Lessons Learned from Assessments of the Integration of Safety into Design of New U.S. Department of Energy Nuclear Facilities

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Office of Enterprise Assessments
U.S. Department of Energy

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Acronyms

BNI	Bechtel National, Inc.
CRAD	Criteria and Review Approach Document
CSDR	Conceptual Safety Design Report
CSMP	Chemical Safety Management Program
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
LAW	Low Activity Waste
NNSA	National Nuclear Security Administration
PDSA	Preliminary Documented Safety Analysis
PrHA	Process Hazard Analysis
SDS	Safety Design Strategy
SER	Safety Evaluation Report
SRL	Safety Review Letter
SSCs	Structures, Systems, and Components
TSR	Technical Safety Requirement
WRPS	Washington River Protection Solutions, LLC
WTP	Waste Treatment and Immobilization Plant

LESSONS LEARNED FROM ASSESSMENTS OF THE INTEGRATION OF SAFETY INTO DESIGN OF NEW U.S. DEPARTMENT OF ENERGY NUCLEAR FACILITIES

Executive Summary

The U.S. Department of Energy (DOE) Office of Environment, Safety and Health Assessments, within the independent Office of Enterprise Assessments (EA), conducted nine assessments of new DOE high-hazard (hazard category 1 and 2) nuclear facility design and construction projects between January 2018 and December 2022. These projects were under the direction of the DOE Office of Environmental Management, the National Nuclear Security Administration, and the Office of Nuclear Energy. The objective of these assessments was to examine the integration of safety into the design, as well as the development of the safety design basis documents for the new nuclear facilities. This lessons-learned report identifies common strengths and weaknesses, best practices, and recommendations to promote organizational learning and improve performance throughout the DOE complex.

This lessons-learned report also compares the results of the assessments to the results from the EA 2018 safety design basis lessons-learned report, *Office of Enterprise Assessments Lessons Learned from Assessments of Integration of Safety into Design of New U.S. Department of Energy Nuclear Facilities – April 2018*, to determine whether there have been changes to previously identified trends. Because EA performs in-process reviews that result in the resolution of most EA concerns prior to the approval of final safety design basis documents, the trends and comparisons discussed in this report are indicative of the quality of the final products, not those submitted for review. To allow for an accurate comparison to the results from the 2018 lessons-learned report, the lessons learned are based on analyzing and grouping significant observations into the following three fundamental areas of safety-in-design integration and safety design basis development: (1) hazard and accident analyses, (2) hazard control selection, and (3) safety functional and performance requirements.

Overall, safety design basis development efforts at most new nuclear facility projects adequately integrated safety into design through following the structured processes defined in DOE-STD-1189, *Integration of Safety into the Design Process*. When compared to the 2018 lessons-learned report, the performance trends identified in the areas of hazard and accident analyses and hazard control selection have improved, while performance trends in the area of safety functional and performance requirements are essentially unchanged. EA identified the following three best practices that were identified at the time the individual assessments were conducted:

- Bechtel National, Inc. (BNI) extensively identified and evaluated potential controls for the chemical hazards that were outside the routine scope of the hazardous material protection program in the hazard analysis. This provided a firm foundation for the identification and grading of the chemical safety management program (CSMP) controls in chapter 18 of the Hanford Site Low Activity Waste Facility documented safety analysis. (Best Practice)
- BNI developed a facility-specific safety and health program to protect the safety and health of workers under 10 CFR 851, *Worker Safety and Health Program*, and implemented it as the CSMP under 10 CFR 830, *Nuclear Safety Management*. The creation of the CSMP, which is described in chapter 18 of the Hanford Site Low Activity Waste Facility documented safety analysis, allowed control of toxic chemical hazards outside the routine scope of the hazardous material protection program without the need for designating safety significant structures, systems, and components (SSCs), thereby simplifying the technical safety requirement and operational requirements. (Best Practice)

- Washington River Protection Solutions, LLC developed functions and requirements evaluation documents and instrument requirements evaluation documents to support safety basis system evaluation of safety significant SSCs at the Hanford Site Tank Farms Tank Side Cesium Removal Project. These documents also support design, procurement, commercial grade dedication, startup, and operations by specifying key design attributes and critical characteristics through systematic and comprehensive failure analysis. (Best Practice)

However, EA identified the following areas where improvements in safety design basis development are needed:

- For two projects, accident analyses provided inadequate information to support the determination of consequences or the derivation of performance criteria for credited controls.
- For one project, the SSC safety functions and functional requirements do not account for all required capabilities or are incompletely developed.
- For one project, the justification for the selection of controls and the evaluation of their ability to perform required safety functions are inadequate.

