NRC FORM 464 Part I (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) / PRIVACY ACT (PA) REQUEST

FOIA/PA	RESPONSE NUMBER
99-372	2

RESPONSE TYPE: ☑ FINAL ☐ PARTIAL

REQUESTER: Diane Curran

DATE: FEB 09 2000

PART I. -- INFORMATION RELEASED

☐ No additional agency records subject to the request have been located.

☐ Requested records are available through another public distribution program. See Comments section.

☐ APPENDICES _____ Agency records subject to the request that are identified in the listed appendices are already available for public inspection and copying at the NRC Public Document Room.

☑ APPENDICES B Agency records subject to the request that are identified in the listed appendices are being made available for public inspection and copying at the NRC Public Document Room.

☐ Enclosed is information on how you may obtain access to and the charges for copying records located at the NRC Public Document Room, 2120 L Street, NW, Washington, DC.

☑ APPENDICES B Agency records subject to the request are enclosed.

☐ Records subject to the request that contain information originated by or of interest to another Federal agency have been referred to that agency (see comments section) for a disclosure determination and direct response to you.

☐ We are continuing to process your request.

☐ See Comments.

PART I.A -- FEES

AMOUNT *

$

* See comments for details

☐ You will be billed by NRC for the amount listed.

☐ You will receive a refund for the amount listed.

☑ None. Minimum fee threshold not met.

☐ Fees waived.

PART I.B -- INFORMATION NOT LOCATED OR WITHHELD FROM DISCLOSURE

☐ No agency records subject to the request have been located.

☐ Certain information in the requested records is being withheld from disclosure pursuant to the exemptions described in and for the reasons stated in Part II.

☐ This determination may be appealed within 30 days by writing to the FOIA/PA Officer, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Clearly state on the envelope and in the letter that it is a "FOIA/PA Appeal."

PART I.C COMMENTS (Use attached Comments continuation page if required)

SIGNATURE - FREEDOM OF INFORMATION ACT AND PRIVACY ACT OFFICER

Carol Ann Reed

APPENDIX B
RECORDS BEING RELEASED IN THEIR ENTIRETY

NO.	DATE	DESCRIPTION/(PAGE COUNT)
1.	10/95	SRP Report, Final Draft Revision, SRP Section 9.1.2 Spent Fuel Storage (44 pages)
2.	4/96	Standard Review Plan, 9.1.2 spent Fuel Storage (19 pages)
3.	Undated	Regulatory Guide 1.13, Spent Fuel Storage Facility Design Basis (3 pages)

SRP REPORT

FINAL DRAFT REVISION

SRP SECTION 9.1.2

SPENT FUEL STORAGE

PREPARED IN SUPPORT OF THE SRP-UDP

PREPARED FOR THE NRC
UNDER CONTRACT JCN J-2055
BY THE IDAHO NATIONAL ENGINEERING LABORATORY

OCTOBER 1995

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FINAL DRAFT REVISION SRP SECTION 9.1.2
(REDLINE/STRIKEOUT COPY)

U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

9.1.2 SPENT FUEL STORAGE

REVIEW RESPONSIBILITIES

Primary - ~~Auxiliary~~Plant Systems Branch (~~ASB~~SPLB)[1]

Secondary - Civil Engineering and Geosciences Branch (ECGB)[2]
Materials and Chemical Engineering Branch (~~CHEB~~EMCB)[3]
Reactor Systems Branch (SRXB)[4]

I. AREAS OF REVIEW

Nuclear reactor plants include storage facilities for the wet storage of spent fuel assemblies. The safety function of the spent fuel pool and storage racks is to maintain the spent fuel assemblies in a safe and subcritical array during all credible storage conditions and to provide a safe means of loading the assemblies into shipping casks.

The ~~ASB~~SPLB[5] reviews the spent fuel storage facility design including the spent fuel storage racks, the spent fuel storage pool that contains the storage racks, the spent fuel pool liner plate, and the associated equipment storage pits to ~~assure~~ensure[6] conformance with the requirements of General Design Criteria 2, 4, 5, 61, 62, and 63.

1. The facility and components are reviewed with respect to the following:

   a. The quantity of fuel to be stored.

   b. The design and arrangement of the storage racks for maintaining a subcritical array during all conditions.

   c. The degree of subcriticality provided along with the analysis and associated assumptions.

d. The effects of external loads and forces on the spent fuel storage racks, pool, and liner plate (e.g., safe shutdown earthquake, crane uplift forces, missiles, and dropped objects).

e. Design codes, materials compatibility, and shielding requirements.

f. The use of applicable codes and standards consistent with the assigned seismic classification.

~~2. The ASB review of the pool's water level control system, cleanup system and cooling system is performed with the spent fuel cooling system review in SRP Section 9.1.3.[7]~~

~~3. The ASB review of provisions to preclude dropping the spent fuel shipping cask into the pool are evaluated during the review of the cask loading pit area in SRP Section 9.1.5.[8]~~

Review Interfaces[9]

~~4~~1.[10] ~~ASB~~SPLB[11] also performs the following reviews under the Standard Review Plan (SRP)[12] sections indicated:

a. Review of flood protection is performed under SRP Section 3.4.1.

b. Review of the protection against internally generated missiles as well as missiles generated by natural phenomena is performed under SRP Sections 3.5.1.1, 3.5.1.2, 3.5.2, and 3.5.1.4.

c. Review of structures, systems, and components to be protected against externally generated missiles is performed under SRP Section 3.5.2.

d. Review of the pool's water level control system, cleanup system and cooling system is performed with the spent fuel cooling system review in SRP Section 9.1.3.[13]

e. Review of provisions to preclude dropping the spent fuel shipping cask into the pool are evaluated during the review of the cask loading pit area in SRP Section 9.1.5.[14]

f. Review of fire protection is performed under SRP Section 9.5.1.[15]

g. Review of equipment qualification is performed under SRP Section 3.11.[16]

~~A secondary review is performed by the Chemical Engineering Branch (CMEB) and the results of its evaluation are used by ASB to complete the overall evaluation of the system. The CMEB reviews the compatibility and chemical stability of the materials wetted by the pool water. In addition, CMEB will verify that there are no potential mechanisms that will: (1) alter the dispersion of the strong fixed neutron absorbers incorporated in the design of the storage racks, and/or (2) cause physical distortion of the tubes retaining~~

~~the stored fuel assemblies. The results of CMEB's evaluation are transmitted to ASB for inclusion in the spent fuel storage SER writeup.~~[17]

2.[18] In addition, ~~ASB~~SPLB[19] will coordinate reviews performed by other branches, and the results are used by ~~ASB~~SPLB[20] in the overall spent fuel storage evaluation. The coordinated reviews are as follows:

a.[21] The ~~Structural Engineering Branch (SEB)~~Civil Engineering and Geosciences Branch (ECGB)[22] determines the acceptability of the design analyses, procedures, and criteria used to established the ability of seismic Category I structures to withstand the effects of natural phenomena such as safe shutdown earthquakes (SSE), the probable maximum flood (PMF), and missiles as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.4.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.

b.[23] The ~~Core Performance Branch (CPB)~~Reactor Systems Branch (SRXB)[24] determines that the criticality limits are acceptable and in accordance with ANS 57.2[25] paragraphs 5.1.1.2.1 and 5.1.1.2.2 as part of its primary responsibility for SRP Section 4.3.

c.[26] The Mechanical Engineering Branch (~~MEB~~EMEB)[27] determines that the components 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.

d.[28] The ~~MEB~~EMEB[29] 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.

e. The EMEB reviews the seismic qualification of Category I instrumentations as part of its primary review responsibility for SRP Section 3.10.[30]

f.[31] The Materials and Chemical Engineering Branch (~~MTEB~~EMCB)[32] verifies that inservice inspection requirements are met for system components as part of its primary review responsibility for SRP Section 6.6.

~~The review for Fire Protection, Technical Specifications, and Quality Assurance is coordinated and performed by the Chemical Engineering Branch, Quality Assurance Branch, and Licensing Guidance Branch as part of their primary review responsibilities for SRP Sections 9.5.1, 16.0, and 17.0, respectively.~~[33]

g. The Technical Specifications Branch (TSB) coordinates and performs reviews of the proposed technical specifications as part of its primary review responsibility for SRP Section 16.0.[34]

h. The Quality Assurance and Maintenance Branch (HQMB) coordinates and performs reviews of quality assurance programs as part of its primary review responsibility for SRP Chapter 17.[35]

~~The Equipment Qualification Branch reviews the seismic qualification of Category I instrumentation 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.~~[36]

3. A secondary review is performed by the Materials and Chemical Engineering Branch (EMCB) and the results of its evaluation are used by SPLB to complete the overall evaluation of the system. The EMCB reviews the compatibility and chemical stability of the materials wetted by the pool water. In addition, EMCB will verify that there are no potential mechanisms that will: (1) alter the dispersion of the strong fixed neutron absorbers incorporated in the design of the storage racks, and/or (2) cause physical distortion of the tubes retaining the stored fuel assemblies. The results of EMCB's evaluation are transmitted to SPLB for inclusion in the spent fuel storage safety evaluation report (SER) writeup.[37]

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~~.[38]

II. ACCEPTANCE CRITERIA

Acceptability of the spent fuel storage facility design as described in the applicant's safety analysis report (SAR) is based on certain General Design Criteria and Regulatory Guides, and on independent calculations and staff judgments with respect to system functions and component selection. The design of the spent fuel storage facility is acceptable if the integrated design is in accordance with the following criteria:

1. General Design Criterion 2 (GDC 2),[39] as it relates to structures housing the facility and the facility itself being capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, and hurricanes. Acceptance for meeting this criterion is based on conformance to position ~~C.3~~C.2[40] of Regulatory Guide 1.13, the applicable portions of Regulatory Guide 1.29, Regulatory Guide 1.117, and ANS 57.2 paragraphs 5.1.1, 5.1.3, 5.1.12, 5.3.2, and 5.3.4.

2. General Design Criterion 4 (GDC 4),[41] as it relates to structures housing the facility and the facility itself being capable of withstanding the effects of environmental conditions and external missiles, and internally generated missiles, pipe whip, and jet impingement forces associated with pipe breaks, such that safety functions will not be precluded. Acceptance for meeting this criterion is based on meeting position ~~C.3~~C.2[42] of Regulatory Guide 1.13, Regulatory Guides 1.115 and 1.117, as well as appropriate paragraphs of ANS 57.2.

3. General Design Criterion 5 (GDC 5),[43] as it relates to shared structures, systems, and components important to safety being capable of performing required safety functions.

