



U.S. NUCLEAR REGULATORY COMMISSION  
**STANDARD REVIEW PLAN**  
OFFICE OF NUCLEAR REACTOR REGULATION

9.1.5 OVERHEAD HEAVY LOAD HANDLING SYSTEMS

REVIEW RESPONSIBILITIES

Primary - Auxiliary Systems Branch (ASB)

Secondary - None

I. AREAS OF REVIEW

The ASB reviews the overhead heavy load handling systems (OHLHS) consisting of all components and equipment used in moving all heavy loads, i.e., loads weighing more than one fuel assembly and its associated handling device at the plant site to assure conformance with the requirements of General Design Criteria 2, 5 and 61. The design layout, which shows the functional geometric layout of the handling equipment, including the areas of movement over and around the fixed locations of safety-related facilities during the handling of heavy loads, is reviewed to determine that the various handling operations can be performed safely. The main emphasis in the OHLHS review is on critical load handling in which inadvertent operations or equipment malfunctions, either separately or in combination, could cause a release of radioactivity, a criticality accident, the inability to cool fuel within the reactor vessel or spent fuel pool or prevent safe shutdown of the reactor.

1. The ASB reviews the transporting, hoisting, and rigging operations in the OHLHS as to methods, selection of handling equipment, and safety devices.
2. The ASB reviews the design of those OHLH systems used in critical load handling operations, i.e. those loads which if dropped have the potential of leading to unacceptable consequences. This review encompasses the following areas:
  - a. the specified performance and load handling requirements as compared to the actual requirements,
  - b. the adequacy of the design, fabrication, installation, inspection, and testing requirements,

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USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

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- c. the adequacy of operator training, load handling procedures and instructions, and
  - d. the adequacy of the measures taken to assure, to the extent possible, that safe load paths are followed. Also, that operational procedures and instructions as well as mechanical and electrical devices are provided to assure travel along safe load paths.
3. ASB also performs the following reviews under the SRP sections indicated:
- a. Review of flood protection is performed under SRP Section 3.4.1.
  - b. Review of the protection against internally generated missiles is performed under SRP Section 3.5.1.1.
  - c. Review of the structures, systems and components to be protected against externally generated missiles is performed under SRP Sections 3.5.1.4 and 3.5.2.
  - d. Review of high- and moderate-energy pipe breaks is performed under SRP Section 3.6.1.

In addition, ASB will coordinate other branches evaluations that interface with the overall evaluation of the OHLHS. The coordinated reviews are as follows:

The Structural Engineering Branch (SEB) determines the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of natural phenomena such as the safe shutdown earthquake (SSE), the probable maximum flood (PMF), and tornado missiles as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5. The Mechanical Engineering Branch (MEB) determines that the components, piping and structures are designed in accordance with applicable codes and standards as part of its primary review responsibility for SRP Sections 3.9.1 through 3.9.3. The MEB, also, determines the acceptability of the seismic and quality group classifications for system components as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2. The MEB also reviews the adequacy of the inservice testing program of pumps and valves as part of its primary review responsibility for SRP Section 3.9.6. The Materials Engineering Branch (MTEB) verifies that inservice inspection requirements are met for system components as part of its primary review responsibility for SRP Section 6.6, and, upon request, verifies the compatibility of the materials of construction with service conditions. The review for Fire Protection, Technical Specifications, and Quality Assurance are coordinated and performed by the Chemical Engineering Branch, Licensing Guidance Branch and Quality Assurance Branch as part of their primary review responsibility for SRP Sections 9.5.1, 16.0 and 17.0, respectively. The Instrumentation and Control Systems Branch (ICSB) and Power Systems Branch (PSB) will determine the adequacy of the design, installation, inspection, and testing of all essential electrical components (sensing, control, and power) as part of their primary review responsibility for SRP Sections 7.6 and 8.0 respectively. The Radiological Assessment Branch (RAB) reviews the design of the fuel handling system and the spent fuel transfer process to determine whether occupational radiation exposures during spent fuel handling operations will be as low as practicable as part of its primary responsibility for SRP Section 12.3. The Equipment Qualification Branch (EQB) reviews the seismic

qualification of Category I instrumentation and electrical equipment and the environmental qualification of mechanical and electrical equipment as part of its primary review responsibility for SRP Sections 3.10 and 3.11 respectively.