Recommendations

This lessons-learned report provides the following recommendations for site contractors:

To improve the development of the hazard and accident analyses:

- Provide enhanced training for the safety analysts on the DOE-STD-3009 expectations for the development of the hazard and accident analysis in safety design basis documents.

To improve the development of safety functional and performance requirements:

- Safety basis organizations should examine their training protocols and ensure that they include the DOE-STD-3009 expectations for the identification of safety functions and functional requirements, as well as system evaluations.

LESSONS LEARNED FROM ASSESSMENTS OF THE INTEGRATION OF SAFETY INTO DESIGN OF NEW U.S. DEPARTMENT OF ENERGY NUCLEAR FACILITIES

1.0 INTRODUCTION

The Office of Environment, Safety and Health Assessments, within the Office of Enterprise Assessments (EA), conducted assessments of U.S. Department of Energy (DOE) nuclear facility design and construction projects. These projects were under the direction of the DOE Office of Environmental Management, the National Nuclear Security Administration (NNSA), and the Office of Nuclear Energy. The objective of these assessments was to examine the integration of safety into the design, as well as the development of the safety design basis for new nuclear facilities or significant modifications to existing nuclear facilities. The safety design basis is required to authorize construction and ultimately leads to the nuclear facility's final safety basis, which comprises the documented safety analysis (DSA) and technical safety requirement (TSR) document. An adequate safety basis provides reasonable assurance that the facility can be operated in a manner that adequately protects workers, the public, and the environment. This lessons-learned report identifies common strengths and weaknesses, best practices, and recommendations to promote organizational learning and improve performance throughout the DOE complex.

2.0 METHODOLOGY

EA manages the Department's independent oversight program. This program is designed to enhance DOE safety and security programs by providing the Secretary and Deputy Secretary of Energy, Under Secretaries of Energy, DOE managers, senior contractor managers, Congress, and other stakeholders with an independent evaluation of the adequacy of DOE policy and requirements, as well as the effectiveness of DOE and contractor line management performance, risk management in safety and security, and other critical functions as directed by the Secretary. DOE Order 227.1A, *Independent Oversight Program*, describes and governs the DOE independent oversight program. EA implements the program through a comprehensive set of internal protocols and assessment guides. EA maintains enhanced oversight of high-hazard nuclear facilities under design and construction in support of congressional direction, first established in the Appropriations Act of fiscal year 2012 and reestablished each subsequent year, which makes the continued annual funding for such facilities contingent upon EA's oversight.

This report reflects an analysis of the collected results of EA's assessments of safety design basis development for nine new high-hazard (hazard category 1 and 2) nuclear facility projects at sites conducted between January 2018 and December 2022. The analysis consisted of an evaluation of the issues identified during recent EA assessments and oversight activities, as well as a comparison to trends identified in the EA 2018 safety design basis lessons-learned report, *Office of Enterprise Assessments Lessons Learned from Assessments of Integration of Safety into Design of New U.S. Department of Energy Nuclear Facilities – April 2018*. The sites and facilities assessed or reviewed, along with the responsible contractors, local DOE offices, and DOE Headquarters program offices, are listed in Table B-1. The table also shows the types of safety design basis documents reviewed for each facility. The results were compared to the EA 2018 safety design basis lessons-learned report to determine whether previously identified performance trends have continued. Like the pre-2018 assessments, EA used an in-process review methodology of comment generation and resolution on draft versions and subsequent final safety design basis documents. The reported assessment weaknesses (i.e., deficiencies and discrepancies) summarized in this lessons-learned report reflect those unresolved issues in the final safety design basis

documents and do not include concerns identified in the earlier drafts that were subsequently resolved in the final document submittals. Discrepancies are open EA assessment issues for which there is an agreed-upon resolution and a commitment for closure in the final safety design basis documents. EA often provides a significant number of comments on the draft documents submitted for review that result in material changes. Therefore, the results and trends discussed in this lessons-learned report are not indicative of the quality of the draft documents submitted for review.

