



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN**9.1.4 LIGHT LOAD HANDLING SYSTEM (RELATED TO REFUELING)****REVIEW RESPONSIBILITIES**

Primary - Organization responsible for the review of light load handling systems associated with the balance of plant.

Secondary - None.

I. AREAS OF REVIEW

The **primary organization** reviews the light load handling system (LLHS) consisting of all components and equipment for handling new fuel from the receiving station to loading spent fuel into the shipping cask for compliance with the requirements of General Design Criteria (GDCs) 2, 5, 61, and 62. The objective of the LLHS review is to avoid criticality accidents, radioactivity releases from damage to irradiated fuel, and unacceptable personnel radiation exposures.

The specific areas of review are as follow:

1. The design layout, which shows the functional geometric layout of the fuel handling equipment and areas, is reviewed for whether the various handling operations can be performed safely.
2. The LLHS grappling, rigging, hoisting, and transporting operations are reviewed to evaluate handling methods, selection of handling equipment, and safety devices.

Rev. 3 - [Month] 2007

USNRC STANDARD REVIEW PLAN

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The standard review plan sections are numbered in accordance with corresponding sections in the Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of the standard format have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) will be based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," until the SRP itself is updated.

These documents are made available to the public as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-0800 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments may be submitted electronically by email to NRR_SRP@nrc.gov.

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3. The LLHS design is reviewed for the following aspects of individual components and of the integrated system:
 - A. Performance and load handling requirements specified for equipment.
 - B. Electrical or mechanical interlocks to prevent criticality accidents, damage to fuel, and excessive personnel exposure.
 - C. Protections against inadvertent criticality, mechanical damage, and overheating as to the methods and equipment for transferring fuel assemblies from the reactor core to the storage location and the methods and equipment for fuel processing, inspection, or cleaning.
4. The design of equipment whose failure could damage stored fuel or essential equipment is reviewed for seismic qualification.
5. Inspection, Test, Analysis, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the applicant's proposed information on the ITAAC associated with the systems, structures, and components (SSCs) related to this Standard Review Plan (SRP) section is reviewed in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria - Design Certification." The staff recognizes that the review of ITAAC is performed after review of the rest of this portion of the application against acceptance criteria contained in this SRP section. Furthermore, the ITAAC are reviewed to assure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.
6. COL Action Items and Certification Requirements and Restrictions. COL action items may be identified in the NRC staff's final safety evaluation report (FSER) for each certified design to identify information that COL applicants must address in the application. Additionally, DCs contain requirements and restrictions (e.g., interface requirements) that COL applicants must address in the application. For COL applications referencing a DC, the review performed under this SRP section includes information provided in response to COL action items and certification requirements and restrictions pertaining to this SRP section, as identified in the FSER for the referenced certified design.

Review Interfaces

The listed SRP sections interface with this section as follows:

1. SRP Sections 3.2.1 and 3.2.2: review of the seismic and quality group classifications for system components.
2. Sections 3.7.1 through 3.7.4, 3.8.4 and 3.8.5: review of the design analyses, procedures, and criteria for establishing the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of natural phenomena like the safe shutdown earthquake.
3. Sections 3.9.1 through 3.9.3: review of codes and standards applied to the design of components, piping, and structures.

4. Section 3.10: review of the seismic qualification of Category I instrumentation and electrical equipment .
5. Sections 12.3 and 12.4: review of the designs of the fuel handling system and the spent fuel transfer process for whether occupational radiation exposures during spent fuel handling will be as low as reasonably achievable.
6. For COL reviews of operational programs, the review of the applicant's implementation plan is performed under SRP Section 13.4, "Operational Review."
7. Chapter 17: review of quality assurance.

The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

II. ACCEPTANCE CRITERIA

Requirements

Acceptability of the LLHS design, as described in the applicant's safety analysis report (SAR) in related sections of SAR Chapters 2 and 3, is based on specific GDCs, regulatory guides (RGs), and engineering codes and standards. Listed below are specific criteria for the LLHS.

The LLHS is acceptable if the integrated design of the structural, mechanical, and electrical elements, the manual and automatic operating controls, and the safety interlocks and devices provide adequate system control for the specific procedures of handling operations, if the redundancy and diversity needed to protect against malfunctions or failures are provided, and if the design complies with the following regulations.