4. General Design Criterion 61 (GDC 61),[44] as it relates to the facility design for fuel storage and handling of radioactive materials. Acceptance for meeting this criterion is based on conformance to positions C.1 and C.4 of Regulatory Guide 1.13 and the appropriate paragraphs of ANS 57.2. Acceptance is also based on meeting the fuel storage capacity requirements noted in subsection III.1 of this SRP section.

5. General Design Criterion 62 (GDC 62),[45] as it relates to the prevention of criticality by physical systems or processes utilizing geometrically safe configurations. Acceptance for meeting this criterion is based on conformance to positions C.1 and C.4 of Regulatory Guide 1.13 and the appropriate paragraphs of ANS 57.2.

6. General Design Criterion 63 (GDC 63),[46] as it relates to monitoring systems provided to detect conditions that could result in the loss of decay heat removal capabilities, to detect excessive radiation levels, and to initiate appropriate safety actions. Acceptance for meeting this criterion is based on conformance with paragraph 5.4 of ANS 57.2.

Technical Rationale[47]

The technical rationale for application of these acceptance criteria to reviewing spent fuel storage is discussed in the following paragraphs:[48]

1. Compliance with GDC 2 requires that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as earthquake, tornado, hurricane, flood, tsunami and seiche without loss of capability to perform their safety functions.

   The function of the spent fuel storage facility is to maintain spent fuel in a subcritical array that can be adequately cooled during all credible storage conditions and to limit offsite exposures in the event of significant release of radioactive materials from the fuel. The requirements of GDC 2 are imposed to verify that the structures, systems, and components of the spent fuel storage facility are designed to withstand the effects of natural phenomena that might occur at the plant site, thereby ensuring that spent fuel will be maintained in a subcritical array. Position C.2 of Regulatory Guide 1.13; the applicable portions of Regulatory Guide 1.29; Regulatory Guide 1.117; and ANS 57.2 paragraphs 5.1.1, 5.1.3, 5.1.12, 5.3.2, and 5.3.4, provide guidance acceptable to the staff for meeting these requirements.

   Meeting the requirements of GDC 2 provides added assurance that stored spent fuel will be maintained in a subcritical configuration that can be adequately cooled after a natural phenomena event.[49]

2. Compliance with GDC 4 requires that structures, systems, and components important to safety be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operations, maintenance, testing, and postulated accidents, including loss of coolant. This requirement includes protection against dynamic

effects, including the effects of missiles, pipe whipping, and discharging fluids resulting from equipment failures and from events and conditions outside the nuclear power unit.

GDC 4 requires that a spent fuel storage facility provide a controlled environment that will facilitate maintaining the fuel in a coolable and subcritical geometry. In addition, the facility is required to protect the fuel from the effects of missiles and jet impingement forces associated with turbine failure, natural phenomena (including tornadoes), and pipe breaks. Position C.2 of Regulatory Guide 1.13, Regulatory Guides 1.115 and 1.117, and appropriate paragraphs of ANS 57.2 provide guidance acceptable to the staff for meeting this requirement.

Meeting the requirements of GDC 4 provides added assurance that the spent fuel storage facility will contain radioactive materials and maintain a subcritical configuration that can be adequately cooled after being exposed to the effects of missiles and natural phenomena.[50]

3. Compliance with GDC 5 requires that structures, systems, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

GDC 5 requires that the fuel storage facility at multiple-unit sites either not be shared among the units or that those systems, structures, or components that are shared will be designed in such a manner that an accident at one facility will not significantly impair the ability of the remaining facility to protect spent fuel. Should an accident that causes damage to the fuel storage facility occur, spent fuel will be a potential source of radioactive effluents. Therefore, spent fuel storage must be designed to minimize the likelihood of such an event.

Meeting the requirements of GDC 5 provides added assurance that spent fuel will not become a source of radioactive effluents.[51]

4. Compliance with GDC 61 requires that fuel storage and handling, radioactive waste, and other systems that may contain radioactive materials be designed to ensure adequate safety under normal and postulated accident conditions.

GDC 61 applies to this SRP section because the reviewer evaluates inspection and testing of components, shielding for radiation protection, containment and filtering, testability of residual heat removal, and preventing the loss of fuel storage coolant inventory. Positions C.1 and C.4 of Regulatory Guide 1.13 and appropriate paragraphs of ANS 57.2 provide guidance acceptable to the staff for meeting the requirements of this criterion.

Meeting the requirements of GDC 61 provides added assurance that criticality and releases of radioactive materials related to the storage and handling of spent fuel will be prevented.[52]

5. Compliance with GDC 62 requires that criticality in the fuel storage and handling system be prevented through the use of physical systems or processes, with preference given to the application of geometrically safe configurations.

The function of the spent fuel storage facility is to maintain spent fuel in a subcritical array that can be adequately cooled during all credible storage conditions and to limit offsite exposures in the event of significant release of radioactivity from the fuel. This role requires that the design of spent fuel storage use potential moderators to provide assurance that spacing be adequate to prevent criticality during earthquakes and flooding. The configuration of spent fuel storage must also prevent the insertion of a fuel assembly anywhere other than in a design location. Positions C.1 and C.4 of Regulatory Guide 1.13 and appropriate paragraphs of ANS 57.2 provide guidance acceptable to the staff for meeting the requirements of this criterion.

Meeting the requirements of GDC 62 provides added assurance that criticality will be prevented in the spent fuel storage facility.[53]

6. Compliance with GDC 63 requires that appropriate systems be provided in fuel storage and radioactive waste systems, and associated handling areas, to detect conditions that may result in loss of residual heat removal capability and excessive radiation levels and to initiate appropriate safety actions.

GDC 63 requires that pool building radiation, pool level, and pool temperature monitoring be provided for the protection of personnel and to detect conditions that could result in the loss of decay heat removal capabilities. In addition, alarms and communications systems must be provided to alert personnel and provide for communications between fuel handling machines, refueling machines, and the control room. Paragraph 5.4 of ANS 57.2 provides guidance acceptable to the staff for meeting these requirements.

Meeting the requirements of GDC 63 provides added assurance that residual heat removal will be adequately provided and that the release of radioactive materials will be prevented.[54]

III. REVIEW PROCEDURES

The procedures below are used during the standard design certification or[55] construction permit (CP) application review to determine that the design criteria and bases and the preliminary design meet the acceptance criteria given in subsection II. For the review of the operating license (OL) or combined license (COL)[56] application, the review procedures and acceptance criteria will be utilized to verify that the initial design criteria and bases have been appropriately implemented in the final design. The OL review includes verification that the content and intent of the technical specifications prepared by the applicant are in agreement with requirements for system testing, minimum performance, and surveillance developed as a result of the staff's review.

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 secondary review branch, ~~CMEB,~~EMCB,[57] will provide an input on a routine basis for those areas of review indicated in this SRP section. The primary reviewer (~~ASB~~SPLB)[58] obtains and uses such input as required to ~~assure~~ensure[59] that this review procedure is complete.

The review procedures given below are for a typical storage system. Any variance of the review, to take account of a proposed unique design, will be such as to ~~assure~~ensure[60] that the facility design conforms to the criteria in subsection II of this SRP section. The reviewer selects and emphasizes material from this SRP section as may be appropriate for a particular case.

1. The SAR is reviewed to determine that the design bases and facility description section indicates the storage capacity provided in the design. The minimum storage capacity in the spent fuel storage pool shall be in accordance with ANS 57.2 paragraph 5.1.15, i.e., for a single unit facility the storage capacity shall equal or exceed one full core discharge plus the maximum normal fuel discharge cycle; for a dual shared storage pool facility the storage capacity shall equal or exceed one full core discharge plus two normal fuel discharge cycles. Due to a lack of sufficient away-from-reactor (AFR) storage capacity, the industry trend has been to use high density storage racks. ~~ASB~~ SPLB[61] reviews high density storage on a case-by-case basis. Low-density storage should be used, at a minimum, for the most recently discharged fuel to decrease the probability of igniting the zircaloy cladding in the event of draining the spent fuel pool.[62]

2. The information provided in the SAR relating to the facility design criteria, safety evaluation, system description, and the layout drawings for the spent fuel pool and storage racks is reviewed to verify that:

   a. Criticality information (including the associated assumptions and input parameters) in the SAR must show that the center-to-center spacing between fuel assemblies and any strong fixed neutron absorbers in the storage racks is sufficient to maintain the array, when fully loaded and flooded with nonborated water, in a subcritical condition. A K_{eff} not greater than 0.95 for this condition is acceptable.

   b. The design of the storage racks is such that a fuel assembly cannot be inserted anywhere other than in a design location.

   c. Failures of nonsafety-related systems or structures not designed to seismic Category I that are located in the vicinity of the spent fuel storage facility are reviewed to ~~assure~~ensure[63] that their failure will not cause an increase in K_{eff} to exceed the maximum allowable. The SAR description section, the general arrangement and layout drawings, and the tabulation of seismic design classifications for structures and systems are reviewed and evaluated to ~~assure~~ensure[64] that this condition is met. A statement in the SAR establishing the above condition as a design

criterion is acceptable at the design certification or[65] CP review stage.

d. Design calculations should show that the storage racks and any anchorages can withstand the maximum fuel handling equipment uplift forces without an increase in K_{eff} or a decrease in pool water inventory. A statement in the SAR that excessive forces cannot be applied due to the design of the fuel handling equipment is acceptable if justification is presented. The evaluation procedures identified in SRP Sections 9.1.4 and 9.1.5 are used to validate this statement.

e. Conventionally the plant's Technical Specification states that the weight of all loads being handled above stored spent fuel shall not exceed that of one fuel assembly and its associated handling tool. This weight and its normal carrying height above the storage racks establishes what was considered the upper bound on the potential energy available to damage the stored spent fuel if a load drop occurs. It has been subsequently noted that lighter loads handled at greater drop heights may have greater amounts of potential energy. Therefore, the following additional requirement is being made. The licensee is required to demonstrate and the reviewer to verify that the available potential energy of all lighter loads, being handled above stored spent fuel, shall not exceed that of one fuel assembly and its associated handling tool when dropped from its normal operating height above stored spent fuel.

f. Sharing of storage facilities in multi-unit plants will not increase the potential for the loss of pool water or decrease the degree of subcriticality provided.

