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Seismic Design Requirements Selection Methodology for the Sludge Treatment and M-91 Solid Waste Processing Facilities Projects

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Seismic Design Requirements Selection Methodology for the Sludge Treatment and M-91 Solid Waste Processing Facilities Projects

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TERMS

CD	Critical Decision
DOE	U.S. Department of Energy
FH	Fluor Hanford, Inc.
IBC	International Building Code
M-91 Project	M-91 Solid Waste Processing Facilities Project
PC	Performance Category
PHMC	Project Hanford Management Contract
RL	U.S. Department of Energy, Richland Operations Office
SDC	Seismic Design Category
SSC	Structure, System, and Component
STP	Sludge Treatment Project

1.0 PURPOSE AND SCOPE

In complying with direction from the U.S. Department of Energy (DOE), Richland Operations Office (RL) (07-KBC-0055, "Direction Associated with Implementation of DOE-STD-1189 for the Sludge Treatment Project," and 08-SED-0063, "RL Action on the Safety Design Strategy (SDS) for Obtaining Additional Solid Waste Processing Capabilities (M-91 Project) and Use of Draft DOE-STD-1189-YR"), it has been determined that the seismic design requirements currently in the Project Hanford Management Contract (PHMC) will be modified by DOE-STD-1189, *Integration of Safety into the Design Process* (March 2007 draft), for these two key PHMC projects. Seismic design requirements for other PHMC facilities and projects will remain unchanged.

Considering the current early Critical Decision (CD) phases of both the Sludge Treatment Project (STP) and the Solid Waste Processing Facilities (M-91) Project and a strong intent to avoid potentially costly re-work of both engineering and nuclear safety analyses, this document describes how Fluor Hanford, Inc. (FH) will maintain compliance with the PHMC by considering both the current seismic standards referenced by DOE O 420.1B, *Facility Safety*, and draft DOE-STD-1189 (i.e., ASCE/SEI 43-05, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*, and ANSI/ANS 2.26-2004, *Categorization of Nuclear Facility Structures, Systems and Components for Seismic Design*, as modified by draft DOE-STD-1189) to choose the criteria that will result in the most conservative seismic design categorization and engineering design.