1. GDC 2 as it relates to the ability of structures, equipment, and mechanisms to withstand the effects of earthquakes.
2. GDC 5 as it relates to **the capability** of shared equipment and components to perform safety functions.
3. GDC 61 as it relates to radioactivity release as a result of fuel damage and the avoidance of excessive personnel radiation exposure.
4. GDC 62 as it relates to prevention of criticality accidents.
5. **10 CFR 52.47(b)(1), as it relates to ITAAC (for design certification) sufficient to ensure that the SSCs in this area of review will operate in accordance with the certification and the Commission regulations.**
6. **10 CFR 52.80(a), as it relates to ITAAC (for combined licenses) sufficient to ensure that the SSCs in this area of review have been constructed and will be operated in conformity with the combined license, the provisions of the Atomic Energy Act, and the Commission's regulations.**

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for review described in Subsection I of this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

1. Acceptance for meeting the relevant aspects of GDC 2 is based on RG 1.29, Positions C.1 and C.2.
2. Acceptance for meeting the relevant aspects of GDC 5 is embodied within the other acceptance criteria
3. Acceptance for meeting the relevant aspects of GDC 61 is based in part on the guidelines of American National Standards Institute/American Nuclear Society (ANSI/ANS) 57.1-1992 (Reference 7).
4. Acceptance for meeting the relevant aspects of GDC 62 is based in part on ANSI/ANS 57.1-1992.

Technical Rationale

The technical rationale for application of these requirements to reviewing this SRP section is discussed in the following paragraphs:

1. GDC 2 requires that SSCs important to safety be designed to resist the effects of natural phenomena like earthquakes.

GDC 2 applies to SRP Section 9.1.4 because it specifies the natural phenomenon (*i.e.*, earthquake) that must be considered in the LLHS design. If not considered, an earthquake could overload LLHS SSCs and cause unsafe conditions (*e.g.*, a fuel assembly drop with the potential for a release of radioactive materials from damaged irradiated fuel or criticality accidents) or unacceptable personnel radiation exposures. SRP Section 9.1.4 cites RG 1.29 Position C.1 for safety-related portions and Position C.2 for nonsafety-related design portions. These positions provide guidance for meeting these requirements.

This requirement provides assurance that LLHS SSCs will perform their intended function of safely carrying loads that, if dropped, could cause unsafe conditions, keeping personnel exposures to radiation within acceptable limits.

2. GDC 5 requires that SSCs important to safety not be shared among nuclear power units unless such sharing can be shown not to significantly impair their ability to perform safety functions, including, in an accident in one unit, an orderly shutdown and cooldown of the remaining units.

GDC 5 requirements ensure LLHS design for essentially independent LLHS SSCs in LLHS shared for use in multiple-unit plants. The shared use in multiple-unit plants, therefore, will not affect the LLHS safety function significantly. SRP Section 9.1.4 provides guidance to meet these requirements.

This requirement provides assurance that the LLHS and its SSCs will continue to perform their required safety functions when the LLHS is shared among nuclear power units and that safe handling of fuel will not be jeopardized.

3. GDC 61 requires that fuel storage and handling, radioactive waste, and other systems that may contain radioactive materials be designed for adequate safety under normal and postulated-accident conditions.

GDC 61 requires LLHS design for safe fuel handling and storage under **normal and accident** conditions. SRP Section 9.1.4 addresses handling of fuel and spent fuel, which, if dropped, mishandled, or damaged, could cause releases of radioactive materials **or** unacceptable personnel radiation exposures. ANSI/ANS 57.1-1992 provides guidance for meeting these requirements.

This requirement provides reasonable assurance that releases of radioactive materials and unacceptable personnel radiation exposures from damage to irradiated fuel will be avoided.

4. GDC 62 requires prevention of criticality in the fuel handling and storage system by physical systems or processes, preferably by geometrically safe configurations.

GDC 62 requirements ensure that fuel handling and storage SSCs will be controlled so criticality will not be reached, ensuring the safety of the public. ANSI/ANS 57.1-1992 provides guidance for meeting these requirements.

These requirements provide assurance that the LLHS will operate under adequately safe conditions and avoid criticality accidents and consequent releases of radioactive materials from damage to or changes in fuel, ensuring acceptable levels of personnel radiation exposure.