3. The reviewer verifies that the safety function of the facility will be maintained, as required, if the facility is subjected to adverse natural phenomena such as earthquakes, tornadoes, hurricanes, and floods. In making this determination, the reviewer considers the following points:

   a. The facility design basis and criteria and the component classification tables are reviewed to verify that the spent fuel storage facility including the storage pool, pool liner, and racks have been classified and designed to seismic Category I requirements. The ~~ASB~~ SPLB[66] will accept a statement that the facility will be designed and constructed as a seismic Category I system (CP or standard design certification).[67]

   b. If the spent fuel pool liner plate will not be designed and constructed to seismic Category I requirements, the spent fuel pool

liner plate is reviewed to verify that a failure of the liner plate as a result of an SSE will not cause any of the following:~~1~~

1. Significant releases of radioactivity due to mechanical damage to the fuel;

2. Significant loss of water from the pool which could uncover the fuel and lead to release of radioactivity due to heatup;

3. Loss of ability to cool the fuel due to flow blockage caused by a portion or one complete section of the liner plate falling on top of the fuel racks;

4. Damage to safety-related equipment as a result of the pool leakage, and

5. Uncontrolled release of significant quantities or radioactive fluids to the environs.

c. The essential portions of the spent fuel storage system are reviewed to verify that protection from the effects of floods, hurricanes, tornadoes, and internally or externally generated missiles is provided. Flood protection and missile protection criteria are discussed in sections of the SRP contained in Chapter 3. The reviewer utilizes the information in those SRP sections, as appropriate, to ~~assure~~ensure[68] that the analyses presented are valid. ~~ASB~~SPLB[69] will accept a statement to the effect that the storage facility is located in a seismic Category I structure that is missile and flood protected.

4. The safe handling of spent fuel assemblies necessitates the underwater transfer of spent fuel between the respective areas of the plant including spent fuel cask loading area. The SAR is reviewed to verify that the design basis and facility description section has stated that a separate spent fuel shipping cask loading area (pit) has been provided adjacent to the spent fuel pool. The reviewer verifies that the loading pit has been designed so that the safety function of the integrated

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~~1 The implementation of this item reflects current regulatory practice. The methods of review described herein will be used in the evaluation of submittals for operating license or construction permit applications docketed after November 17, 1977, which is based on the first application to which this method was specifically applied. Implementation for applications docketed prior to November 17, 1977 is not considered necessary since stresses induced in the fuel pool liner plate welds due to an SSE will usually be well below the maximum allowable stress levels and therefore liner failure is not considered a likely event. Even in the event that a liner plate failed, it would not likely block the coolant outlet of spent fuel assemblies completely and sufficient cooling of stored spent fuel would be maintained. Therefore, the spent fuel pool liner plate seismic design is not considered a significant safety issue and backfit is not required.~~[70]

system will be maintained during adverse environmental conditions. In addition, the reviewer verifies that the following are included in the design:

a. An interconnecting fuel transfer canal should be capable of being isolated from the fuel pool and cask loading area. A statement in the SAR that these features are included in the design is acceptable. The reviewer uses engineering judgment to ~~assure himself~~verify[71] that the means provided meet the stated intent.

b. In regard to the handling of heavy loads, e.g., the spent fuel shipping cask in the vicinity of the spent fuel storage pool, the reviewer is required to establish and verify in SRP Section 9.1.5 that one of the alternative approaches described in Section 5 of NUREG-0612 has been satisfied. If Sections 5.1.1 and 5.1.6 of NUREG-0612 have not been met, the SAR safety evaluations, results of design calculations, and the general arrangement and layout drawings should show that the spent fuel loading ~~put~~pit[72] has been designed to withstand the loads from dropped heavy objects including the shipping cask, and that the loading area is not an integral part of the storage pool floor so that if a dropped object should breach the pit area, loss of fuel pool water would not result in an unacceptable level.

For standard design certification reviews, the above review procedures are used to verify that the design as set forth in the standard SAR (including inspections, tests, analyses, and acceptance criteria (ITAAC); site interface requirements; and COL action items) meets the acceptance criteria given in subsection II.[73]

IV. EVALUATION FINDINGS

The reviewer verifies that the information provided and ~~his~~ that the[74] review support conclusions of the following type, to be included in the staff's ~~safety evaluation report~~SER:[75]

The spent fuel storage facility includes the spent fuel storage racks, the spent fuel storage pool that contains the storage racks, and the associated equipment storage pits. Based on the review of the applicant's proposed design criteria, design bases, and safety classification for the spent fuel storage facility and the provisions necessary to maintain a subcritical array, the staff concludes that the design of the spent fuel storage facility and supporting systems is in conformance with the Commission's regulations as set forth in General Design Criteria 2, 4, 5, 61, 62, and 63.

This conclusion is based on the following:

1. The applicant has met the requirements of General Design Criterion 2 by conforming with position ~~C.3~~C.2[76] of Regulatory Guide 1.13 and the applicable portions of Regulatory Guides 1.29 and 1.117, as well as paragraphs 5.1.1, 5.1.3, 5.1.12, 5.3.2, and 5.3.4 of ANS 57.2.

2. The applicant has met the requirements of General Design Criterion 4 pertaining to the environmental and missile protection design basis by conforming to position ~~C.3~~C.2[77] of Regulatory Guide 1.13 and the applicable portions of Regulatory Guides 1.115 and 1.117, as well as appropriate paragraphs of ANS 57.2.

3. The applicant has met the requirements of General Design Criterion 5 since the failure of any portion of the shared spent fuel storage facility will not impair the ability of plants systems to perform their safety function.

4. The applicant has met the requirements of General Design Criteria 61 and 62 pertaining to fuel storage, handling, criticality, and radioactivity control by conforming to positions C.1 and C.4 of Regulatory Guide 1.13 and the appropriate paragraphs of ANS 57.2.

5. The applicant has met the requirements of General Design Criterion 63 pertaining to monitoring the status of the stored spent fuel by conforming to paragraph 5.4 of ANS 57.2.

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other SER sections, the staff's ITAAC evaluation, including design acceptance criteria (DAC), site interface requirements, and COL action items that are relevant to this SRP section.[78]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the 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 on its evaluation of conformance with Commission regulations.

~~Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced NUREG and Regulatory Guides.~~[79]

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 4, "~~Environmental and Missile Design Bases~~Environmental and Dynamic Effects Design Bases."[80]

3. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."

4. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."

5. 10 CFR Part 50, Appendix A, General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handling."

6. 10 CFR Part 50, Appendix A, General Design Criterion 63, "Monitoring Fuel and Waste Storage."

7. Regulatory Guide 1.13, ~~"Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations."~~"Spent Fuel Storage Facility Design Basis."[81]

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

9. Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles."

10. Regulatory Guide 1.117, "Tornado Design Classification."

11. ANS 57.2/ANSI N210-1976, "Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations."

12. NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."

SRP REPORT

FINAL DRAFT REVISION

SRP SECTION 9.1.2

SPENT FUEL STORAGE

ATTACHMENT A

PROPOSED CHANGES IN ORDER OF OCCURRENCE

Draft SRP Section 9.1.2
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1	Current PRB name and abbreviation	Changed PRB to Plant Systems Branch (SPLB).
2	SRP-UDP format item	Added ECGB as an SRB per NRC guidance.
3	Current SRP name and abbreviation	Updated SRB to Materials and Chemical Engineering Branch (EMCB).
4	SRP-UDP format item	Added SRXB as an SRB per NRC guidance.
5	Current PRB abbreviation	Changed PRB to SPLB.
6	Editorial revision	Changed "assure" to "ensure."
7	SRP-UDP format item	Removed section to reflect current SRP format.
8	SRP-UDP format item	Removed section to reflect current SRP format.
9	SRP-UDP format item	Added "Review Interfaces" to AREAS OF REVIEW and organized in numbered paragraph form to describe how SPLB reviews aspects of the new fuel storage facility design under other SRP sections and how branches support the review.
10	SRP-UDP format item	Changed item number to reflect current SRP format.
11	Current PRB abbreviation	Change PRB to SPLB.
12	Editorial	Defined "SRP" as "Standard Review Plan."
13	Current SPLB review responsibility	Changed the responsibility for this review from ASB to SPLB. Relocated the paragraph from Areas of Review in the current SRP section.
14	Current SPLB review responsibility	Changed the responsibility for this review from ASB to SPLB. Relocated the paragraph from Areas of Review in the current SRP section.
15	Current SPLB review responsibility	Modified to reflect review responsibility for SRP Section 9.5.1.
16	Current SPLB review responsibility	Modified to reflect review responsibility for SRP Section 3.11.
17	SRP-UDP format item	Removed section to reflect current SRP format.
18	SRP-UDP format item	Added item number to reflect current SRP format.
19	Current PRB abbreviation	Changed PRB to SPLB.
20	Current PRB abbreviation	Changed PRB to SPLB.
21	SRP-UDP format item	Added item number to reflect current SRP format.

Item	Source	Description
22	Current ECGB review responsibility	Changed to reflect primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.4.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.
23	SRP-UDP format item	Added item number to reflect current SRP format.
24	Current SRXB review responsibility	Changed to reflect primary review responsibility for SRP Section 4.3.
25	Integrated Impact No. 398	This standard is outdated. ANS 57.2/ANSI N210-1976 was revised in 1983 to ANSI/ANS-57.2-1983.
26	SRP-UDP format item	Added item number to reflect current SRP format.
27	Current PRB abbreviation	Changed PRB to EMEB.
28	SRP-UDP format item	Added item number to reflect current SRP format.
29	Current PRB abbreviation	Changed PRB to EMEB.
30	Current EMEB review responsibility	Reflect review responsibility for SRP Section 3.10.
31	SRP-UDP format item	Added item number to reflect current SRP format.
32	Current SRP name and abbreviation	Modified to reflect EMCB's primary review responsibility for SRP Section 6.6.
33	SRP-UDP format item	Removed section to reflect current SRP format.
34	SRP-UDP format item	Rewrote section to reflect current SRP format.
35	SRP-UDP format item	Rewrote section to reflect current SRP format.
36	SRP-UDP format item	Removed section to reflect current SRP format.
37	SRP-UDP format item	Moved section to this location and revised to reflect current SRP format and review responsibilities.
38	Editorial	Simplified for clarity and readability.
39	Editorial	Introduced "GDC 2" as initialism for "General Design Criterion 2."
40	Current Revision of RG 1.13	Changed to reflect paragraph number in current revision (Rev. 1) of RG 1.13.
41	Editorial	Introduced "GDC 4" as initialism for "General Design Criterion 4."
42	Current Revision of RG 1.13	Changed to reflect paragraph number in current revision (Rev. 1) of RG 1.13.
43	Editorial	Introduced "GDC 5" as initialism for "General Design Criterion 5."
44	Editorial	Introduced "GDC 61" as initialism for "General Design Criterion 61."
45	Editorial	Introduced "GDC 62" as initialism for "General Design Criterion 62."

