



Strengthening Line Management Oversight and
Federal Monitoring of Nuclear Facilities

The background image for this section shows the interior of a nuclear reactor. It features a complex network of yellow cables and green lighting, with various pipes and structural elements visible.

Standard Review Plan
Safety Design Strategy

The background image for this section shows a different view of the nuclear reactor interior. It features a complex network of pipes and structural elements, with blue and green lighting illuminating the scene.

April 2014

OFFICE OF ENVIRONMENTAL MANAGEMENT

Standard Review Plan

Safety Design Strategy

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



April 2014

FOREWORD

The Chief of Nuclear Safety (CNS) is developing a series of Standard Review Plans (SRPs) to provide 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.

For safety-in-design reviews, the EM project review process encompasses key Critical Decision (CD) milestones and products established by DOE O 413.3B, *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 safety-in-design related SRPs follow the CD process and address key functional areas of project management, engineering and design, safety, environment, security, and quality assurance, grouped by each specific CD phase.

This SRP on Safety Design Strategy (SDS) provides the starting point for a set of corporate Performance Objectives and Criteria contained in Appendix A. 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.

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ACRONYMS

AE	Acquisition Executive
CD	Critical Decision
CNS	Chief of Nuclear Safety
COR	Code of Record
CSDR	Conceptual Safety Design Report
DOE	Department of Energy
EM	Environmental Management
FPD	Federal Project Director
FRAM	Functions, Responsibilities, and Authorities Manual
IPT	Integrated Project Team
SAE	Secretarial Acquisition Executive
SBAA	Safety Basis Approval Authority
SDIT	Safety Design Integration Team
SDS	Safety Design Strategy
SER	Safety Evaluation Report
SC	Safety Class
SS	Safety Significant
SSC	System, Structure, and Component

I. INTRODUCTION

Integration of safety into design development is a key element of the Department of Energy (DOE) project design process and programs. In a memorandum to DOE elements, dated December 5, 2005, on the integration of safety in design, the Deputy Secretary of Energy stated:

I expect safety to be fully integrated into design early in the project. Specifically, by the start of the preliminary design, I expect a hazard analysis of alternatives to be complete and the safety requirements for the design to be established. I expect both the project management and safety directives to lead projects on the right path so that safety issues are identified and addressed adequately early in the project design.

The need to integrate safety into the design from the earliest stages is identified in DOE O 413.3B. The Order requires the development of a Conceptual Safety Design Report for Critical Decision (CD)-1, a Preliminary Safety Design Report at CD-2, a Preliminary Documented Safety Analysis Report for CD-3, and a Documented Safety Analysis Report for CD-4 and to be updated in the remaining facility life cycle – operations and decommissioning.

Early in the conceptual design phase, a Safety Design Strategy (SDS) should be developed for Hazard Category 1, 2, and 3 nuclear projects. The SDS provides preliminary information on the scope of anticipated significant hazards and the general strategy for addressing those hazards. The SDS is updated throughout subsequent project phases and should contain enough detail to guide design on overarching design criteria, establish major safety structures, systems, and components, and identify significant project risks associated with the proposed facility relative to safety.

Consistent with DOE O 413.3B and DOE-STD-1189 for nuclear facilities, adequate resources shall be provided to develop an SDS and a Code of Record (COR) early in the design phase. The COR shall be maintained throughout the CD process and for the remainder of the nuclear facility's lifecycle. The COR shall serve as the management tool and source for the set of requirements that are used to design, construct, operate and decommission nuclear facilities. A SRP on Code of Record has also been developed to provide consistent COR review.