III. REVIEW PROCEDURES

The LLHS provides for handling of fuel assemblies and light loads like control rods, burnable poison rods, and flow-limiting orifices. The general objective of the review is to confirm that the LLHS design precludes system malfunctions or failures that could cause criticality accidents, a release of radioactivity, or excessive personnel radiation exposures. There are variations in the designs of proposed handling systems; hence, there are variations in system requirements and the type and number of loads handled. For the purpose of this review, the LLHS does not include equipment used to handle heavy loads (*i.e.*, weights exceeding that of one fuel assembly and its handling tool).

The procedures listed here are used in the construction permit or early site permit (ESP) review for whether LLHS design criteria and bases and the preliminary LLHS design described in the SAR meet the acceptance criteria of subsection II of this SRP section. For operating license (OL) or COL reviews, the procedures verify whether the design criteria and bases are implemented appropriately in the LLHS final design.

The reviewer will select and emphasize material from the procedures described below, as may be appropriate for a particular case.

For each area of review specified in subsection I of this SRP section, the review procedure is identified below. These review procedures are based on the identified SRP acceptance criteria. For deviations from these specific acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives to the SRP criteria provide an acceptable method of complying with the relevant NRC requirements identified in subsection II.

1. The LLHS system performance requirements are reviewed for whether they cover the handling system concept used in the design and describe the component and subsystem functions within the integrated system. The reviewer verifies whether the LLHS physical arrangement for stored fuel and fuel handling areas has been described sufficiently to establish that the various handling operations can be performed safely.
2. The performance specifications developed as part of the design and described in the SAR are reviewed for whether the design, material selection, manufacturing, installation, testing, and operating procedures equal or exceed performance specifications. The reviewer verifies whether the applicant's selected consensus standards, engineering codes, and industrial or manufacturing association standards are adequate and appropriate for the LLHS.
3. The SAR information is reviewed for whether the specific arrangement of the system and subsystems and the load handling paths are described for locations of objects that could damage fuel or cause a criticality accident. The SAR description of operating and test procedures is reviewed for whether load proof-testing, design-rated load testing, nondestructive testing, preventive checks, and attachment of the load ensure reliable load-handling operations. The reviewer covers the following points:
 - A. Performance and design criteria applied to specific components comply with consensus standards and provide for reliable fuel handling.
 - B. The instrumentation and control system, including the limit and safety devices necessary to maintain safety in a component failure within the system, are reviewed to determine whether the control system adequately limits loads or limits load movement, assuming a single failure, to prevent fuel damage to the extent that a release of radioactivity, a criticality accident, or significant radiation exposure could occur.
 - C. The fuel transfer carriage and other devices (inspection stands, cleaning stands, and fuel processing stands) are reviewed to determine whether the design adequately protects against inadvertent criticality, unacceptable radiation exposure, mechanical damage, and overheating. The fuel transfer system is reviewed for the adequacy of provisions to prevent damage to fuel assemblies especially during the time it receives or transfers them to other LLHS equipment. The LLHS load with the potential to cause the greatest damage to stored fuel should be identified for the fuel handling accident evaluation.
4. The SAR information for the light load handling equipment, including equipment storage areas, is reviewed to determine whether a seismic event could cause damage to spent fuel or essential equipment. Equipment necessary to preclude inadvertent criticality

should be designed consistently with RG 1.29 Position C.1. Equipment failure of which could damage stored fuel or other equipment essential for plant safety should be designed consistently with RG1.29 Position C.2.

5. For reviews of DC and COL applications under 10 CFR Part 52, the reviewer should follow the above procedures to verify that the design set forth in the safety analysis report and, if applicable, site interface requirements meet the acceptance criteria. For DC applications, the reviewer should identify necessary COL action items. With respect to COL applications, the scope of the review is dependent on whether the COL applicant references a DC, an ESP, or other NRC-approved material, applications, and/or reports.

After this review, SRP Section 14.3 should be followed for the review of Tier I information for the design, including the postulated site parameters, interface criteria, and ITAAC.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's safety evaluation report (SER). The reviewer also states the bases for those conclusions.