To allow for an accurate comparison to the results from the 2018 lessons-learned report, the lessons learned are based on grouping significant observations from EA assessments into the following three fundamental areas of safety-in-design integration and safety design basis development: (1) hazard and accident analyses, (2) hazard control selection, and (3) safety functional and performance requirements.

Appendix A lists the contributors to this lessons-learned effort, the members of the Quality Review Board, and the EA management responsible for this evaluation. Appendix B addresses the scope of this review, applicable criteria and review approach documents, and the analysis methodology. The EA assessment reports and field notes, as well as other source documents used in this review, are listed in Appendix B.

3.0 RESULTS

This portion of the report summarizes the results, including strengths and weaknesses, from the assessment reports, as well as potential concerns identified during the other oversight reviews.

This lessons-learned review analyzed three best practices and eight issues (i.e., no findings, two deficiencies, and six discrepancies) identified in EA assessments since January 2018. Concerns that were identified by EA during the in-process reviews that resulted in changes to the final safety design basis documents are not summarized nor do they form the basis for the trends discussed in this section. These assessment results were categorized as shown in Table 1 below. Further details are provided in the following sections of this report.

Table 1. EA-identified Best Practices, Deficiencies, and Discrepancies

Major Areas	# Best Practices	# Deficiencies	# Discrepancies
Hazard and Accident Analyses	1	2	1
Hazard Control Selection	1	0	2
Safety Functional and Performance Requirements	1	0	3

Overall, EA identified that safety design basis development efforts at new nuclear facility projects adequately integrated safety into the design by following the structured processes defined in DOE-STD-1189, *Integration of Safety into the Design Process*. When compared to the 2018 lessons-learned report, the performance trends identified in the areas of hazard and accident analyses and hazard control selection have improved, while performance trends in the area of safety functional and performance requirements are essentially unchanged. Depending on project maturity and contractual implementation considerations, the 2016 version of the standard is often used for the analyzed safety design basis activities. This lessons-learned review did not correlate the quality of project safety design basis development based on the

different versions of the standard contractually applied to the projects evaluated (i.e., 2008 versus 2016). EA observed weaknesses in each of the areas of hazard and accident analyses; hazard control selection; and safety functional and performance requirements. The assessments found two instances of insufficient hazard and accident analyses, including some weaknesses in implementing hazard analysis methodology for analyzing relatively complex processes. EA also found incomplete or inadequate identification of candidate hazard controls and inadequate identification of functional requirements for safety structures, systems, and components (SSCs).

3.1 Hazard and Accident Analyses

This portion of the lessons-learned review addresses the strengths and weaknesses associated with hazard and accident analyses, which is the initial step in developing the safety design basis for a nuclear facility.

Strengths

In general, EA assessments of nuclear facility projects found that hazard and accident analyses supporting safety design basis development followed established methods, were appropriate to the nuclear facility's design phase and the complexity of operations, and enabled identifying an adequate set of hazard controls. In most cases, the safety design basis documents provided comprehensive evaluations of an appropriate spectrum of potential facility and process upsets comprising representative and unique events.

Weaknesses

Most comments generated in the EA in-process reviews of the draft versions of the safety design basis documents were resolved in the final versions of the documents. As a result, very few performance issues (two deficiencies and one discrepancy) involving hazard and accident analyses were identified in the assessment reports.

EA identified two deficiencies at one nuclear facility project associated with the hazard and accident analyses at the preliminary documented safety analysis (PDSA) phase of development. The deficiencies involved: (1) not meeting the DOE-STD-1189 required conditions for using an alternate dispersion factor based on a co-located worker receptor distance of more than 100 meters from the point of release, and (2) an analysis of a vehicle fire that insufficiently supported derivation of performance criteria for the credited control. At another nuclear facility project, EA identified a discrepancy involving the lack of justification for the airborne release fraction, which was extrapolated based on non-applicable data, used for accident analysis involving high pressure releases from plutonium containers.

