U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

9.1.4 LIGHT LOAD HANDLING SYSTEM (RELATED TO REFUELING)

REVIEW RESPONSIBILITIES

Primary - Auxiliary Systems Branch (ASB)

Secondary - None

I. AREAS OF REVIEW

The ASB reviews the light load handling system (LLHS) consisting of all components and equipment used in handling new fuel from the receiving station to the loading of the spent fuel into the shipping cask to assure conformance with the requirements of General Design Criteria 2, 5, 61 and 62. The design layout, which shows the functional geometric layout of the handling equipment, which defines the travel paths through, over and around rigid objects during fuel handling, is reviewed to determine that the various handling operations can be performed safely. The objective of the LLHS review is the avoidance of criticality accidents, radioactivity releases resulting from damage to irradiated fuel, and unacceptable personnel radiation exposures.

1. The ASB reviews the grappling, rigging, hoisting and transporting operations in the light load handling system as to methods, selection of handling equipment, and safety devices.

2. The ASB reviews the design of the LLHS with respect to the following aspects of individual components and the integrated system:

   a. Performance and load handling requirements specified for equipment.

   b. The methods and equipment for transferring fuel assemblies from the reactor core to the storage location.

   c. The electrical and/or mechanical interlocks provided to prevent criticality accidents, damage to fuel and excessive personnel exposure.

   d. The methods and equipment for transferring stored fuel to the spent fuel shipping cask.

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

4. 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 Section 3.5.2,

   d. Review of high and moderate energy pipe breaks is performed under SRP Section 3.6.1.

Should the LLHS design deviate significantly from previously accepted designs, ASB will request pertinent reviews by other branches. Input from these branches will be coorindated by the ASB and incorporated into the ASB overall system evaluation. 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 thru 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 thru 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 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 will be as low as practicable as part of its primary review 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 LLHS 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 engineering codes and standards. Listed below are specific criteria as they relate to 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 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 on meeting Regulatory Guide 1.29, position C.1 and C.2, and positions C.1 and C.6 of Regulatory Guide 1.13.

2. General Design Criterion 5, as related to the capability of shared equipment and components important to safety.

3. General Design Criterion 61 as related to a radioactivity release as a result of fuel damage, and the avoidance of excessive personnel radiation exposure. Acceptance, in part, is based on the guidelines of position C.3 of Regulatory Guide 1.13 and ANS 57.1/ANSI-N208.

4. General Design Criterion 62 as it relates to criticality accidents. Acceptance is based on part on meeting position C.3 of Regulatory Guide 1.13 and ANS 57.1/ANSI N208.

5. In meeting Criteria 61 and 62 specific criteria regarding the maximum kinetic energy of any load lighter than a fuel assembly is identified in item 6, Subsection III of this SRP section.

III. REVIEW PROCEDURES

The light load handling system provides for handling of fuel assemblies, and other associated light loads such as control rods, and 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 result in criticality accidents, a release of radioactivity or excessive personnel radiation exposures. There are variations in the designs of proposed handling systems; hence, there will be variations in system requirements and the type and number of loads to be handled. For the purpose of this review, the LLHS will not include the equipment used to handle heavy loads, i.e. loads whose weight exceed that of one fuel assembly and its associated handling tool.

The procedures listed here are used in the construction permit (CP) review to determine that the LLHS design criteria and bases and the preliminary LLHS 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 LLHS final design.

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

1. The system performance requirements for the LLHS 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 system. 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. The reviewer verifies that the consensus standards, engineering codes, and industrial or manufacturing association standards selected and used are adequate and appropriate for the LLHS.

3. The information presented in the SAR is reviewed to determine that the specific arrangement of the system and subsystems and the load handling paths to be used are described with respect to locations of objects having the potential of damaging fuel or causing a criticality accident. 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 LLHS, will cause the most adverse consequence), 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 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 load movement, assuming a single failure, to prevent damaging the fuel to the extent that a release of radioactivity or a criticality accident could occur.

   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 attachment of the load assures reliable load handling operations.

4. The information presented in the SAR for the light load handling equipment, including the equipment storage areas, is reviewed to determine that a seismic event cannot result in damage to spent fuel or essential equipment.

5. The fuel transfer carriage design is reviewed to determine the adequacy of the means provided to prevent damage to fuel assemblies especially during the time it receives or transfers the fuel assemblies to other LLHS equipment.

6. The maximum potential kinetic energy capable of being developed by any load handled above stored spent fuel, if dropped, is not to exceed the kinetic energy of one fuel assembly and its associated handling tool when dropped from the height at which it is normally handled above the spent fuel pool storage racks.

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 light load handling system includes all components and equipment used in moving fuel and other related light loads between the receiving area, storage areas and reactor vessel. Based on the review of the applicant's proposed design criteria and design bases for the LLHS, and the requirements for safe operation of the LLHS, the staff concludes that the design of the LLHS and supporting systems is in conformance with the Commission's regulations as set forth in General Design Criteria 2, 5, 61 and 62. This conclusion is based on the following:

1. The system design meets the requirements of General Design Criterion 2 as it relates to protection of safety-related equipment and spent fuel from the effects of earthquakes. Criterion 2 is met since the system is designed in accordance with position C.1 of Regulatory Guide 1.29 for safety-related portions of the system and position C.2 for nonsafety related portions. The system also meets postions C.1 and C.6 of Regulatory Guide 1.13.

2. The system meets the requirements of General Design Criterion 5 with respect to sharing of structures, systems and components since such sharing does not impair the system's safety function in the event of a single failure.

3. The system also meets the requirements of General Design Criteria 61 and 62 as they relate to the prevention of unacceptable radioactivity releases and criticality accidents. These criteria are met since the system is designed in accordance with position C.3 of Regulatory Guide 1.13 and the guidelines of ANS 57.1/ANSI N208.

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.

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. 10 CFR Part 50, Appendix A, General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handling."

5. Regulatory Guide 1.29, "Seismic Design Classification."

6. ANS 57.1/ANSI N208 "Design Requirements for LWR Fuel Handling Systems." (proposed)

BRANCH TECHNICAL POSITION ASB 9-1
OVERHEAD HANDLING SYSTEMS FOR NUCLEAR POWER PLANTS

(BTP ASB 9-1 has been deleted for use in SRP Section 9.1.4 and has been superseded by NUREG 0554 for use in SRP Section 9.1.5)