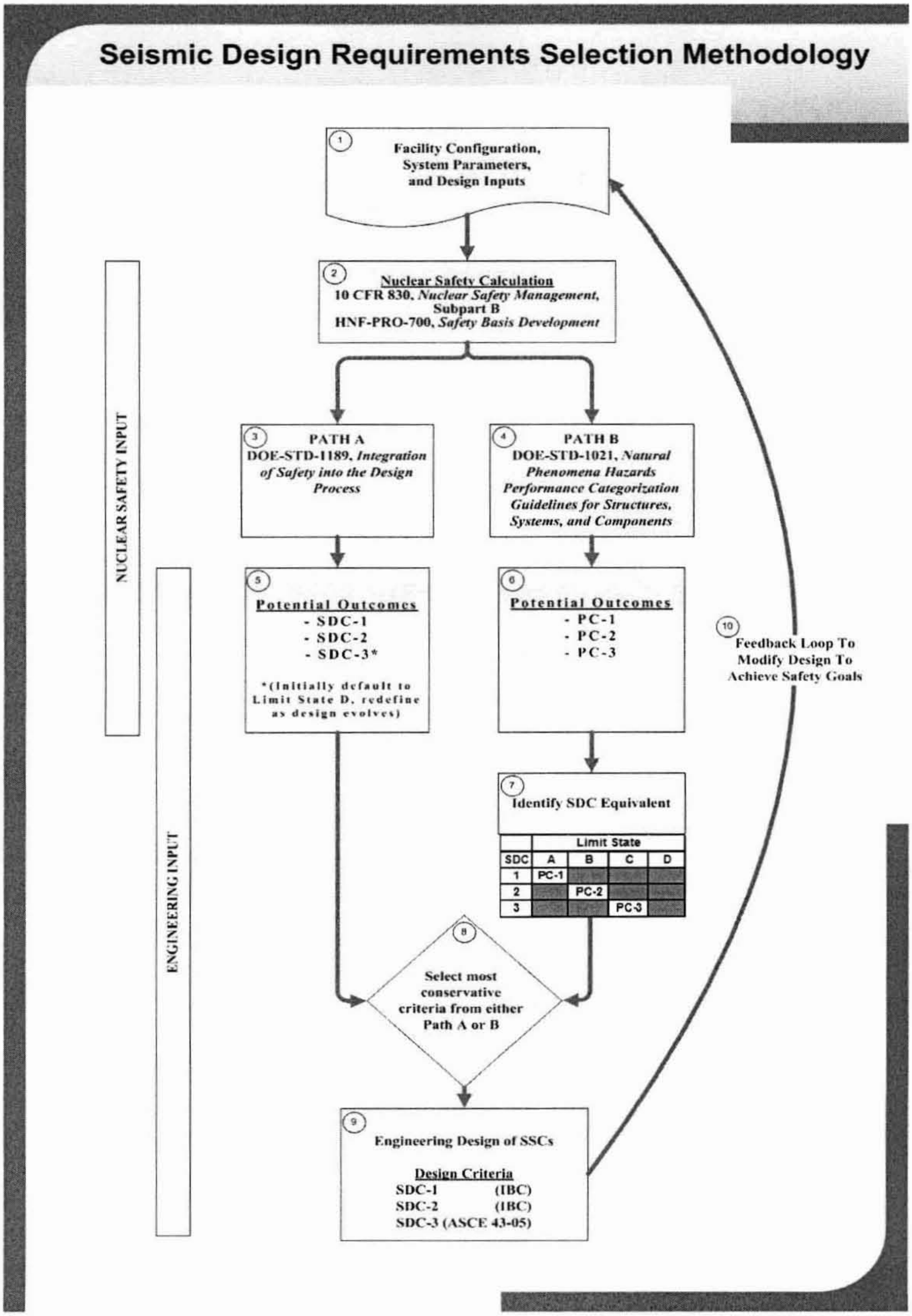
Following the process described in this document will result in a conservative seismic design categorization and design products. This approach is expected to resolve discrepancies between the existing and new requirements and reduce the risk that project designs and analyses will require revision when the draft DOE-STD-1189 is finalized.

It is recognized that this methodology may require updating upon approval and issuance of DOE-STD-1189.

2.0 OVERVIEW OF SEISMIC DESIGN REQUIREMENTS METHODOLOGY

Figure 1 is a graphical depiction of the methodology that has been developed to identify the design requirements that will be applied to the design of the STP and M-91 Project.

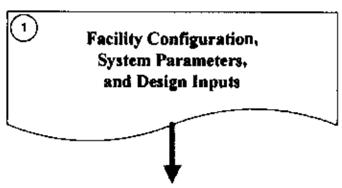
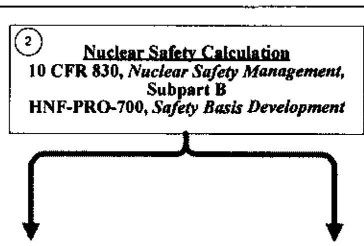
Figure 1. Seismic Design Requirements Selection Methodology.



3.0 DESCRIPTION OF SEISMIC METHODOLOGY ELEMENTS AND TECHNICAL BASES

This section includes, in tabular form, a detailed description of the technical bases and related information for each of the flow chart blocks included in Figure 1.

Table 1. Description of Seismic Methodology Elements and Technical Bases. (5 sheets)

Seismic Methodology Element	Technical Bases
	In accordance with HNF-8739, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH)*[1], hazard and accident analysis is based on a review of existing and available documentation. For the facility in design, DOE-STD-1189 defines the requisite documentation as: facility general layout drawings; process and instrumentation diagrams; process flow sheets; electrical one-line diagrams; and a listing of material at risk by location. Additional information that may be required to define energy sources includes such items as equipment elevations; tank and piping pressure ratings; pump curves; and process temperatures and pressures. This element is a direct feed into Block 2.
	Scenario development and consequence calculations are performed in accordance with DOE-STD-3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis*, which provides a safe harbor methodology under 10 CFR 830, *Nuclear Safety Management,* Subpart B, "Safety Basis." The specific methodology agreed upon by RL and FH for PHMC work is documented in HNF-PRO-700, "Safety Basis Development," and HNF-8739. Candidate engineered controls are classified as Safety Class or Safety Significant based on the criteria contained in HNF-8739. This element is a direct feed into Blocks 3 and 4.