Item	Source	Description
46	Editorial	Introduced "GDC 63" as initialism for "General Design Criterion 63."
47	SRP-UDP format item, develop technical rationale	Added "Technical Rationale" to ACCEPTANCE CRITERIA and organized in numbered paragraph form to describe the basis for referencing the General Design Criteria.
48	SRP-UDP format item, develop technical rationale	Added lead-in sentence for "Technical Rationale."
49	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 2.
50	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 4.
51	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 5.
52	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 61.
53	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 62.
54	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 63.
55	SRP-UDP format item	Added reference to the standard design certification application review.
56	SRP-UDP format item	Added reference to the combined license application review.
57	Current SRB abbreviation	Changed SRB and review responsibility to EMCB.
58	Current PRB abbreviation	Changed PRB to SPLB.
59	Editorial revision	Changed "assure" to "ensure."
60	Editorial revision	Changed "assure" to "ensure."
61	Current PRB abbreviation	Changed PRB to SPLB.
62	Integrated Impact No. 399	The staff concluded in NUREG-1242 (SER for the EPRI Evolutionary Plant) that the spent fuel storage design is to use low-density storage racks for, as a minimum, the most recently discharged fuel.
63	Editorial revision	Changed "assure" to "ensure."
64	Editorial revision	Changed "assure" to "ensure."
65	SRP-UDP format item	Added reference to the standard design certification review.
66	Current PRB abbreviation	Changed PRB to SPLB.
67	SRP-UDP format item	Added reference to the standard design certification review.
68	Editorial revision	Changed "assure" to "ensure."
69	Current PRB abbreviation	Changed PRB to SPLB.

Item	Source	Description
70	SRP-UDP format item	Deleted the footnote limiting certain review procedures to applications docketed after 1977.
71	Editorial revision	Changed "assure himself" to "verify."
72	Editorial revision	Corrected "put" to "pit."
73	SRP-UDP format item	Added the standard paragraph giving additional procedures applicable to a standard design certification review.
74	Editorial	Modified to eliminate gender-specific reference.
75	Editorial	Used "SER" as previously defined in this SRP section.
76	Current Revision of RG 1.13	Changed to reflect paragraph number in current revision (Rev. 1) of RG 1.13.
77	Current Revision of RG 1.13	Changed to reflect paragraph number in current revision (Rev. 1) of RG 1.13.
78	SRP-UDP format item	Added the standard paragraph describing additional findings applicable to a standard design certification review.
79	Editorial revision	Deleted obsolete scheduling information.
80	Current Revision of 10 CFR Part 50, Appendix A	Updated title of GDC 4.
81	Current Revision of RG 1.13	Change to reflect title of current revision (Rev. 1) of RG 1.13.

SRP REPORT

FINAL DRAFT REVISION

SRP SECTION 9.1.2

SPENT FUEL STORAGE

ATTACHMENT B
CROSS REFERENCE OF REVISION OPTIONS CHECKLIST
INTEGRATED IMPACTS

Draft SRP Section 9.1.2
Attachment B - Cross Reference of Revision Options Checklist
Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
398	Incorporates latest version of ANSI/ANS 57.2.	No change made. Endnote added to "Review Interface," item 2.b
399	Incorporates staff position concerning the use of high density storage racks.	Subsection III, REVIEW PROCEDURES, subparagraph 1

SRP REPORT

FINAL DRAFT REVISION

SRP SECTION 9.1.2

SPENT FUEL STORAGE

REVISION OPTIONS CHECKLIST DOCUMENTATION,
PARTS A-F AND ASSOCIATED POTENTIAL IMPACTS

REVISION OPTIONS CHECKLIST

SRP Section 9.1.2 **Integrated Impact No.: 398**

PART A - INTEGRATED IMPACT IDENTIFICATION

SRP section number: 9.1.2

Enter potential impact number or related potential impact numbers
22960

Reactor Type(s): GENERIC

Integrated impact number: 398

Enter a brief description of the integrated impact

ANS 57.2/ANSI N210-1976 is cited as a guidance document related to prevention of criticality and provides design objectives for spent fuel storage facilities. The current version is ANSI/ANS-57.2-1983. PNL is conducting a detailed side-by-side comparison between the current and cited versions of the standard. Pending completion and review of the side-by-side comparison, consideration should be given to citing the current version of the standard.

PART B - DETERMINATION OF IMPACT SIGNIFICANCE

Major	
Significant	
Moderate	
Minor	X

SRP Section 9.1.2

Part C - Characterization of Type and Nature of Change

Enter a brief narrative:

A footnote was added in the RSO copy of the revised draft at the first point where ANS 57.2 is cited. The footnote serves to alert the staff that SRP Section 9.1.2 references an outdated standard.

SRP Section 9.1.2

Part D - Discussion of Possible Changes

Statement of Option: Add a footnote to the RSO draft text advising that the standard is outdated. Make no change to the text.

Pros:

1. ANS 57.2 (no version specified) is cited in SRP Section 9.1.2 as Specific Criteria related to prevention of criticality, maintaining residual heat removal capability, and to radiological aspects of the design of a spent fuel storage facility (General Design Criteria 2, 4, 61, 62, and 63). The Staff position regarding ANS 57.2 is stated in Regulatory Guide 1.13 proposed Revision 2 (12/81). In addition, acceptance of these standards as they relate to meeting the requirements of GDC 61 and GDC 62 is indicated in the Final Safety Evaluation Reports for the EPRI Evolutionary Plant, NUREG-1242, the ABB-CE System 80+, NUREG-1462, and the GE ABWR, NUREG-1503.

2. Before SRP Section 9.1.2 is revised to use the current version of ANS 57.2 as part of the acceptance criteria, a detailed comparison will be required to evaluate the differences between the version in effect when Revision 3 of SRP Section 9.1.2 was released and the current version of the standard.

3. This impact applies all nuclear power plant designs. This SRP section and the referenced ANS/ANSI standard are applicable to applications for early site permits, construction permits and combined licenses.

Cons: No cons identified for the Integrated Impact.

Is potential research indicated?	Yes___	No_X_
Is potential rulemaking, regulatory guide revision, or other regulatory action indicated?	Yes_X_	No___
Are there additional options?	Yes___	No_X_

SRP Section 9.1.2

Part E - Identification of Conflicts

Conflict Identified: Yes___ No_X_

Conflicting Potential Impact No. _____

Provide a narrative describing the nature of conflict:

Provide a narrative describing potential conflict resolution:

Provide a narrative describing the rationale for the resolution:

Is potential research indicated?	Yes ___	No ___
Is potential rulemaking, regulatory guide revision, or other regulatory action indicated?	Yes ___	No ___
Are there additional conflicts?	Yes ___	No ___

SRP Section 9.1.2

Part F - Type I/Type II Determination

Type I - Revisions to SRP Without Public Comments

1. Do the suggested revisions incorporate new or revised requirements or guidance that have received public comment and have been approved by the Director, NRR, and therefore do not require additional public comments?

   Yes ___ No ___

2. Do the suggested revisions incorporate new positions that have been approved by the Director, NRR, and by CRGR and EDO as being so clearly needed that public comment period would cause an unacceptable delay in implementing them?

   Yes ___ No ___

3. Do the suggested revisions involve only minor changes, such as clarifications, corrections, changes in names or assignments of branches, or deletions of unused references?

   Yes ___ No ___

Type II - Revisions to the SRP With Public Comments

1. Do the suggested revisions incorporate proposed new or revised requirements, positions, or guidance that have not been reviewed and approved by the Director, NRR, CRGR and the EDO, or which could result in new sections for the SRP?

   Yes ___ No ___

Provide rationale for above determination

No change was made to the text of the SRP section.

END OF REPORT

Potential Impact/Section Consistency Report

SRP Section 9.1.2 Potential Impact No. 22960

Document Type, No.: C&S: ANS 57.2
Title: Requirements for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Plants, Design
Revision No., Date:

SRP Section No.: 9.1.2
Title: SPENT FUEL STORAGE
Revision No., Date: 3, 07/01/81

Reactor Types: GENERIC

Summary: ANS 57.2/ANSI N210-1976, which is cited as a guidance document, was revised in 1983. The standard provides guidance for designing spent fuel storage facilities at nuclear power stations.

Impact Location(s): Entire Document

Impact Criteria: 1. Staff position, guidance or requirement.

Search Index: Manual
Search String: None

Consistency Check Information

Consistency Check Status: Retain Impact

Work Assignment No: 1340

1. Is it Adequately covered in the SRP?	Yes ___	No X
2. Retain as technical rationale for acceptance criteria?	Yes ___	No X
3. Was this potential impact incorrectly assigned to this SRP section?	Yes ___	No X
4. Should this potential impact be eliminated from further consideration for some other reason?	Yes ___	No X

REVISION OPTIONS CHECKLIST

SRP Section 9.1.2 Integrated Impact No.: 399

PART A - INTEGRATED IMPACT IDENTIFICATION

SRP section number: 9.1.2

Enter potential impact number or related potential impact numbers
22959

Reactor Type(s): EVOLUTIONARY

Integrated impact number: 399

Enter a brief description of the integrated impact

Revise Review Procedures for review of the design of fuel storage racks provided for storage of recently discharged fuel. Section III.1 of SRP 9.1.2 states that the staff reviews high density storage on a case-by-case basis.

In the EPRI FSER, the staff recommended that FDA/DC applicants submit a design that uses low-density storage racks in the spent fuel pool for, as a minimum, the most recently discharged fuel.

Consideration should be given to revising Review Procedures for review of the design of fuel storage racks provided for storage of recently discharged fuel to reflect the above staff position.

PART B - DETERMINATION OF IMPACT SIGNIFICANCE

Major	____
Significant	____
Moderate	X
Minor	____

SRP Section 9.1.2

Part C - Characterization of Type and Nature of Change

Enter a brief narrative:

Modify "REVIEW PROCEDURES" as follows:

Add the following sentence to the end of subparagraph 1 stating the NRC position concerning the use of low-density storage racks for the storage of spent fuel:

Low-density storage should be used, at a minimum, for the most recently discharged fuel to decrease the probability of igniting the zircaloy cladding in the event of draining the spent fuel pool.