Specific DOE O 413.3B requirements regarding SDS preparation and update include:

Prior to CD-1, *For Hazard Category 1, 2, and 3 nuclear facilities, prepare a Safety Design Strategy, with the concurrence of the CNS or with written advice of the CDNS, as appropriate, for projects subject to DOE-STD-1189-2008.*

Prior to CD-2, *For Hazard Category 1, 2, and 3 nuclear facilities, update the Safety Design Strategy, with the concurrence of CNS or with written advice from CDNS, as appropriate, for projects subject to DOE-STD-1189-2008.*

Prior to CD-3, *For Hazard Category 1, 2, and 3 nuclear facilities, update the Safety Design Strategy, with the concurrence of CNS or with written advice from CDNS, as appropriate, for projects subject to DOE-STD-1189-2008.*

DOE-STD-1189-2008 provides the Department's expectations for incorporating safety into the design process for new or major modifications to DOE Hazard Category 1, 2, and 3 nuclear facilities. The Standard describes the safety-in-design philosophies to be used with the project management requirements of DOE O 413.3B. The Standard addresses the development of an SDS. Review of the SDS is an essential element to ensure that the project will meet the requirements and expectations of DOE Orders and guidance and should be completed prior to authorization to proceed to CD-1 and CD-2.

The SDS is a tool to guide project design, document safety documentation development planning, and provide approving authorities with sufficient information on which to make decisions. It provides a single source for the safety policies, philosophies, major safety requirements, and safety goals for the project. The SDS describes the major hazards anticipated in the facility (including type, quantity and form), how those hazards will be addressed using safety structures, systems, and components (SSCs) considering natural phenomena, confinement ventilation, and other significant safety needs. Any risks to these decisions from new technology or assumptions should be identified. In addition, the SDS identifies major safety documentation deliverables to be provided within each project phase.

A statement of DOE expectations for safety-in-design at the pre conceptual stage is intended to address the DOE O 413.3B requirement for safety-in-design planning and a tailoring strategy as related to safety and to provide the basis for development of an SDS during the conceptual design stage. The SDS should address all the elements of the SDS format and content to the degree supportable, appropriate to that design stage. The SDS is expected to be revised and updated as the project matures.

II. PURPOSE

The SDS SRP is a tool that assists DOE Federal project review teams in evaluating the adequacy of the SDS prior to CD-1 approval and the adequacy of SDS updates required prior to CD-2 and CD-3 approvals. The SDS SRP focuses on the safety design package key elements, including safety guidance and requirements, hazards identification, key safety decisions, risks to project safety decisions, safety analysis approach and planning, and safety design integration team (SDIT) interactions.

III. ROLES AND RESPONSIBILITIES

A successful SDS 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. 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 and risks.

It is strongly recommended that the team leader should either be a project or systems engineer experienced in the management of a multidisciplinary review team (e.g. fire protection,

criticality, radiological protection, nuclear) that matches to the extent practicable the contractor’s SDIT.

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

The roles and responsibilities for all involved in the SDS review must be clear and consistent with various requirements of DOE O 413.3B and the DOE Functions, Responsibilities, and Authorities Manual (FRAM). The table below provides a compilation of SDS review roles and responsibilities.

Position	Responsibility
Field Element Manager	Provides support and resources to the FPD and Review Team Leader in carrying out the review.
	Facilitates the conduct of the review. Assigns office space, computer equipment, and support personnel to the team as necessary to accomplish the review in the scheduled timeframe.
Federal Project Director	Identifies the need for a SDS review, determines the scope of the review effort, and coordinates with EM-HQ for review and concurrences.
	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 SBAA, 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 from both the IPT as well as from the DOE Field Line Manager overseeing the facility or project.
	Leads the SDS 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 FPD and SBAA for approval.
	Leads the onsite portion of the review.
	Ensures that the review team members complete and document their portions of the review and characterizes the findings.

Position	Responsibility
	Coordinates incorporation of factual accuracy comments by Federal and contractor personnel on the draft report.
	Forwards the final review report if it is part of or referenced by the Project Execution Plan to the AE or SAE for consideration in making the decision to authorize CD approval.
	Participates, as necessary, in the closure verification of the findings from the review report.
Review Team Member	Refines and finalizes the criteria for the 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 reviews.
	Participates in the onsite review activities, conducts interviews, reviews documents, conducts walk downs, and makes observations as necessary.
	Based on the criteria and review approaches in the Review Plan, assesses whether his/her assigned criteria have been met.
	Documents the results of the review for his/her areas. Prepares input to the review report.
	Makes recommendations to the Review Team Leader for characterization of findings in his/her area of review.
	Resolves applicable Federal and contractor factual accuracy comments on the draft review report.
	Prepares the final review report for his/her area of review.