The LLHS includes all components and equipment for moving fuel and other related light loads between the receiving area, storage areas, and reactor vessel. After review of the applicant's proposed LLHS design criteria, design bases, and requirements for safe operation, the staff concludes that the design of the LLHS and supporting systems complies with NRC regulations in GDCs 2, 5, 61, and 62. This conclusion is based on the following findings:

1. The system design meets GDC 2 requirements for protection of safety-related equipment and spent fuel from the effects of earthquakes. Criterion 2 is met because the system is designed in accordance with RG 1.29 Position C.1 for safety-related portions and Position C.2 for nonsafety-related portions of the system.
2. The system meets GDC 5 requirements for sharing of SSCs because such sharing does not impair the system's safety function.
3. The system also meets the requirements of GDCs 61 and 62 for prevention of unacceptable radioactivity releases, unacceptable radiation exposure, and criticality accidents. These criteria are met because the system is designed in accordance with ANSI/ANS 57.1-1992 guidelines.

For DC and COL reviews, the findings will also summarize (to the extent that the review is not discussed in other SER sections) the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable, and interface requirements and combined license action items relevant to this SRP section.

V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of DC applications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 52. Except when the applicant proposes an acceptable alternative method for complying with

specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section, unless superseded by a later revision.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, GDC 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of Structures, Systems and Components."
3. 10 CFR Part 50, Appendix A, GDC 61, "Fuel Storage and Handling and Radioactivity Control."
4. 10 CFR Part 50, Appendix A, GDC 62, "Prevention of Criticality in Fuel Storage and Handling."
6. RG 1.29, "Seismic Design Classification."
7. NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program - Non-ITAAC Inspections," issued April 25, 2006.
8. ANSI/ANS57.1-1992, "Design Requirements for LWR Fuel Handling Systems."

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the draft Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 52, which were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

SRP Section 9.1.4
Description of Changes

This SRP section affirms the technical accuracy and adequacy of the guidance previously provided in Draft Revision 3, dated June 1996, of this SRP section. See ADAMS accession number ML063230018.

In addition, this SRP section was administratively updated in accordance with NRR Office Instruction LIC-200, Revision 1, "Standard Review Plan (SRP) Process." The revision also adds standard paragraphs to extend application of this updated SRP section to prospective applicant submissions pursuant to 10 CFR Part 52.

The technical changes are incorporated in Revision 3, dated [Month] 2007:

1. General changes included editorial and formatting changes.
2. Standard language was added throughout the SRP section to extend the applicability to licensing and DC reviews submitted under 10 CFR Part 52, including the applicability of the Combined License Applications for Nuclear Power Plants (LWR Edition) - Regulatory Guide DG-1145 as superseded by the final guide expected December 2006.
3. Any references to heavy load handling system requirements or procedures were taken out to focus this SRP section solely on light load handling systems.

Review Responsibilities - Reflects changes in review branches resulting from reorganization and branch consolidation. Change is reflected throughout the SRP.

I. AREAS OF REVIEW

1. Review steps were clarified to conform with the procedures set in the Review Procedures section.
2. Heavy load requirements such as "travel paths" and "equipment for transferring stored fuel to the spent fuel shipping cask" were removed to avoid associations with a heavy load handling system.
3. Re-organized the format of the review steps to show: arrangement of system, transportation operations, component and integrated system description, equipment design, and a standard review of ITAAC.

II. ACCEPTANCE CRITERIA

1. General formatting and grammar changes.
2. Removed references to RG 1.13 as irrelevant to this section.

3. Added standard sentences to identify acceptance criteria for ITAAC for DC and COL reviews.

III. REVIEW PROCEDURES

1. Added statements for clarification purposes.
2. Arranged the format of this section to agree with the setup defined in Areas of Review.
3. Removed guidelines that did not pertain to LLHS.
4. Added standard sentences to identify acceptance criteria for ITAAC related to DC and COL reviews.

IV. EVALUATION FINDINGS

A new paragraph was added at the end of the Evaluation Findings to address design certification reviews. This paragraph addresses DC specific items including ITAAC, design acceptance criteria, site interface requirements, and combined license action items.

V. IMPLEMENTATION

Added standard paragraph to indicate applicability of this section to reviews of future applications.

VI. REFERENCES

Changed ANS 57.1/ANSI N208. ANS 57.1 to ANSI/ANS57.1-1992.