Comparison to 2018 Results

The EA assessments included in the 2018 lessons-learned report identified three contractor performance issues (two findings and one deficiency) associated with hazard and accident analyses. The findings involved candidate design basis accidents that were not representative of the underlying bounded hazard events. The deficiency involved events that did not address the possibility of backflow from leaks in a nuclear waste processing facility receipt process system transfer line.

In the 2018 lessons-learned report, the weaknesses associated with hazard and accident analyses included inadequacies in hazard and accident analyses, and inadequacies in the implementation of hazard analysis methodology. Examples of inadequacies in the hazard analysis, which involved potential accident scenarios that had not been systematically or fully evaluated, included the following:

- A hazard analysis did not fully analyze glovebox fire scenarios and their unmitigated consequences.

- Seismic events were not adequately analyzed.
- The potential effects of flooding on SSC operation were not addressed.

This trend has improved during the current review period. In the more recent assessment data, weaknesses associated with hazard and accident scenarios were limited to the appropriateness of the consequence analysis and sufficiency of the accident analysis to support the derivation of performance criteria for safety SSCs, rather than failures to fully analyze accident scenarios.

The 2018 lessons-learned report also identified several issues with the implementation of the methodology for defining and characterizing hazard or accident scenarios. Examples included failure modes that were not consistently identified and evaluated, hazard analyses that did not sufficiently explore the various potential conditions of the event, and the lack of consistency in consideration of applicable operational modes. The 2018 lessons-learned report included specific recommendations to address issues associated with the system definition, failure, bounding accidents, and the incorporation of lessons learned. This trend has continued during the current review period, as several identified issues involved incomplete or inadequate hazard analyses.

3.2 Hazard Control Selection

This portion of the lessons-learned review addresses the strengths and weaknesses associated with hazard control selection.

Strengths

In general, EA assessments of nuclear facility projects found hazard control selection to be generally appropriate to the facility's design phase and the complexity of expected operations.

Weaknesses

Most comments generated in the EA in-process reviews of the draft versions of the safety design basis documents were resolved in the final versions of the documents. As a result, very few performance issues (two discrepancies) involving hazard control selection were identified in the assessment reports.

EA identified two discrepancies at one facility associated with the hazard control selection at the CSDR phase of development. The discrepancies involved: (1) the safety function of the fire walls not including confinement for the activated gaseous fire suppression system inerting agent, and (2) the incomplete justification for the selection of a gaseous fire suppression system for plutonium process areas in the preliminary fire hazards analysis.

Comparison to 2018 Results

The EA assessments included in the development of the 2018 lessons-learned report did not identify any findings or deficiencies associated with hazard control selection. In the 2018 lessons-learned report, the weaknesses (discrepancies) associated with hazard control selection involved incomplete identification of hazard controls, inadequacies in candidate controls for bounding hazard events, and bias in hazard control selection for potential accident scenarios. Examples of these weaknesses included the following:

- A drop hazard without adequate preventive engineered controls
- A bounding release event with preventive engineered controls that did not address all causes

- A bounding seismic event that combined seismic and high temperature events without defining how the event was representative of all high temperature events
- The selection of mitigative controls instead of preventive controls
- The misidentification of preventive controls as mitigative controls.

These trends have improved during the current review period. In the more recent assessment data, weaknesses associated with hazard control selection were limited to the justification for the selected controls or the ability to demonstrate the required safety functions, rather than the completeness of the selected control set or whether the controls had been properly characterized.

3.3 Safety Functional and Performance Requirements

This portion of the lessons-learned review addresses the strengths and weaknesses associated with safety functional and performance requirements.

Strengths

In general, the safety functions and functional requirements of the safety SSCs documented in the safety design bases were consistent with the hazard and accident analyses.