IV. REVIEW SCOPE AND CRITERIA

This SDS SRP provides a set of performance expectations and criteria that are organized based on the key technical and safety areas and disciplines identified in the DOE Orders and guidance. These review areas are summarized below and include safety guidance and requirements, hazards identification, key safety decisions, risks to project safety decisions, safety analysis approach and planning, safety design integration team interactions, and the COR.

For each review area, Appendix A of this SRP provides the performance objectives and review criteria. These performance objectives and review criteria will provide consistent guidance to project-specific SDS review teams to develop their specific lines of inquiry, if necessary.

As verification that the SDS complies with DOE-STD-1189-2008, Appendix A of this SRP provides performance expectations and criteria that must be completed by the DOE Lead Reviewer and attached to the official correspondence package approving the SDS.

If any of the above elements are not satisfactorily addressed, the DOE Lead Reviewer should prepare correspondence that either rejects the SDS or provides explicit actions expected on the part of the design contractor (i.e., actions, completion dates). The SDS should be rejected if it has major deficiencies with respect to DOE-STD-1189-2008 requirements. In cases where the

SDS has incomplete information because of the lack of available design information, the Lead Reviewer may consider a condition of approval with expectations tied to future design phases.

V. SDS FORMAT AND CONTENT

The SDS should be tailored based on complexity and risk, and should reference available information sources where possible. It should also address important aspects that affect the development of the safety design basis documentation or the interface with design and operations or areas that require concurrence (assumptions, calculations, decisions that affect the technical baseline, or the data used to generate hazard and safety analysis required from an Integrated Hazard Analysis). Additionally, the SDS content will vary significantly through the course of a major project that spans several years. As the project moves from conceptual design to preliminary design to final design, construction, and startup, the detailed information within the SDS will change, and the focus of various portions of the SDS will change to be consistent with project needs. The intent of this format and content guidance is to establish the minimum expectation for the types of material that will be addressed in the SDS. The depth of treatment is where tailoring occurs. The intent of the SDS is that it be as detailed as needed to communicate to the decision makers and the SDIT the strategy for successfully integrating safety and design and producing safety design basis documentation that will be approved to allow either entry into the next critical decision or into operation.

1.0 Purpose

This section introduces the SDS for the project. Effectively, this section should simply state that the SDS for the specific project will describe the overall safety strategy, the strategy for certain high-cost, safety-related design decisions, identify key assumptions or inputs that may represent potential risks to those design decisions, and the expected safety deliverables through the project.

2.0 Description of Project/Modification

This section provides a brief description of the project/modification or proposed activity consistent with the level of knowledge of the project phase. Fundamentally, the description should provide enough detail to allow the reader to understand the discussion that follows regarding safety strategy. Such details may include mission, proposed location(s), description of major facilities/processes or changes to existing facilities/processes, and major hazards (including type, quantity, and form). Aspects that may be relevant to the overall strategy should also be included, such as storage capabilities of hazardous materials, waste streams and processes, and support systems. Reference to other project documents is acceptable; however, the SDS should provide enough detail as a standalone document to provide understanding to the reader.

3.0 Safety Strategy

This section is the core of the SDS and should present the overall safety strategy for the project. The following topics should be addressed in the section.

3.1 Safety Guidance and Requirements

This review area is to ensure that the SDS presents the overarching philosophies and goals to be used by the project to address the identified hazards. This review area also addresses the adequacy of the criteria or approach to safety functional classification and the safety design criteria to be applied to the project. The references include DOE O 420.1C and DOE G 420.1-1A.

3.2 Hazard Identification

This area is to ensure that the documentation provides a logical discussion of the major hazards involved in the project and the possible consequences those hazards may pose. This review area will also ensure that the hazards identification is based on the initial or assumed inventories.

3.3 Key Safety Decisions

This review area is to ensure that safety decisions that could potentially result in significant cost or have resulted in costly rework in past projects are explicitly addressed, and the strategy is justified.

4.0 Risks to Project Safety Decisions

This review area is to ensure that the any key risks associated with the identified safety decisions are identified and addressed.