[1] HNF-8739, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH)*, is the RL-approved PHMC methodology for hazard and accident analysis.

Table 1. Description of Seismic Methodology Elements and Technical Bases. (5 sheets)

Seismic Methodology Element	Technical Bases
(3) **PATH A** **DOE-STD-1189, *Integration of Safety into the Design Process***	The consequence calculation performed in Block 2 is modified as mandated by DOE-STD-1189, Appendix A, which specifies an alternate dispersion coefficient for the collocated worker. This element is a direct feed into Block 5.
(4) **PATH B** **DOE-STD-1021, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components***	Consequence calculations performed for use with DOE-STD-1021, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, are required to be performed and safety classification(s) assigned to candidate engineered controls in accordance with DOE-STD-3009. Additional structures, systems, and components (SSC) may be assigned a safety classification as prescribed in DOE-STD-1021 based on such considerations as common-cause failure or adverse affect on operator actions. This element is a direct feed into Block 6.

Table 1. Description of Seismic Methodology Elements and Technical Bases. (5 sheets)

Seismic Methodology Element	Technical Bases
5 **Potential Outcomes** - SDC-1 - SDC-2 - SDC-3* *(Initially default to Limit State D, redefine as design evolves)	Results of the consequence calculation performed in Block 2, as modified in Block 3, are compared with the criteria provided in ANSI/ANS 2.26, as modified by Appendix A of DOE-STD-1189, to make a determination of the SSC Seismic Design Category (SDC). The block at left shows that for a potential outcome of SDC-3, the direction is to initially default to Limit State D[2]. This decision is expected to be refined as the design evolves and additional information is gained. If sufficient information on SSC safety function is available to justify a Limit State of less than Limit State D, that justification will be prepared and the Limit State will be downgraded accordingly. This element is a direct feed into Block 8.
6 **Potential Outcomes** - PC-1 - PC-2 - PC-3	Results of the assignment of safety classification performed in Blocks 2 and 4 are compared with the criteria provided in DOE-STD-1021 to make a determination of the SSC Performance Category (PC). This element is a direct feed into Block 7.

[2] Based on the following statement from ANSI/ANS 2.26-2004, Section 4.2.3, no limit state definitions are required for outcomes that result in SDC-1 or SDC-2 determinations: *No Limit State identification is required for SDC-1 s and SDC-2, whose design requirements are identified in the IBC.*

Table 1. Description of Seismic Methodology Elements and Technical Bases. (5 sheets)

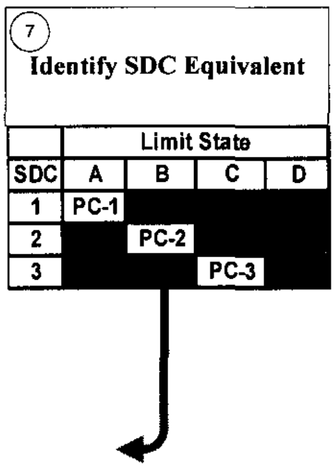
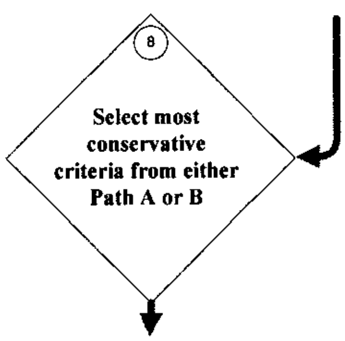
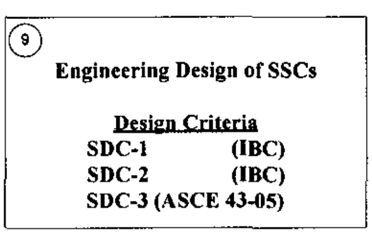
Seismic Methodology Element	Technical Bases
	Results of the determination of PC performed in Block 6 are compared with the SDC Equivalency chart as prepared by the DOE Seismic Design Implications Working Group (shown at left) in order to translate to the equivalent SDC and Limit State. It should be noted that these Limit States are assigned based on equivalency and may not be downgraded in subsequent iteration of the process via Path A. The shaded blocks in the figure at left show SDC and Limit State combinations that are neither defined nor allowed. This element is a direct feed into Block 8.
	The more conservative SDC and associated Limit State is selected from the results of work performed in Blocks 5 and 7. This defines the SDC and associated Limit State for the SSC. This element is a direct feed into Block 9.
	The design for SDC-1 Limit State A (General Service) and SDC-2 Limit State B (Safety Significant) SSCs will be in accordance with the model building code for the State of Washington (i.e., the International Building Code [IBC]). The design for SDC-3 (Safety Class or Safety Significant) SSCs will be in accordance with ASCE 43-05. As outlined in Block 7, the design of SDC-3 Limit State C SSCs is equivalent to PC-3. However, SDC-3, Limit State D may be at least the initial outcome of the consequence calculation (see Blocks 3 and 5). SDC-3 Limit State D design is more conservative than PC-3. The **Limit State** is the limiting acceptable deformation, displacement, or stress that an SSC may experience during or following an earthquake and still perform its safety function. **Limit State C:** SSC may sustain minor permanent distortion but shall still perform its safety function with no post-earthquake repair required.