For those areas of review identified above as being reviewed as part of the primary review responsibility of other branches, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP section of the corresponding primary branch.

## II. ACCEPTANCE CRITERIA

Acceptability of the OHLHS design, as described in the applicant's safety analysis report (SAR) including related sections of Chapters 2 and 3 of the SAR, is based on specific general design criteria, regulatory guides, and safety engineering codes and standards. Listed below are specific criteria as they relate to the OHLHS.

The OHLHS is acceptable if the integrated design of the structural, mechanical, and electrical elements, the manual and automatic operating controls, the safety interlocks and devices, and the load handling instructions, inspections, maintenance and testing, 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 conforms to the relevant requirements of the following regulations:

1. General Design Criterion 2, as related to the ability of structures, equipment, and mechanisms to withstand the effects of earthquakes. Acceptance is based in part on meeting position C.1 of Regulatory Guide 1.29 for safety-related equipment and position C.2 for nonsafety-related equipment, and positions C.1 and C.6 of Regulatory Guide 1.13.
2. General Design Criterion 4 as it relates to protection of safety-related equipment from the effects of internally generated missiles (i.e. dropped loads). Acceptance is based in part on meeting positions C.3 and C.5 of Regulatory Guide 1.13.
3. General Design Criterion 5 as related to the sharing of equipment and components important to safety.
4. General Design Criterion 61 as related to the safe handling and storage of fuel.

Other specific criteria necessary to meet the relevant requirements of General Design Criterion 2, 4 and 61 are as follows:

- a. NUREG-0554 (formerly proposed Regulatory Guide 1.104 and Branch Technical Position ASB 9-1)
- b. NUREG-0612
- c. ANS 57.1/ANSI N208
- d. ANS 57.2/ANSI N210

### III. REVIEW PROCEDURES

The OHLHSs are provided for handling heavy loads i.e. loads whose weight exceeds that of one fuel assembly and its associated handling device such as a reactor vessel head, internals, shield plug segments and spent fuel casks. Due to variations in plant designs, the ASB shall review the analyses made of the potential consequences that could follow the dropping of each heavy load at any point along its path of travel. In those cases where the consequences are unacceptable the load is to be considered a critical load and hence subject to the acceptance criteria presented in this SRP section. The general objective of the review is to confirm that the OHLHS design precludes system malfunctions or failures that would prevent safe shutdown of the reactor, or cause an unacceptable release of radioactivity, a criticality accident or the inability to cool the fuel in the reactor vessel or spent fuel storage pool.

The procedures listed here are used in the construction permit (CP) review to determine that the OHLHS design criteria and bases and the preliminary OHLHS design described in the SAR meet the acceptance criteria given in subsection II of this SRP section. For operating license (OL) reviews the procedures are used to verify that the design criteria and bases have been appropriately implemented in the OHLHS final design.

Upon request by the ASB, the coordinating review branches will provide input for the areas of review in subsection I of this SRP section. The ASB obtains and uses such input as required to assure that this review procedure is complete.

The reviewer will select and emphasize material from this SRP section, as may be appropriate for a particular case.