SRP Section 9.1.2

Part D - Discussion of Possible Changes

Statement of Option: Add to REVIEW PROCEDURES the NRC position concerning the use of low-density storage racks for the storage of spent fuel.

Pros:

1. The NRC staff in its review of the EPRI Evolutionary Plant, NUREG-1242-Vol 2., Section 3.2.30, stated that although the likelihood of complete draining of the spent fuel pool was low, the use of high-density storage racks increased the probability of a zircaloy-cladding fire as compared with the use of low-density or open-frame racks. The staff concluded that the use of low-density storage racks was justified by a favorable value/impact ratio. Consequently the staff expects an applicant to submit a design that uses low-density storage racks in the spent fuel pool for, as a minimum, the most recently discharged fuel.

2. The current staff position regarding low-density storage racks for spent fuel should be given in the SRP section. Recommendations to revise Regulatory Guide 1.1.3, Spent Fuel Storage Facility Design Basis, to reflect the staff's position concerning the use of low-density storage racks for the storage of spent fuel are provided on an IPD 7.0 Form in this report.

3. This SRP section is applicable to applications for early site permits, construction permits and combined licenses.

Cons: No cons identified for the Integrated Impact.

Is potential research indicated?	Yes___	No_X_
Is potential rulemaking, regulatory guide revision, or other regulatory action indicated?	Yes_X_	No___
Are there additional options?	Yes___	No_X_

SRP Section 9.1.2

Part E - Identification of Conflicts

Conflict Identified: Yes___ No_X_

Conflicting Potential Impact Nos.

Provide a narrative describing the nature of conflict:

Provide a narrative describing potential conflict resolution:

Provide a narrative describing conflict rationale:

Is potential research indicated?	Yes ___	No ___
Is potential rulemaking, regulatory guide revision, or other regulatory action indicated?	Yes ___	No ___
Are there additional conflicts?	Yes ___	No ___

SRP Section 9.1.2

Part F - Type I/Type II Determination

Type I - Revisions to the SRP Without Public Comments

1. Do the suggested revisions incorporate new or revised requirements or guidance that have received public comment and have been approved by the Director, NRR, and therefore do not require additional public comments?

   Yes X No ___

2. Do the suggested revisions incorporate new positions that have been approved by the Director, NRR, and by CRGR and EDO as being so clearly needed that a public comment period would cause an unacceptable delay in implementing them?

   Yes ___ No X

3. Do the suggested revisions involve only minor changes, such as clarifications, corrections, changes in names or assignments of branches, or deletions of unused references?

   Yes ___ No X

Type II - Revisions to the SRP with Public Comments

1. Do the suggested revisions incorporate proposed new or revised requirements, positions, or guidance that have not been reviewed and approved by the Director, NRR, CRGR and the EDO, or which could result in new sections for the SRP?

   Yes ___ No X

Provide Rationale for Above Determination

The position represented by this revision was taken in the EPRI Evolutionary Plant FSER. This FSER has been available for public comment and for Commission review.

END OF REPORT

Potential Impact/Section Consistency Report

SRP Section 9.1.2 Potential Impact No. 22959

Document Type, No.: FINAL SER EPRI CH 1
Title: EPRI URD-EPD: OVERALL REQUIREMENTS
Revision No., Date:

SRP Section No.: 9.1.2
Title: SPENT FUEL STORAGE
Revision No., Date: 3, 07/01/81

Reactor Types: EVOLUTIONARY

Summary: Although the likelihood of the complete draining of the spent fuel pool was low, the use of high-density storage racks increased the probability of a zircaloy-cladding fire as compared with the use of low-density or open-frame racks. The staff concluded that the use of low-density storage racks was justified by a favorable value/impact ratio for new designs and recommended that EPRI make a commitment to use low-density storage racks, at least for the most recently discharged fuel. Therefore, the staff will expect the FDA/DC applicant to submit a design that uses low-density storage racks in the spent fuel pool for, as a minimum, the most recently discharged fuel.

Impact Location(s): Block(s) as follows:
From: Appendix B, Section 3.2.30

Impact Criteria: 1. *Staff position, guidance or requirement.*
3. Information that can be used for establishing criteria bases or licensing requirements for evolutionary reactors

Search Index: epri_eva
Search String: spent fuel pool

Consistency Check Information

Consistency Check Status: Retain Impact

Work Assignment No: 1340

1. Is it Adequately covered in the SRP?	Yes ___	No X
2. Retain as technical rationale for acceptance criteria?	Yes ___	No X
3. Was this potential impact incorrectly assigned to this SRP section?	Yes ___	No X
4. Should this potential impact be eliminated from further consideration for some other reason?	Yes ___	No X

SRP REPORT

FINAL DRAFT REVISION

SRP SECTION 9.1.2

SPENT FUEL STORAGE

CONSISTENCY REPORTS FOR RECENTLY DEVELOPED
POTENTIAL IMPACTS

Potential Impact/Section Consistency Report Worksheet

SRP Section: 9.1.2
Potential Impact Number: 23699
Type No: NRC BULLETIN 94-01

Consistency Check Information

Provide a 1 to 2 sentence discussion where appropriate, for each item below.

1. Is it adequately covered in the SRP? Yes___ No___

2. Should it be retained as technical rationale for acceptance criteria? Yes___ No___

3. Was the PI incorrectly assigned to this SRP section? Yes___ No___

4. Should this impact be eliminated from further consideration for some other reason? Yes_X_ No___

   Bulletin 94-01, Potential Fuel Draindown Caused By Inadequate Maintenance Practices at Dresden Unit 1, was issued to inform all licensees of the results of a special NRC inspection at Dresden Nuclear Power Station Unit 1 concerning conditions that resulted from freeze damage to service water piping. The investigation revealed that there was a potential for a portion of the system inside the containment to fail and result in partial draindown of the spent fuel pool. The bulletin also requested action of all holders of licenses for nuclear power reactors that are permanently shutdown with spent fuel in the spent fuel pool (except Shoreham).

   This bulletin does not establish new requirements or acceptance criteria. Even though some of the requested actions were considered backfits, these actions did not impose any new requirements. The requested actions resulted because established regulatory requirements exist but were not satisfied and, therefore, the backfits are to bring facilities into compliance with existing requirements.

Candidate for Integrated Impact Yes___ No_X_

Potential Impact/Section Consistency Report Worksheet

SRP Section: 9.1.2
Potential Impact Number: 24255
Type No: NRC BULLETIN 84-03

Consistency Check Information

Provide a 1 to 2 sentence discussion where appropriate, for each item below.

1. Is it adequately covered in the SRP? Yes___ No___

2. Should it be retained as technical rationale for acceptance criteria? Yes___ No___

3. Was the PI incorrectly assigned to this SRP section? Yes___ No___

4. Should this impact be eliminated from further consideration for some other reason? Yes_X_ No___

   Requested licensees and CP holders to evaluate the potential for, and consequences of, a refueling cavity water seal failure. No new requirements identified. (see related PIs 14697 and 15013).

Candidate for Integrated Impact Yes___ No_X_

SRP REPORT

FINAL DRAFT REVISION

SRP SECTION 9.1.2

SPENT FUEL STORAGE

RESEARCH/REGULATORY ACTION NEEDS
IPD 7.0 FORMS

Research/Regulatory Action Needs Form (IPD 7.0)

Need Number: INEL 9.1.2, R/R A-1

Need Title: Comparison study for ANS 57.2 and develop regulatory guide

Need Source: Integrated Impact No. 398 as a result of SRP-UDP activities

SRP Section(s): 9.1.2

Research Need	X	Rulemaking Need	___
Regulatory Guide Development/Revision Need	X	Other Regulatory Action Need	___
Codes/Standards Development Needs	___		

Description of Need: SRP Section 9.1.2, "Spent Fuel Storage," cites ANS 57.2, "Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations," as Specific Criteria related to meeting the requirements of General Design Criteria 2, 4, 61, 62, and 63 as they relate to protection of the stored spent fuel, prevention of criticality, radiological aspects of the design of a new fuel storage facility, and to monitoring requirements. A detailed comparison study of the current version of ANS 57.2 (1983) and the version in effect when Revision 3 of SRP Section 9.1.2 was issued should be performed to determine whether the current version should be endorsed by NRC.

The Staff position regarding ANS 57.2 is stated in Regulatory Guide 1.13, Proposed Revision 2 (12/81). However, Regulatory Guide 1.13 does not cite the current version of ANS 57.2. The regulatory guide should be revised to cite the current version and state the current staff position regarding ANS 57.2 as it relates to meeting the requirements of General Design Criteria 2, 4, 61, 62, and 63.

References: NUREG/CR-5973, Rev. 1, Codes and Standards and Other Guidance Cited in Regulatory Documents.

Analyst's Name (print): J. L. Edson

Signature _____ Date ___

Analyst's Supervisor's Approval _____ Date _____

ILPB Approval Yes _____ No _____

ILPB Signature _____ Date _____

Research/Regulatory Action Needs Form (IPD 7.0)

Need Number: INEL 9.1.2, R/R A-2

Need Title: Revise RG 1.13 to address high density storage racks

Need Source: Integrated Impact No. 399 as a result of SRP - UDP activities

SRP Section(s): 9.1.2

Research Need	___	Rulemaking Need	___
Regulatory Guide Development/Revision Need	X	Other Regulatory Action Need	___
Codes/Standards Development Needs	___		

Description of Need: The NRC staff in its review of the EPRI Evolutionary Plant, NUREG-1242-Vol 2., Section 3.2.30, stated that although the likelihood of complete draining of the spent fuel pool was low, the use of high-density storage racks increased the probability of a zircaloy-cladding fire as compared with the use of low-density or open-frame racks. The staff concluded that the use of low-density storage racks was justified by a favorable value/impact ratio. Consequently the staff expects an applicant to submit a design that uses low-density storage racks in the spent fuel pool for, as a minimum, the most recently discharged fuel.

Regulatory Guide 1.13, Proposed Revision 2, does not address the issue concerning the use of high density fuel storage racks. RG 1.13 should be revised to reflect the staff's position concerning the use of high density fuel storage racks.

References: NUREG-1242-Vol 2., NRC Review of Electric Power Research Institute's Advanced Light Water Reactor Utility Requirements Document.

Regulatory guide 1.13, Proposed Revision 2, Spent Fuel Storage Facility Design Basis.