5.0 Safety Analysis Approach and Plan

This review area is to ensure that the SDS adequately describes the safety analysis process and deliverables planned for the project.

6.0 Safety Design Integration Team – Interfaces and Integration

This review area is focused on the evaluation of the strategy for establishing and employing an SDIT within the project. The review area will also address the primary interfaces, not only for the design function, but also for major project areas and disciplines.

VI. REVIEW PLANS, APPROVAL, AND DOCUMENTATION

The execution of a review of the SDS as directed by the FPD is essentially an internal review. Documentation of this review should be consistent with management assessments, self-assessment programs, and identified deficiencies or opportunities for improvement that must be clearly identified and tracked to closure to ensure the effectiveness of the IPT and Federal project team and the ultimate success of the project.

The SDS must be approved by the FPD and SBAA, following the concurrence of EM-40 and the Chief of Nuclear Safety, though DOE-STD-1189-2008 does not require a Safety Evaluation Report (SER) or equivalent to document the approval basis. For the purposes of meeting the Standard, the approval basis may be in the form of a letter that is formally transmitted to the design contractor. The DOE Lead Reviewer shall ensure that a formal correspondence package addresses whether the following elements have been met:

- (1) The SDS is prepared by the design contractor's SDIT (i.e., reflects input from appropriate project personnel);
- (2) SDS format and content are consistent with DOE-STD-1189-2008, Appendix E;
- (3) The SDS is submitted to DOE prior to official contractor submission of a facility's conceptual design documents; and
- (4) EM-40 and the Chief of Nuclear Safety have concurred.

VII. REFERENCE MATERIAL

- DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, November 2010
- DOE-STD-1189-2008, *Integration of Safety into the Design Process*, March 2008
- DOE O 420.1C, *Facility Safety*, December 2012
- DOE G 420.1-1A, *Nonreactor Nuclear Safety Design Guide for use with DOE O 420.1C, Facility Safety*, December 2012
- DOE O 414.1D, *Quality Assurance*, April 2011
- DOE G 414.1-4, *Safety Software Guide for use with 10 CFR 830, Subpart A, Quality Assurance, and DOE O 414.1C (now 1D), Quality Assurance*, June 2005

APPENDIX A - PERFORMANCE OBJECTIVES AND CRITERIA

Review Topical Area	Identifier
Description	DE
Safety Guidance and Requirements	SG
Hazards Identification	HI
Key Safety Decisions	SD
Risks to Project Safety Decisions	PR
Safety Analysis Approach & Plan	SA
SDIT Interface and Integration	II

ID #	Performance Objectives and Criteria ¹	Met?
Description of Project/Modification -- Does this section provide a brief description of the project/modification or proposed activity consistent with the level of knowledge of the project phase?		
DE	The description provides enough information for senior decisions-makers to understand the mission, location, major facilities/processes, and major hazards (including type, quantify, form) (DE-1)	
	The description includes adequate relevant discussion of storage capabilities of hazardous materials, waste streams and processes, and support systems. (DE-2)	
Safety Guidance and Requirements -- Are safety guidance and requirements (overarching philosophies and goals) for the project presented in the SDS document and are they reasonably conservative to the phase of the project or the maturity of the design?		
SG	The safety-in-design approach and philosophy is described or defined (e.g., assurance of protection of public from radiological exposure, minimization of materials-at-risk, passive controls over active, segmentation of hazards, approach to protection of facility worker) in sufficient detail in the SDS. (SG-1)	
	A description of criteria or approach for safety functional classification of radiological and toxicological hazards to public and workers is presented in the SDS and meets STD-1189, Appendix A. (SG-2)	
	The SDS identifies safety design criteria to be applied to the project. The nuclear safety design criteria are specified in DOE O 420.1C, <i>Facility Safety</i> , and DOE G 420.1-1A, <i>Nonreactor Nuclear Safety Design Guide for use with DOE O 420.1C, Facility Safety</i> . (SG-3)	

¹ The site should provide the technical bases and assumptions that support the answers provided to each review criterion. If possible, the review teams should independently verify the technical bases and assumptions.