Weaknesses

Most comments generated in the EA in-process reviews of the draft versions of the safety design basis documents were resolved in the final versions of the documents. As a result, very few performance issues (three discrepancies) involving safety functional and performance requirements were identified in the assessment reports.

EA identified three discrepancies at one nuclear facility project at the conceptual safety design report (CSDR) phase of development associated with safety functional and performance requirements. The discrepancies involved: (1) the ventilation system did not include a functional requirement to prevent over-pressurization of the glovebox during a potential failure of a nitrogen supply line, although the glovebox was credited to mitigate this event; (2) the safety function of the gloveboxes to maintain structural integrity during and after seismic events was not identified; and (3) some safety SSCs lacked an adequate technical basis to demonstrate that the control can perform the required safety function.

Comparison to 2018 Results

The EA assessments included in the development of the 2018 lessons-learned report identified two contractor performance issues (one finding and one discrepancy) associated with safety functional and performance requirements. The finding involved engineering calculations that contained technical errors and did not identify and track the assumptions used in the calculation. The discrepancy involved a waste processing facility safety design basis SSC functional requirement for coaxial piping that did not include the design requirement to prevent leakage, which can backflow into nuclear facility design features.

In the 2018 lessons-learned report, other identified weaknesses (discrepancies) associated with safety functional and performance requirements involved inadequacies in safety classification, seismic design categorization, and design criteria. Examples of these weaknesses included the following:

- Elements of the freeze protection system were not functionally classified.
- The backup electrical power supply to a safety system was not classified as safety significant.

- The controls identified for several postulated accidents with high worker consequences were incorrectly classified as non-safety.
- The safety function of a safety system could have been adversely impacted by potential system interactions with non-safety equipment.
- The seismic design category of SSCs was not adequate because safety system boundaries were not defined properly.
- A design analysis for barriers did not address protecting the safety SSCs.
- Safety design requirements for control systems were incomplete.
- A function of the safety class seismic power cutoff system was not fully defined and implemented because the operational controls did not require that the cutoff contactor open and isolate power to all required areas.

Except for inadequacies in seismic design categorization and the definition of safety system boundaries, which are not identified as issues in the recent assessments, these trends are essentially unchanged. During the current review period, inadequate safety designation and incomplete system evaluations for SSCs were noted. The 2018 lessons-learned report included specific recommendations to address issues associated with safety SSC functional and performance requirements and the functional classification of support and interfacing systems.

4.0 BEST PRACTICES

A best practice is a safety-related practice, technique, process, or program attribute observed during an appraisal that may merit consideration by other DOE and contractor organizations for implementation because it has been demonstrated to substantially improve the safety or security performance of a DOE operation, or it represents or contributes to superior performance (beyond compliance). Additionally, a best practice could be identified because it solves a problem or reduces the risk of a condition or practice that affects multiple DOE sites or programs, or it provides an innovative approach or method to improve effectiveness or efficiency. The following best practices were identified at the time that the individual assessments were conducted and may be valuable to other DOE nuclear facility projects:

- Bechtel National, Inc. (BNI) extensively identified and evaluated potential controls for the chemical hazards that were outside the routine scope of the hazardous material protection program in the hazard analysis. This provided a firm foundation for the identification and grading of the chemical safety management program (CSMP) controls in chapter 18 of the Hanford Site Waste Treatment and Immobilization Plant (WTP) Low Activity Waste (LAW) Facility DSA.
- BNI developed a facility-specific safety and health program to protect the safety and health of workers under 10 CFR 851, *Worker Safety and Health Program*, and implemented it as the CSMP under 10 CFR 830, *Nuclear Safety Management*. The creation of the CSMP, which is described in chapter 18 of the Hanford Site Low Activity Waste Facility DSA, allowed control of toxic chemical hazards outside the routine scope of the hazardous material protection program, without the need for designating safety significant SSCs, thereby simplifying the WTP LAW TSR document and operational requirements.
- Washington River Protection Solutions, LLC (WRPS) developed functions and requirements evaluation documents and instrument requirements evaluation documents to support the safety basis system evaluation of safety significant equipment for Hanford Site Tank Farms Tank Side Cesium Removal Project. These documents also support design, procurement, commercial grade dedication, startup, and operations by specifying key design attributes and critical characteristics through systematic and comprehensive failure analysis.