Analyst's Name (print): J. L. Edson

Signature _____ Date: _____

Analyst's Supervisor's Approval _____ Date _____

ILPB Approval Yes _____ No _____

ILPB Signature _____ Date _____

SRP REPORT

FINAL DRAFT REVISION

SRP SECTION 9.1.2

SPENT FUEL STORAGE

ITEMS FOR FURTHER CONSIDERATION

Items for Further Consideration

1. Take a critical look at subparagraph 1.b under Review Interfaces. Does SRP Section 3.5.2 belong here? It appears, more logically, under subparagraph 1.c.

   Should SRP Sections 3.5.1.5 and 3.5.1.6 be included as review interfaces?

   Should SRP Section 3.5.1.3, with EMCB as the responsible review branch, be included under subparagraph 2?

2. Should SRP Section 9.1.4 be added as a review interface under subparagraph 1?

U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

9.1.2 SPENT FUEL STORAGE

REVIEW RESPONSIBILITIES

Primary - ~~Auxiliary~~Plant Systems Branch (~~ASB~~SPLB)[1]

Secondary - Civil Engineering and Geosciences Branch (ECGB)[2]
Materials and Chemical Engineering Branch (~~CMEB~~EMCB)[3]
Reactor Systems Branch (SRXB)[4]

I. AREAS OF REVIEW

Nuclear reactor plants include storage facilities for the wet storage of spent fuel assemblies. The safety function of the spent fuel pool and storage racks is to maintain the spent fuel assemblies in a safe and subcritical array during all credible storage conditions and to provide a safe means of loading the assemblies into shipping casks.

The ~~ASB~~SPLB[5] reviews the spent fuel storage facility design including the spent fuel storage racks, the spent fuel storage pool that contains the storage racks, the spent fuel pool liner plate, and the associated equipment storage pits to ~~assure~~ensure[6] conformance with the requirements of General Design Criteria 2, 4, 5, 61, 62, and 63.

1. The facility and components are reviewed with respect to the following:

   a. The quantity of fuel to be stored.

   b. The design and arrangement of the storage racks for maintaining a subcritical array during all conditions.

c. The degree of subcriticality provided along with the analysis and associated assumptions.

d. The effects of external loads and forces on the spent fuel storage racks, pool, and liner plate (e.g., safe shutdown earthquake, crane uplift forces, missiles, and dropped objects).

e. Design codes, materials compatibility, and shielding requirements.

f. The use of applicable codes and standards consistent with the assigned seismic classification.

~~2. The ASB review of the pool's water level control system, cleanup system and cooling system is performed with the spent fuel cooling system review in SRP Section 9.1.3.~~[7]

~~3. The ASB review of provisions to preclude dropping the spent fuel shipping cask into the pool are evaluated during the review of the cask loading pit area in SRP Section 9.1.5.~~[8]

Review Interfaces[9]

41.[10] ~~ASBSPLB~~[11] also performs the following reviews under the Standard Review Plan (SRP)[12] sections indicated:

a. Review of flood protection is performed under SRP Section 3.4.1.

b. Review of the protection against internally generated missiles as well as missiles generated by natural phenomena is performed under SRP Sections 3.5.1.1, 3.5.1.2, 3.5.2, and 3.5.1.4.

c. Review of structures, systems, and components to be protected against externally generated missiles is performed under SRP Section 3.5.2.

d. Review of the pool's water level control system, cleanup system and cooling system is performed with the spent fuel cooling system review in SRP Section 9.1.3.[13]

e. Review of provisions to preclude dropping the spent fuel shipping cask into the pool are evaluated during the review of the cask loading pit area in SRP Section 9.1.5.[14]

f. Review of fire protection is performed under SRP Section 9.5.1.[15]

g. Review of equipment qualification is performed under SRP Section 3.11.[16]

~~A secondary review is performed by the Chemical Engineering Branch (CMEB) and the results of its evaluation are used by ASB to complete the overall evaluation of the system. The CMEB reviews the compatibility and chemical stability of the materials wetted by the pool water. In addition, CMEB will verify that there are no potential mechanisms that will: (1) alter the dispersion of the strong fixed neutron absorbers incorporated in the design of the storage racks, and/or (2) cause physical distortion of the tubes retaining the stored fuel assemblies. The results of CMEB's evaluation are transmitted to ASB for inclusion in the spent fuel storage SER writeup.~~[17]

2.[18] In addition, ~~ASB~~SPLB[19] will coordinate reviews performed by other branches, and the results are used by ~~ASB~~SPLB[20] in the overall spent fuel storage evaluation. The coordinated reviews are as follows:

a.[21] The ~~Structural Engineering Branch (SEB)~~Civil Engineering and Geosciences Branch (ECGB)[22] determines the acceptability of the design analyses, procedures, and criteria used to established the ability of seismic Category I structures to withstand the effects of natural phenomena such as safe shutdown earthquakes (SSE), the probable maximum flood (PMF), and missiles as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.4.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.

b.[23] The ~~Core Performance Branch (CPB)~~Reactor Systems Branch (SRXB)[24] determines that the criticality limits are acceptable and in accordance with ANS 57.2[25] paragraphs 5.1.1.2.1 and 5.1.1.2.2 as part of its primary responsibility for SRP Section 4.3.

c.[26] The Mechanical Engineering Branch (~~MEB~~EMEB)[27] determines that the components 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.

d.[28] The ~~MEB~~EMEB[29] 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.

e. The EMEB reviews the seismic qualification of Category I instrumentations as part of its primary review responsibility for SRP Section 3.10.[30]

f.[31] The ~~Materials Engineering Branch (MTEB)~~ ECGB[32] verifies that inservice inspection requirements are met for system components as part of its primary review responsibility for SRP Section 6.6.

~~The review for Fire Protection, Technical Specifications, and Quality Assurance is coordinated and performed by the Chemical Engineering Branch, Quality Assurance Branch, and Licensing Guidance Branch as part of their~~

~~primary review responsibilities for SRP Sections 9.5.1, 16.0, and 17.0, respectively.~~[33]

g. The Technical Specifications Branch (TSB) coordinates and performs reviews of the proposed technical specifications as part of its primary review responsibility for SRP Section 16.0.[34]

h. The Quality Assurance and Maintenance Branch (HQMB) coordinates and performs reviews of quality assurance programs as part of its primary review responsibility for SRP Chapter 17.[35]

~~The Equipment Qualification Branch reviews the seismic qualification of Category I instrumentation 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.~~[36]

i. A secondary review is performed by the Materials and Chemical Engineering Branch (EMCB) and the results of its evaluation are used by SPLB to complete the overall evaluation of the system. The EMCB reviews the compatibility and chemical stability of the materials wetted by the pool water. In addition, EMCB will verify that there are no potential mechanisms that will: (1) alter the dispersion of the strong fixed neutron absorbers incorporated in the design of the storage racks, and/or (2) cause physical distortion of the tubes retaining the stored fuel assemblies. The results of EMCB's evaluation are transmitted to SPLB for inclusion in the spent fuel storage safety evaluation report (SER) writeup.[37]

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~~.[38]

II. ACCEPTANCE CRITERIA

Acceptability of the spent fuel storage facility design as described in the applicant's safety analysis report (SAR) is based on certain General Design Criteria and Regulatory Guides, and on independent calculations and staff judgments with respect to system functions and component selection. The design of the spent fuel storage facility is acceptable if the integrated design is in accordance with the following criteria:

1. General Design Criterion 2 (GDC 2),[39] as it relates to structures housing the facility and the facility itself being capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, and hurricanes. Acceptance for meeting this criterion is based on conformance to position ~~C.3~~C.2[40] of Regulatory Guide 1.13, the applicable portions of Regulatory Guide 1.29, Regulatory Guide 1.117, and ANS 57.2 paragraphs 5.1.1, 5.1.3, 5.1.12, 5.3.2, and 5.3.4.

2. General Design Criterion 4 (GDC 4),[41] as it relates to structures housing the facility and the facility itself being capable of withstanding the effects of environmental conditions and external missiles, and internally generated missiles, pipe whip, and jet impingement forces associated with pipe breaks, such that safety functions will not be precluded. Acceptance for meeting this criterion is based on meeting position ~~C.3~~C.2[42] of Regulatory Guide 1.13, Regulatory Guides 1.115 and 1.117, as well as appropriate paragraphs of ANS 57.2.

3. General Design Criterion 5 (GDC 5),[43] as it relates to shared structures, systems, and components important to safety being capable of performing required safety functions.

4. General Design Criterion 61 (GDC 61),[44] as it relates to the facility design for fuel storage and handling of radioactive materials. Acceptance for meeting this criterion is based on conformance to positions C.1 and C.4 of Regulatory Guide 1.13 and the appropriate paragraphs of ANS 57.2. Acceptance is also based on meeting the fuel storage capacity requirements noted in subsection III.1 of this SRP section.

5. General Design Criterion 62 (GDC 62),[45] as it relates to the prevention of criticality by physical systems or processes utilizing geometrically safe configurations. Acceptance for meeting this criterion is based on conformance to positions C.1 and C.4 of Regulatory Guide 1.13 and the appropriate paragraphs of ANS 57.2.

6. General Design Criterion 63 (GDC 63),[46] as it relates to monitoring systems provided to detect conditions that could result in the loss of decay heat removal capabilities, to detect excessive radiation levels, and to initiate appropriate safety actions. Acceptance for meeting this criterion is based on conformance with paragraph 5.4 of ANS 57.2.

Technical Rationale[47]

The technical rationale for application of these acceptance criteria to reviewing spent fuel storage is discussed in the following paragraphs:[48]

1. Compliance with GDC 2 requires that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as earthquake, tornado, hurricane, flood, tsunami and seiche without loss of capability to perform their safety functions.

   The function of the spent fuel storage facility is to maintain spent fuel in a subcritical array that can be adequately cooled during all credible storage conditions and to limit offsite exposures in the event of significant release of radioactive materials from the fuel. The requirements of GDC 2 are imposed to verify that the structures, systems,

and components of the spent fuel storage facility are designed to withstand the effects of natural phenomena that might occur at the plant site, thereby ensuring that spent fuel will be maintained in a subcritical array. Position C.2 of Regulatory Guide 1.13; the applicable portions of Regulatory Guide 1.29; Regulatory Guide 1.117; and ANS 57.2 paragraphs 5.1.1, 5.1.3, 5.1.12, 5.3.2, and 5.3.4, provide guidance acceptable to the staff for meeting these requirements.

Meeting the requirements of GDC 2 provides assurance that stored spent fuel will be maintained in a subcritical configuration that can be adequately cooled after a natural phenomena event.[49]

2. Compliance with GDC 4 requires that structures, systems, and components important to safety be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operations, maintenance, testing, and postulated accidents, including loss of coolant. This requirement includes protection against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids resulting from equipment failures and from events and conditions outside the nuclear power unit.