1. The system performance requirements for the OHLHS are reviewed to determine that they cover the handling system concept used in the design, and describe the component and subsystem functions within the integrated systems. The performance requirements should also define any degradation considered for components and describe the procedures that are followed to detect and correct degraded conditions.
2. The performance specifications required as part of the design and described in the SAR are reviewed to determine that the design, material selection, manufacturing, installation, testing, and operating procedures equal or exceed the performance requirements and are within the state-of-the-art practice.
3. The information presented in the SAR is reviewed to determine that the specific arrangement of the systems and subsystems and the load handling paths to be used are described with respect to locations of equipment. The reviewer determines that the heavy loads will not be transported over equipment which would lead to unacceptable consequences should the load be dropped. For overhead cranes and associated lifting devices that do not pose an unacceptable risk to plant structures or equipment, the reviewer covers the following points:
  - a. The size, shape, and dimensions of the potentially most damaging load (the load which, if dropped by the crane, will cause the most damage), its weight and center of gravity, lifting points, stability, and handling speeds are compared with the performance specifications

to determine the compatibility of the design with load handling and movement requirements. The reviewer uses the guidance of NUREG-0554 and NUREG-0612 as well as the requirements of codes and standards and, if required, performs an independent analysis to determine acceptability of the system.

- b. The instrumentation and control system, including the limit and safety devices provided for automatic and manual operation for both normal and emergency conditions, that are required to operate to maintain safety in the event of a failure of the system, are reviewed. The results of failure modes and effects analyses are used by the reviewer to determine that the control system adequately limits loads or limits crane load movement, assuming a single failure, without affecting the function of essential equipment or causing the release of radioactivity.
  - c. The description of operating and test procedures presented in the SAR is reviewed to determine that load proof-testing, design-rated load testing, nondestructive testing, preventive checks, and inspections are in accordance with the requirements of the appropriate safety standards.
4. For cranes that have been designed to be single failure-proof, the reviewer determines that the design conforms to NUREG-0554 and NUREG-0612.
  5. The review for seismic design is performed by SEB and the review for seismic and quality group classification is performed by MEB as indicated in subsection I of this SRP section.

#### IV. EVALUATION FINDINGS

The reviewer verifies that the information provided and his review support conclusions of the following type, to be included in the staff's safety evaluation report:

The OHLH systems include all components and equipment used in the handling of all heavy loads at the plant site over the lifetime of the facility. Based on the review of the applicant's proposed design criteria and design bases for the OHLHS, and the requirements for safe operation of the OHLHS, the staff concludes that the design of the OHLHS and supporting systems is in conformance with the Commission's regulations as set forth in General Design Criteria 2, 4, 5 and 61. This conclusion is based on the following:

1. The requirements of General Design Criterion 2 are met as they relate to protection against the effects of earthquakes since the safety-related portions of the system are designed in accordance with position C.1 of Regulatory Guide 1.29 and C.1 of Regulatory Guide 1.13 and the nonsafety-related portions meet position C.2 of Regulatory Guide 1.29 and position C.6 of Regulatory Guide 1.13. In meeting Criterion 2, the applicant has also designed the systems to meet the guidelines of NUREGs 0554 and 0612 as they relate to protection against natural phenomena.

2. The requirements of General Design Criteria 4 and 61 are met as they relate to prevention of internally generated missiles that could prevent safe shutdown, cause an unacceptable release of radioactivity, a criticality accident or the inability to cool the fuel in the reactor vessel or spent fuel storage pool. To meet Criteria 4 and 61 the applicant designed the systems in accordance with positions C.3 and C.5 of Regulatory Guide 1.13 and followed the guidelines of NUREGs 0554 and 0612 and followed industry standards ANS 57.1/ANSI N208 and ANS 57.2/ANSI N210 in the system design.
3. The requirements of General Design Criterion 5 are met since any single failure will not impair the safety function of the overhead heavy load handling system nor prevent the safe shutdown and cooldown of either or both units.

#### V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's Regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission Regulations.

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced Regulatory Guides and NUREGs.

#### VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems and Components."
3. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."
4. Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Bases."
5. Regulatory Guide 1.29, "Seismic Design Classification."
6. NUREG-0554, "Single-Failure-Proof Cranes for Nuclear Power Plants."
7. NUREG-0612, "Control of Heavy Loads At Nuclear Power Plants."
8. ANS 57.1/ANSI N208, "Design Requirements for Light Water Reactor Fuel Handling System."
9. ANS 57.2/ANSI N210, "Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Plants."