5.0 RECOMMENDATIONS

The following recommendations are based on the analysis of assessments as summarized in section 3.0 of this report. While the underlying deficiencies from the individual assessments did not apply to every reviewed site, the recommended actions are intended to provide insights for potential improvements at all DOE nuclear sites. Consequently, site contractors should evaluate the applicability of the following recommended actions to their respective nuclear facilities project and/or organizations and consider their use as appropriate in accordance with Headquarters and/or site-specific program objectives.

To improve the development of the hazard and accident analyses:

- Provide enhanced training for the safety analysts on the DOE-STD-3009 expectations for the development of the hazard and accident analysis in safety design basis documents.

To improve the development of safety functional and performance requirements:

- Safety basis organizations should examine their training protocols and ensure that they include the DOE-STD-3009 expectations for the identification of safety functions and functional requirement, as well as system evaluations.

Appendix A
Supplemental Information

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Appendix B
Scope, Requirements and Guidance, and Assessed Sites

This lessons-learned report identifies common strengths and weaknesses, best practices, and recommendations, with the goal of increasing organizational learning throughout the U.S. Department of Energy (DOE) complex. This lessons-learned report is based on an analysis of Office of Enterprise Assessments (EA) assessments and reviews of DOE high-hazard (hazard category 1 and 2) nuclear facility design and construction projects between January 2018 and December 2022. The facilities and associated safety design basis documents are detailed in Table B-1. These projects are under the direction of the DOE Office of Environmental Management, the National Nuclear Security Administration, and the Office of Nuclear Energy. The objective of these assessments and reviews was to evaluate the integration of safety into the design, as well as the development of the safety design basis for the new nuclear facilities. The safety design basis leads to the facility's final safety basis, which comprises the documented safety analysis and technical safety requirements.

The assessments included elements from the following criteria and review approach documents (CRADs) to determine whether the policies, procedures, and operational performance met DOE objectives for effectiveness in the areas examined. These elements address the adequacy of programs and performance.

- EA CRAD 31-29, *Review of Nuclear Facility Safety Design Basis Development*, Rev. 1
- EA CRAD 31-03, *Safety Basis Upgrade Review (DOE-STD-3009-2014)*, Rev. 1
- EA CRAD 31-35, *Hazard Category 3 Nuclear Facility Documented Safety Analysis and Technical Safety Requirements*, Rev. 0

In order to allow for an accurate comparison to the results from the 2018 lessons-learned report, all strengths, weaknesses, and deficiencies identified in the independent assessment reports for the facilities listed in Table B-1 were binned into the following three categories for analysis:

- Hazard and Accident Analyses
- Hazard Control Selection
- Safety Functional and Performance Requirements.

Table B-1. Assessed Sites and Associated Safety Design Basis Document

Assessed Site	Nuclear Facility Project and Safety Design Basis Document Type	Contractor	DOE Headquarters Program Office	DOE Field Element
Hanford Site	Tank Farms Low Activity Waste Pretreatment System (DOE-STD-1189-2008) Process Hazards Analysis	Washington River Protection Solutions, LLC	Office of Environmental Management	Office of River Protection