GDC 4 requires that a spent fuel storage facility provide a controlled environment that will facilitate maintaining the fuel in a coolable and subcritical geometry. In addition, the facility is required to protect the fuel from the effects of missiles and jet impingement forces associated with turbine failure, natural phenomena (including tornadoes), and pipe breaks. Position C.2 of Regulatory Guide 1.13, Regulatory Guides 1.115 and 1.117, and appropriate paragraphs of ANS 57.2 provide guidance acceptable to the staff for meeting this requirement.

Meeting the requirements of GDC 4 provides assurance that the spent fuel storage facility will contain radioactive materials and maintain a subcritical configuration that can be adequately cooled after being exposed to the effects of missiles and natural phenomena.[50]

3. Compliance with GDC 5 requires that structures, systems, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

GDC 5 requires that the fuel storage facility at multiple-unit sites either not be shared among the units or that those systems, structures, or components that are shared will be designed in such a manner that an accident at one facility will not significantly impair the ability of the remaining facility to protect spent fuel. Should an accident that causes damage to the fuel storage facility occur, spent fuel will be a potential

source of radioactive effluents. Therefore, spent fuel storage must be designed to minimize the likelihood of such an event.

Meeting the requirements of GDC 5 provides assurance that spent fuel will not become a source of radioactive effluents.[51]

4. Compliance with GDC 61 requires that fuel storage and handling, radioactive waste, and other systems that may contain radioactive materials be designed to ensure adequate safety under normal and postulated accident conditions.

GDC 61 applies to this SRP section because the reviewer evaluates inspection and testing of components, shielding for radiation protection, containment and filtering, testability of residual heat removal, and preventing the loss of fuel storage coolant inventory. Positions C.1 and C.4 of Regulatory Guide 1.13 and appropriate paragraphs of ANS 57.2 provide guidance acceptable to the staff for meeting the requirements of this criterion.

Meeting the requirements of GDC 61 provides assurance that criticality and releases of radioactive materials related to the storage and handling of spent fuel will be prevented.[52]

5. Compliance with GDC 62 requires that criticality in the fuel storage and handling system be prevented through the use of physical systems or processes, with preference given to the application of geometrically safe configurations.

The function of the spent fuel storage facility is to maintain spent fuel in a subcritical array that can be adequately cooled during all credible storage conditions and to limit offsite exposures in the event of significant release of radioactivity from the fuel. This role requires that the design of spent fuel storage use potential moderators to provide assurance that spacing be adequate to prevent criticality during earthquakes and flooding. The configuration of spent fuel storage must also prevent the insertion of a fuel assembly anywhere other than in a design location. Positions C.1 and C.4 of Regulatory Guide 1.13 and appropriate paragraphs of ANS 57.2 provide guidance acceptable to the staff for meeting the requirements of this criterion.

Meeting the requirements of GDC 62 provides assurance that criticality will be prevented in the spent fuel storage facility.[53]

6. Compliance with GDC 63 requires that appropriate systems be provided in fuel storage and radioactive waste systems, and associated handling areas, to detect conditions that may result in loss of residual heat removal capability and excessive radiation levels and to initiate appropriate safety actions.

GDC 63 requires that pool building radiation, pool level, and pool temperature monitoring be provided for the protection of personnel and to detect conditions that could result in the loss of decay heat removal capabilities. In addition, alarms and communications systems must be provided to alert personnel and provide for communications between fuel handling machines, refueling machines, and the control room. Paragraph 5.4 of ANS 57.2 provides guidance acceptable to the staff for meeting these requirements.

Meeting the requirements of GDC 63 provides assurance that residual heat removal will be adequately provided and that the release of radioactive materials will be prevented.[54]

III. REVIEW PROCEDURES

The procedures below are used during the construction permit (CP) application review to determine that the design criteria and bases and the preliminary design meet the acceptance criteria given in subsection II. For the review of the operating license (OL) application, the review procedures and acceptance criteria will be utilized to verify that the initial design criteria and bases have been appropriately implemented in the final design. The OL review includes verification that the content and intent of the technical specifications prepared by the applicant are in agreement with requirements for system testing, minimum performance, and surveillance developed as a result of the staff's review.

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 secondary review branch, ~~CMEB,~~EMCB,[55] will provide an input on a routine basis for those areas of review indicated in this SRP section. The primary reviewer (~~ASB~~SPLB)[56] obtains and uses such input as required to ~~assure~~ensure[57] that this review procedure is complete.

The review procedures given below are for a typical storage system. Any variance of the review, to take account of a proposed unique design, will be such as to ~~assure~~ensure[58] that the facility design conforms to the criteria in subsection II of this SRP section. The reviewer selects and emphasizes material from this SRP section as may be appropriate for a particular case.

1. The SAR is reviewed to determine that the design bases and facility description section indicates the storage capacity provided in the design. The minimum storage capacity in the spent fuel storage pool shall be in accordance with ANS 57.2 paragraph 5.1.15, i.e., for a single unit facility the storage capacity shall equal or exceed one full core discharge plus the maximum normal fuel discharge cycle; for a dual shared storage pool facility the storage capacity shall equal or exceed one full core discharge plus two normal fuel discharge cycles. Due to a lack of sufficient away-from-reactor (AFR) storage capacity, the industry trend has been to use high density storage racks. ~~ASB~~ SPLB[59] reviews high

density storage on a case-by-case basis. Low-density storage should be used, at a minimum, for the most recently discharged fuel to decrease the probability of igniting the zircaloy cladding in the event of draining the spent fuel pool.[60]

2. The information provided in the SAR relating to the facility design criteria, safety evaluation, system description, and the layout drawings for the spent fuel pool and storage racks is reviewed to verify that:

   a. Criticality information (including the associated assumptions and input parameters) in the SAR must show that the center-to-center spacing between fuel assemblies and any strong fixed neutron absorbers in the storage racks is sufficient to maintain the array, when fully loaded and flooded with nonborated water, in a subcritical condition. A K_{eff} not greater than 0.95 for this condition is acceptable.

   b. The design of the storage racks is such that a fuel assembly cannot be inserted anywhere other than in a design location.

   c. Failures of nonsafety-related systems or structures not designed to seismic Category I that are located in the vicinity of the spent fuel storage facility are reviewed to ~~assure~~ensure[61] that their failure will not cause an increase in K_{eff} to exceed the maximum allowable. The SAR description section, the general arrangement and layout drawings, and the tabulation of seismic design classifications for structures and systems are reviewed and evaluated to ~~assure~~ensure[62] that this condition is met. A statement in the SAR establishing the above condition as a design criterion is acceptable at the CP review stage.

   d. Design calculations should show that the storage racks and any anchorages can withstand the maximum fuel handling equipment uplift forces without an increase in K_{eff} or a decrease in pool water inventory. A statement in the SAR that excessive forces cannot be applied due to the design of the fuel handling equipment is acceptable if justification is presented. The evaluation procedures identified in SRP Sections 9.1.4 and 9.1.5 are used to validate this statement.

   e. Conventionally the plant's Technical Specification states that the weight of all loads being handled above stored spent fuel shall not exceed that of one fuel assembly and its associated handling tool. This weight and its normal carrying height above the storage racks establishes what was considered the upper bound on the potential energy available to damage the stored spent fuel if a load drop occurs. It has been subsequently noted that lighter loads handled at greater drop heights may have greater amounts of potential energy. Therefore, the following additional requirement is being

made. The licensee is required to demonstrate and the reviewer to verify that the available potential energy of all lighter loads, being handled above stored spent fuel, shall not exceed that of one fuel assembly and its associated handling tool when dropped from its normal operating height above stored spent fuel.

f. Sharing of storage facilities in multi-unit plants will not increase the potential for the loss of pool water or decrease the degree of subcriticality provided.

3. The reviewer verifies that the safety function of the facility will be maintained, as required, if the facility is subjected to adverse natural phenomena such as earthquakes, tornadoes, hurricanes, and floods. In making this determination, the reviewer considers the following points:

a. The facility design basis and criteria and the component classification tables are reviewed to verify that the spent fuel storage facility including the storage pool, pool liner, and racks have been classified and designed to seismic Category I requirements. The ~~ASB~~ SPLB[63] will accept a statement that the facility will be designed and constructed as a seismic Category I system (CP).

b. If the spent fuel pool liner plate will not be designed and constructed to seismic Category I requirements, the spent fuel pool liner plate is reviewed to verify that a failure of the liner plate as a result of an SSE will not cause any of the following:~~1~~

1. Significant releases of radioactivity due to mechanical damage to the fuel;

2. Significant loss of water from the pool which could uncover the fuel and lead to release of radioactivity due to heatup;

3. Loss of ability to cool the fuel due to flow blockage caused by a portion or one complete section of the liner plate falling on top of the fuel racks;

4. Damage to safety-related equipment as a result of the pool leakage, and

5. Uncontrolled release of significant quantities or radioactive fluids to the environs.

c. The essential portions of the spent fuel storage system are reviewed to verify that protection from the effects of floods, hurricanes, tornadoes, and internally or externally generated missiles is provided. Flood protection and missile protection criteria are discussed in sections of the SRP contained in Chapter 3. The

reviewer utilizes the information in those SRP sections, as appropriate, to ~~assure~~ensure[64] that the analyses presented are valid. ~~ASB~~SPLB[65] will accept a statement to the effect that the storage facility is located in a seismic Category I structure that is missile and flood protected.

4. The safe handling of spent fuel assemblies necessitates the underwater transfer of spent fuel between the respective areas of the plant including spent fuel cask loading area. The SAR is reviewed to verify that the design basis and facility description section has stated that a separate spent fuel shipping cask loading area (pit) has been provided adjacent to the spent fuel pool. The reviewer verifies that the loading pit has been designed so that the safety function of the integrated system will be maintained during adverse environmental conditions. In addition, the reviewer verifies that the following are included in the design:

   a. An interconnecting fuel transfer canal should be capable of being isolated from the fuel pool and cask loading area. A statement in the SAR that these features are included in the design is acceptable. The reviewer uses engineering judgment to ~~assure himself~~verify[67] that the means provided meet the stated intent.

   b. In regard to the handling of heavy loads, e.g., the spent fuel shipping cask in the vicinity of the spent fuel storage pool, the reviewer is required to establish and verify in SRP Section 9.1.5 that one of the alternative approaches described in Section 5 of NUREG-0612 has been satisfied. If Sections 5.1.1 and 5.1.6 of NUREG-0612 have not been met, the SAR safety evaluations, results of design calculations, and the general arrangement and layout drawings should show that the spent fuel loading ~~put~~pit[68] has been designed to withstand the loads from dropped heavy objects including the shipping cask, and that the loading area is not an integral part of the storage pool floor so that if a dropped object should breach the

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[1] ~~The implementation of this item reflects current regulatory practice. The methods of review described herein will be used in the evaluation of submittals for operating license or construction permit applications docketed after November 17, 1977, which is based on the first application to which this method was specifically applied. Implementation for applications docketed prior to November 17, 1977 is not considered necessary since stresses induced in the fuel pool liner plate welds due to an SSE will usually be well below the maximum allowable stress levels and therefore liner failure is not considered a likely event. Even in the event that a liner plate failed, it would not likely block the coolant outlet of spent fuel assemblies completely and sufficient cooling of stored spent fuel would be maintained. Therefore, the spent fuel pool liner plate seismic design is not considered a significant safety issue and backfit is not required.~~[66]

pit area, loss of fuel pool water would not result in an unacceptable level.