Table 1. Description of Seismic Methodology Elements and Technical Bases. (5 sheets)

Seismic Methodology Element	Technical Bases
	Limit State D: SSC shall maintain its elastic behavior and perform its safety function during and following an earthquake. Gaseous, particulate, and liquid confinement by SSCs is maintained. For more details on the Limit States, refer to ANSI/ANS-2.26-2004. This block either leads to detailed engineering seismic design calculations or to the feedback loop described in Item 10.
Feedback Loop (Item 10)	Item 10 is included to show a feedback loop to Block 1. The product of Block 9 becomes the input that is fed back into Block 1 and is intended to show the iterative nature of the design process considering the results of nuclear safety analysis. Based on design or safety goals that may be established specific to the project, this loop may be exercised more than once during each critical decision design phase. **If the results of Block 9 would have the affect of driving significant upgrades to existing facilities with limited remaining life or would substantially increase project lifecycle costs for limited risk reduction, project personnel should enter into discussions with their DOE counterparts to ensure that appropriate decisions are made.**

PC = Performance category.
SDC = Seismic Design Category.
SSC = Structure, system, and component.

4.0 REFERENCES

10 CFR 830, *Nuclear Safety Management*, Subpart B, "Safety Basis."

ANSI/ANS 2.26-2004, *Categorization of Nuclear Facility Structures, Systems and Components for Seismic Design*, American Nuclear Society, La Grange Park, Illinois.

ASCE/SEI 43-05, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*, American Society of Civil Engineers, Reston, Virginia.

DOE O 420.1B, *Facility Safety*, U.S. Department of Energy, Washington, D.C.

DOE-STD-1021, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*, U.S. Department of Energy, Washington, D.C.

DOE-STD-1189, DRAFT, *Integration of Safety into the Design Process*, U.S. Department of Energy, Washington, D.C., March 2007.

DOE-STD-3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis*, Change Notice 3, U.S. Department of Energy, Washington, D.C.

HNF-8739, 2004, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH)*, Rev. 1, Fluor Hanford, Inc., Richland, Washington.

HNF-PRO-700, *Safety Basis Development*, Fluor Hanford, Inc., Richland, Washington.

07-KBC-0055, 2007, "Direction Associated with Implementation of DOE-STD-1189 for the Sludge Treatment Project," (Letter to C. M. Murphy, Fluor Hanford, Inc.) S. A. Sieracki, U.S. Department of Energy, Richland Operations Office, September 4.

08-SED-0063, 2008, "RL Action on the Safety Design Strategy (SDS) for Obtaining Additional Solid Waste Processing Capabilities (M-91 Project) and Use of Draft DOE-STD-1189-YR," (letter, to C.M. Murphy, Fluor Hanford, Inc.) S. A. Sieracki, and D. S. Shoop, U.S. Department of Energy, Richland Operations Office, January 17.