(NPH-2.9)**	
	Are the design calculations being reviewed in-process by DOE reviewers? **(NPH-2.10)**	
	Has a seismic structural model, with soil-structure interaction analysis, soil settlement profiles, and critical soil profiles (if necessary), been completed, as required by ASCE/SEI 43-05, Sections 3 and 4? **(NPH-2.11)**	
	Has the seismic structural model been executed to develop a preliminary structural design for ensuring adequate load path, as required by ASCE/SEI 43-05, Sections 3 and 4? **(NPH-2.12)**	
	Has an initial in-structure floor spectrum been established per ASCE/SEI 43-05, Section 2.3, and have any vulnerable components (those that may be difficult to seismically design and/or require seismic testing) been identified? **(NPH-2.13)**	
	Has a peer review of geotechnical, seismic, and structural design, as well as component qualification, been completed, as required by ASCE/SEI 43-05, Section 9.1? **(NPH-2.14)**	
	Do the project structural engineers demonstrate a sound understanding of the load path? **(NPH-2.15)**	
	Are appropriate finite element techniques and established calculation procedures being used in structural modeling and design? (NPH-2.16)	
	Are the applicable national codes and standards being used appropriately? **(NPH-2.16)**	
	Are the estimated loads on the facility SSCs, calculated per ASCE/SEI 43-05, Sections 3 and 4, consistent with the conceptual design SDC and limit state for the individual SSCs? **(NPH-2.17)**	
	Do the design calculations reflect the most current facility layout?	
	Does the shear distribution in the structure, calculated per ASCE/SEI 43-05, Sections 3 and 4, appear reasonable? **(NPH-2.18)**	
	Are the piping and equipment sizes and weights appropriately accounted for in the structural calculations? **(NPH-2.19)**	
	If active confinement is not required after a seismic event, has a justification been provided? **(NPH-2.20)**	
	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-2.21)**	
	Is the seismic loading evaluated consistent with site-specific design response spectra? **(NPH-2.22)**	

ID #	Performance Objectives and Criteria[4]	Met?
Engineering Design - Process Design/Layout		
ED-1	Have the Facility Plans, Piping and Instrumentation Diagrams (P&ID), and preliminary detail drawings been coordinated with the Process Descriptions, Flow Diagrams, and Process Calculations and the facility layout supports the process requirements?	
	Do the Facility and System drawings in the submitted design package meet the expectations of the Site procedure or contract specification for completeness and format? **(ED-1.1)**	
	Does the 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)**	
	Do the 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 SSC of the safety related systems properly characterized as to their safety pedigree in accordance with DOE O 420.1B and DOE-STD-3009? The necessary documents to support procurement and control of safety related SSCs have been developed? **(ED-1.4)**	
	Do 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? The various engineering areas are being closely integrated into the layout? (i.e. electrical cable trays, HVAC ductwork, piping and instrument penetrations/runs) **(ED-1.7)**	
	Layout drawings and floor plans are coordinated with system drawings? The facility layout supports the process flow and facilitates movement of parts and tools to perform the facility mission? **(ED-1.8)**	
	Does the preliminary 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 preliminary design address 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?	
	Do 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)**	

ID #	Performance Objectives and Criteria[4]	Met?
	Do 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)**	
	Are the operating and design loads and load combinations correctly specified for each system and equipment? Are adequate calculations exist to support the selected design? **(ED-2.3)**	
	Are the 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 the 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)**	
	Does the preliminary design include the necessary strengthening, support, or restraints to meet the selected seismic performance criteria? **(ED-2.8)**	
	Is 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 the tanks and piping systems of welded construction 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)**	
	Are all system components expected to be in contact with strong acids or caustics corrosion resistant? **(ED-2.12)**	
	Is the use of traps avoided? Is the piping designed to minimize entrapment and buildup of solids in the system? **(ED-2.13)**	
	Does the preliminary design address 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 and 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)**	
	Where standard off-the-shelf electrical materials and equipment been selected, are there provisions for testing and labeling by a nationally recognized testing laboratory (international standards organization or recognized testing agency)? If not, have evaluation and approval by the authority having jurisdiction (AHJ) been performed? **(ED-3.2)**	

ID #	Performance Objectives and Criteria[4]	Met?
	Are preliminary panel schedules and control diagrams are developed for the electrical systems? Do load and fault calculations support the design requirements? **(ED-3.3)**	
	The electrical portion of the design is sufficiently mature to define all major components (e.g., transformers, fuses and circuit breakers, and motors) as well as include adequate excess electrical capacity to provide for future expansion? **(ED-3.4)**	
	Are the basic cable tray layouts sufficiently developed to identify layout interferences and material quantity needs? Have the cable tray designs been integrated into a 3-D model? **(ED-3.5)**	
	When the facility includes a control room, have the design considerations of DOE-HNDBK-1132-99, section 4.1, Control Centers/Control Rooms, been taken into consideration? **(ED-3.6)**	
	Has the preliminary design incorporated provisions so that I&C system components can be tested periodically for operability and required functional performance? **(ED-3.7)**?	
	Does the design of instrument channels and associated logic ensure that I&C components fail in a safe failure mode? **(ED-3.8)?**	
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)**	
	Are the design designations for seismic criteria of the safety related HVAC and Confinement Systems consistent with the SDS and PDSR and are detailed enough 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? Technical bases (i.e., calculations) developed to support performance requirements? (i.e., air flows, pressures, etc.) **(ED-4.6)**	
	Do 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)**	

ID #	Performance Objectives and Criteria[4]	Met?
	Are operating areas continuously monitored for hazardous release? Consideration is 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? **(ED-4.9)**	
Configuration Management		
CM	Has the contractor established a Configuration Management (CM) 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 the roles and responsibilities for configuration management and change control clearly assigned and understood? **(CM-1.2)**	
	Are the design changes and field changes being documented, reviewed and approved and effected documents are modified to reflect approved design changes? **(CM-1.3)**	
	Are safety SSCs been identified and are subjected to the CM program? **(CM-1.4)**	
	Is a design authority clearly established for safety SSCs who is responsible for maintaining design control (i.e., establishing and maintaining design requirements, ensuring that design output documents accurately reflect the design basis, managing any changes to baseline documents)? **(CM-1.5)**	