ID #	Performance Objectives and Criteria ¹	Met?
	A Code of Record process has been established for identifying and maintaining the set of requirements to facilitate accessibility, traceability and maintainability of the requirements throughout project lifecycle. See SRP on Code of Record (SG-4)	
Hazards Identification -- Is the SDS document hazard identification information complete?		
HI	Major hazards (those that drive identification of safety-class (SC) or major safety-significant (SS) systems, structures and components) and possible consequences are adequately discussed in the SDS document, including type, quantity, and form. (HI-1)	
	The SDS hazard identification is based on initial or assumed hazardous inventories. (HI-2)	
	The SDS assumed hazardous inventories are consistent with that used in the initial hazard categorization in accordance with DOE-STD-1027-92. (HI-3)	
	The initial hazard categorization level is provided. (HI-4)	
Key Safety Decisions -- Are key safety decisions (those that potentially result in significant cost or have resulted in costly rework in past projects) explicitly addressed (including any and all assumptions) and the strategy justified consistent with hazard identification information and any associated preliminary consequence estimates?		
SD	Seismic and other natural phenomena design categorization meets DOE-STD-1189, Appendix A, and DOE EM policy on implementation of DOE-STD-1189 issued April 15, 2009. Expected facility design categorization is defined based on initial hazard considerations. (SD-1)	
	Confinement strategy discusses overall approach, including use of active confinement systems and definition of expected functional classification of any confinement system(s). The strategy is consistent with DOE EM policy on implementation of DOE-STD-1189 issued April 15, 2009, and DNFSB Recommendation 2004-2 Implementation Plan Document <i>Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems</i> . (SD-2)	
	Fire mitigation strategy describes overall approach to fire protection including use of fire barriers, segregation, and safety functional classification of suppression systems as well as other similar measures. Strategy is consistent with DOE EM policy on implementation of DOE-STD-1189 issued April 15, 2009. (SD-3)	
	Anticipated safety functions - major safety functions, their function classification [Safety Class (SC), Safety Significant (SS)] and major safety function (e.g. confinement) are identified and adequately presented. (This includes the identification of any potential need for emergency power for safety purposes, especially as regards confinement ventilation systems.) (SD-4)	

ID #	Performance Objectives and Criteria ¹	Met?
Risks to Project Safety Decisions -- Are the risks to project safety decisions summarized in the SDS?		
PR	Risks associated with key safety decisions are described (e.g., new technology, need for additional data to substantiate assumptions, hazardous material inventory assumptions, project constraints regarding schedule, cost and location) in the SDS and included in the Risk Management Plan. (PR-1)	
Safety Analysis Approach and Plan -- Does the SDS adequately describe the safety analysis approach and plan for deliverables? (e.g., a summary of the analysis steps and processes to be used)		
SA	Deliverables expected to be completed, submitted, and approved are described for all project phases. (SA-1)	
	Integration with other safety discipline efforts is described (e.g., Fire Hazards Analysis). (SA-2)	
	Any tailoring approaches (e.g., design/build) affecting safety basis are identified and safety design basis development is described sufficiently to facilitate concurrence by approving authorities. Any tailoring approaches selected for satisfying DOE O 413.3B requirements for safety documentation are described. (SA-3)	
	Major safety analysis tools (e.g., computer codes) to be used satisfy the requirements of 10 CFR 830 Subpart A and DOE O 414.1D, <i>Quality Assurance</i> . Use of any safety analysis tools not included in the DOE Safety Software Central Registry is described and justified, including the approach for qualification per DOE O 414.1D and DOE G 414.1-4 on safety software. (SA-4)	
SDIT – Interfaces and Integration -- Does the SDS describe the strategy for employing an SDIT and the key SDIT interfaces?		
II	The role of the SDIT is described, along with any key interactions among Integrated Project Team. Discussion addresses primary interfaces within the project team that are specifically aimed at facilitating coordination not only with design functions, but with traditional worker safety disciplines, emergency management, and safeguards and security. This is done to ensure coordination among these various interests to ensure development of a design compliant with various requirements while achieving the overall safety strategy. (II-1)	