Assessed Site	Nuclear Facility Project and Safety Design Basis Document Type	Contractor	DOE Headquarters Program Office	DOE Field Element
Hanford Site	Waste Treatment and Immobilization Plant (WTP) - High Level Waste Facility (DOE-STD-3009-94 CN3) Engineering Study, Preliminary Documented Safety Analysis (PDSA), Safety Evaluation Report (SER)	Bechtel National, Inc.	Office of Environmental Management	Office of River Protection
Hanford Site	WTP - Low Activity Waste Facility (DOE-STD-3009-94) Documented Safety Analysis (DSA), Technical Safety Requirement (TSR) document, SER	Bechtel National, Inc.	Office of Environmental Management	Office of River Protection
Hanford Site	Tank Farms Tank Side Cesium Removal (DOE-STD-1189-2008) Process Hazard Analysis (PrHA), Safety Design Strategy (SDS), PDSA, SER	Washington River Protection Solutions, LLC	Office of Environmental Management	Office of River Protection
Hanford Site	Waste Encapsulation and Storage Facility (WESF) (DOE-STD-1189-2008) SDS, PDSA/SER, Functional Design Criteria, Final Design Report	CH2M HILL Plateau Remediation Company	Office of Environmental Management	Richland Operations Office
Idaho National Laboratory	Versatile Test Reactor (DOE-STD-1189-2016) Conceptual Safety Design Report (CSDR), Safety Review Letter (SRL)	Battelle Energy Alliance, LLC	Office of Nuclear Energy	Idaho Operations Office
Savannah River Site	K-Area Complex Surplus Plutonium Disposition Project (DOE-STD-1189-2016) CSDR, SRL	Savannah River Nuclear Solutions, LLC	Office of Environmental Management	Savannah River Operations Office

Assessed Site	Nuclear Facility Project and Safety Design Basis Document Type	Contractor	DOE Headquarters Program Office	DOE Field Element
Savannah River Site	Plutonium Processing Facility (DOE-STD-1189-2016) SDS, CSDR, SRL	Savannah River Nuclear Solutions, LLC	National Nuclear Security Administration (NNSA)	NNSA Office of Acquisition and Project Management Savannah River Field Office
Nevada National Security Site	U1a Enhanced Capabilities for Subcritical Experiments Project (DOE-STD-1189-2016) PDSA, SER	Mission Support and Test Services, LLC	NNSA	Nevada Field Office

Source Documents

Hanford Site Waste Treatment and Immobilization Plant - Low Activity Waste Facility

- EA Report, *Safety Basis Assessment at the Hanford Site Waste Treatment and Immobilization Plant Low-Activity Waste Facility - May 2020*
- EA Field Note, *WTP LAW Facility DSA and TSR Change Package Incorporating Confirmed Analytical Limit, Setpoint, and Probability of Failure Calculations*, FN-EA-31-Hanford ORP-8-12-2019

Hanford Site Tank Farms Low Activity Waste Pretreatment System

- EA Field Note, *Hanford Tank Farm "Optimized" Low Activity Waste Pretreatment System 45% Design Review Kick-Off Meeting*, FN-EA-31-WRPS-9-5-2018

Hanford Site Tank Farms Tank Side Cesium Removal

- EA Field Note, *Hanford Tank Farm - Tank Side Cesium Removal and Test Bed Initiative Projects Scoping Visit*, FN-EA-31-WRPS-8-06-18
- EA Field Note, *Hanford Tank Farm - Tank-Side Cesium Removal 30% Design Review*, FN-EA-31-WRPS-8-29-2018
- EA Field Note, *Hanford Tank Farm - Tank-Side Cesium Removal Project 60% Design Review*, FN-EA-31-WRPS-1-8-2019
- EA Field Note, *Hanford Tank Farm - Tank Farm DSA/TSR Modifications to Support Test Bed Initiative Project*, FN-EA-31-WRPS-3-18-2019
- EA Field Note, *Hanford Tank Farm - Tank-Side Cesium Removal PrHA Rev. 1 and Select 90% Design Media Review*, FN-EA-31-ORP-04-15-2019 Rev. 1
- EA Report, *Preliminary Documented Safety Analysis Assessment at the Hanford Site Tank Farms Tank Side Cesium Removal Project – April 2020*

- EA Report, *Safety Basis Assessment at the Hanford Site Tank Farms Tank Side Cesium Removal Facility – June 2021*

Hanford Site Waste Treatment and Immobilization Plant - High Level Waste Facility

- EA Field Note, *Waste Treatment and Immobilization Plant Safety Basis Development Updates*, FN-EA-31-WTP-6-27-2019
- EA Field Note, *Waste Treatment and Immobilization Plant Safety Basis Development Updates*, FN-EA-31-Hanford ORP-9-9-2019
- EA Field Note, *WTP HLW C5V Availability Evaluation Engineering Study Review*, FN-EA-31-Hanford ORP-10-03-2019
- EA Report, *Preliminary Documented Safety Analysis Assessment for the Hanford Site High-Level Waste Facility – June 2021*

Hanford Site Waste Encapsulation and Storage Facility

- EA Field Note, *CHPRC Management of the Cesium and Strontium Capsules Project Winter Visit*, FN-EA-31-CHPRC/WESF-1-09-2019
- EA Field Note, *CHPRC Management of the Cesium and Strontium Capsules Project*, FN-EA-31-Hanford RL-5/15/19
- EA Field Note, *Preliminary Documented Safety Analysis for the Capsule Storage Area Draft (60%)*, FN-EA-31-CHPRC/WESF-8-06-18
- EA Field Note, *CHPRC Management of the Cesium and Strontium Capsules Project Cask Storage System Final Design Review Kickoff Meeting*, FN-EA-31-CHPRC/WESF-11-14-18
- EA Report, *Preliminary Documented Safety Analysis Assessment at the Hanford Site Capsule Storage Area – January 2021*

Nevada National Security Site U1a Enhanced Capabilities for Subcritical Experiments Project

- EA Report, *Independent Assessment of the Preliminary Documented Safety Analysis for the Nevada National Security Site U1a Enhanced Capabilities for Subcritical Experiments Project – September 2022*

Pantex Plant Material Staging Facility

- EA Field Note, *High-Level Review of the Material Staging Facility Project Conceptual Safety Design Report*, FN-EA-31-PTX-7-1-2019

Savannah River Site Plutonium Processing Facility

- EA Field Note, *Review of Safety Design Strategy for Savannah River Plutonium Processing Facility*, FN-EA-31-SRS-5-1-2019
- EA Report, *Conceptual Safety Design Report Assessment for the Savannah River Plutonium Processing Facility – December 2021*

Savannah River Site K-Area Complex Surplus Plutonium Disposition Project

- EA Report, *Office of Enterprise Assessments Assessment of the Savannah River Site K-Area Complex Surplus Plutonium Disposition Project Conceptual Safety Design Report – December 2018*

Savannah River Site Tritium Capabilities Production Project

- EA Field Note, *Tritium Capabilities Production Project Conceptual Safety Design Review*, FN-EA-31-SRS-TPC-2-12-2018

Idaho National Laboratory Versatile Test Reactor

- EA Report, *Conceptual Safety Design Report Assessment for the Versatile Test Reactor – September 2020*

EA Report, *Office of Enterprise Assessments Lessons Learned from Assessments of Integration of Safety into Design of New U.S. Department of Energy Nuclear Facilities – April 2018*

EA Report, *Office of Enterprise Assessments Targeted Assessment of the Waste Treatment and Immobilization Plant High-Level Waste Facility Radioactive Liquid Waste Disposal System Safety Basis Change Package – May 2016*

EA Report, *Office of Enterprise Assessments Review of the Hanford Site Waste Treatment and Immobilization Plant Low-Activity Waste Facility Hazards Analysis Reports for the Melter and Melter Offgas Systems – September 2015*

EA Report, *Independent Oversight Review of the Savannah River Site Salt Waste Processing Facility Safety Basis and Design Development – August 2013*

EA Report, *Office of Enterprise Assessments Targeted Assessment of the Hanford Site Tank Farms Low Activity Waste Pretreatment System Preliminary Safety Design Basis – December 2017*

EA Report, *Independent Oversight Appraisal of the Uranium Processing Facility Safety Basis Preliminary Safety Design Report Process at the Y-12 National Security Complex – May 2013*

EA Report, *Office of Enterprise Assessments Review of the Hanford Site Waste Treatment and Immobilization Plant Hazards Analysis Report for the Low-Activity Waste Facility Reagent Systems – July 2015*

EA Report, *Office of Enterprise Assessments Assessment of the Y-12 National Security Complex Uranium Processing Facility Preliminary Documented Safety Analysis – January 2018*

EA Report, *Office of Enterprise Assessments Targeted Assessment of the Y-12 National Security Complex Uranium Processing Facility Preliminary Safety Design Basis – April 2017*

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