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[69]

IV. EVALUATION FINDINGS

The reviewer verifies that the information provided and ~~his~~ that the[70] review support conclusions of the following type, to be included in the staff's ~~safety evaluation report~~SER:[71]

> The spent fuel storage facility includes the spent fuel storage racks, the spent fuel storage pool that contains the storage racks, and the associated equipment storage pits. Based on the review of the applicant's proposed design criteria, design bases, and safety classification for the spent fuel storage facility and the provisions necessary to maintain a subcritical array, the staff concludes that the design of the spent fuel storage facility and supporting systems is in conformance with the Commission's regulations as set forth in General Design Criteria 2, 4, 5, 61, 62, and 63.
>
> This conclusion is based on the following:
>
> 1. The applicant has met the requirements of General Design Criterion 2 by conforming with position ~~C.3~~C.2[72] of Regulatory Guide 1.13 and the applicable portions of Regulatory Guides 1.29 and 1.117, as well as paragraphs 5.1.1, 5.1.3, 5.1.12, 5.3.2, and 5.3.4 of ANS 57.2.
>
> 2. The applicant has met the requirements of General Design Criterion 4 pertaining to the environmental and missile protection design basis by conforming to position ~~C.3~~C.2[73] of Regulatory Guide 1.13 and the applicable portions of Regulatory Guides 1.115 and 1.117, as well as appropriate paragraphs of ANS 57.2.
>
> 3. The applicant has met the requirements of General Design Criterion 5 since the failure of any portion of the shared spent fuel storage facility will not impair the ability of plants systems to perform their safety function.
>
> 4. The applicant has met the requirements of General Design Criteria 61 and 62 pertaining to fuel storage, handling, criticality, and

radioactivity control by conforming to positions C.1 and C.4 of Regulatory Guide 1.13 and the appropriate paragraphs of ANS 57.2.

5. The applicant has met the requirements of General Design Criterion 63 pertaining to monitoring the status of the stored spent fuel by conforming to paragraph 5.4 of ANS 57.2.

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[74]

V. IMPLEMENTATION

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

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[75] 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 on its evaluation of 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.[76]

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced NUREG and 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 4, "~~Environmental and Missile Design Bases~~Environmental and Dynamic Effects Design Bases."[77]

3. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."

4. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."

5. 10 CFR Part 50, Appendix A, General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handling."

6. 10 CFR Part 50, Appendix A, General Design Criterion 63, "Monitoring Fuel and Waste Storage."

7. Regulatory Guide 1.13, ~~"Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations."~~"Spent Fuel Storage Facility Design Basis."[78]

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

9. Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles."

10. Regulatory Guide 1.117, "Tornado Design Classification."

11. ANS 57.2/ANSI N210-1976, "Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations."

12. NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."

SRP Draft Section 9.1.2
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current PRB name and abbreviation	Changed PRB to Plant Systems Branch (SPLB).
2.	SRP-UDP format item	Added ECGB as an SRB per NRC guidance.
3.	Current SRP name and abbreviation	Updated SRB to Materials and Chemical Engineering Branch (EMCB).
4.	SRP-UDP format item	Added SRXB as an SRB per NRC guidance.
5.	Current PRB abbreviation	Changed PRB to SPLB.
6.	Editorial revision	Changed "assure" to "ensure."
7.	SRP-UDP format item	Removed section to reflect current SRP format.
8.	SRP-UDP format item	Removed section to reflect current SRP format.
9.	SRP-UDP format item	Added "Review Interfaces" to AREAS OF REVIEW and organized in numbered paragraph form to describe how SPLB reviews aspects of the new fuel storage facility design under other SRP sections and how branches support the review.
10.	SRP-UDP format item	Changed item number to reflect current SRP format.
11.	Current PRB abbreviation	Change PRB to SPLB.
12.	Editorial	Defined "SRP" as "Standard Review Plan."
13.	Current SPLB review responsibility	Changed the responsibility for this review from ASB to SPLB. Relocated the paragraph from Areas of Review in the current SRP section.
14.	Current SPLB review responsibility	Changed the responsibility for this review from ASB to SPLB. Relocated the paragraph from Areas of Review in the current SRP section.
15.	Current SPLB review responsibility	Modified to reflect review responsibility for SRP Section 9.5.1.
16.	Current SPLB review responsibility	Modified to reflect review responsibility for SRP Section 3.11.
17.	SRP-UDP format item	Removed section to reflect current SRP format.
18.	SRP-UDP format item	Added item number to reflect current SRP format.
19.	Current PRB abbreviation	Changed PRB to SPLB.
20.	Current PRB abbreviation	Changed PRB to SPLB.
21.	SRP-UDP format item	Added item number to reflect current SRP format.

Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
22.	Current ECGB review responsibility	Changed to reflect primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.4.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.
23.	SRP-UDP format item	Added item number to reflect current SRP format.
24.	Current SRXB review responsibility	Changed to reflect primary review responsibility for SRP Section 4.3.
25.	Integrated Impact No. 398	This standard is outdated. ANS 57.2/ANSI N210-1976 was revised in 1983 to ANSI/ANS-57.2-1983.
26.	SRP-UDP format item	Added item number to reflect current SRP format.
27.	Current PRB abbreviation	Changed PRB to EMEB.
28.	SRP-UDP format item	Added item number to reflect current SRP format.
29.	Current PRB abbreviation	Changed PRB to EMEB.
30.	Current EMEB review responsibility	Reflect review responsibility for SRP Section 3.10.
31.	SRP-UDP format item	Added item number to reflect current SRP format.
32.	Current SRP name and abbreviation	Modified to reflect the ECGB's primary review responsibility for SRP Section 6.6.
33.	SRP-UDP format item	Removed section to reflect current SRP format.
34.	SRP-UDP format item	Rewrote section to reflect current SRP format.
35.	SRP-UDP format item	Rewrote section to reflect current SRP format.
36.	SRP-UDP format item	Removed section to reflect current SRP format.
37.	SRP-UDP format item	Moved section to this location and revised to reflect current SRP format and review responsibilities.
38.	Editorial	Simplified for clarity and readability.
39.	Editorial	Introduced "GDC 2" as initialism for "General Design Criterion 2."
40.	Current Revision of RG 1.13	Changed to reflect paragraph number in current revision (Rev. 1) of RG 1.13.
41.	Editorial	Introduced "GDC 4" as initialism for "General Design Criterion 4."
42.	Current Revision of RG 1.13	Changed to reflect paragraph number in current revision (Rev. 1) of RG 1.13.
43.	Editorial	Introduced "GDC 5" as initialism for "General Design Criterion 5."

Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
44.	Editorial	Introduced "GDC 61" as initialism for "General Design Criterion 61."
45.	Editorial	Introduced "GDC 62" as initialism for "General Design Criterion 62."
46.	Editorial	Introduced "GDC 63" as initialism for "General Design Criterion 63."
47.	SRP-UDP format item, develop technical rationale	Added "Technical Rationale" to ACCEPTANCE CRITERIA and organized in numbered paragraph form to describe the basis for referencing the General Design Criteria.
48.	SRP-UDP format item, develop technical rationale	Added lead-in sentence for "Technical Rationale."
49.	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 2.
50.	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 4.
51.	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 5.
52.	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 61.
53.	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 62.
54.	SRP-UDP format item, develop technical rationale	Added technical rationale for GDC 63.
55.	Current SRB abbreviation	Changed SRB and review responsibility to EMCB.
56.	Current PRB abbreviation	Changed PRB to SPLB.
57.	Editorial revision	Changed "assure" to "ensure."
58.	Editorial revision	Changed "assure" to "ensure."
59.	Current PRB abbreviation	Changed PRB to SPLB.
60.	Integrated Impact No. 399	The staff concluded in NUREG-1242 (SER for the EPRI Evolutionary Plant) that the spent fuel storage design is to use low-density storage racks for, as a minimum, the most recently discharged fuel.
61.	Editorial revision	Changed "assure" to "ensure."
62.	Editorial revision	Changed "assure" to "ensure."
63.	Current PRB abbreviation	Changed PRB to SPLB.
64.	Editorial revision	Changed "assure" to "ensure."

Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
65.	Current PRB abbreviation	Changed PRB to SPLB.
66.	SRP-UDP format item	Deleted the footnote limiting certain review procedures to applications docketed after 1977.
67.	Editorial revision	Changed "assure himself" to "verify."
68.	Editorial revision	Corrected "put" to "pit."
69.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
70.	Editorial	Modified to eliminate gender-specific reference.
71.	Editorial	Used "SER" as previously defined in this SRP section.
72.	Current Revision of RG 1.13	Changed to reflect paragraph number in current revision (Rev. 1) of RG 1.13.
73.	Current Revision of RG 1.13	Changed to reflect paragraph number in current revision (Rev. 1) of RG 1.13.
74.	SRP-UDP Format Item, Implement 10 CFR 52 Related Changes	To address design certification reviews a new paragraph was added to the end of the Evaluation Findings. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items.
75.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
76.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
77.	Current Revision of 10 CFR Part 50, Appendix A	Updated title of GDC 4.
78.	Current Revision of RG 1.13	Change to reflect title of current revision (Rev. 1) of RG 1.13.

SRP Draft Section 9.1.2
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
398	Incorporates latest version of ANSI/ANS 57.2.	No change made. Endnote added to "Review Interface," item 2.b
399	Incorporates staff position concerning the use of high density storage racks.	Subsection III, REVIEW PROCEDURES, subparagraph 1
1168	Revise the Acceptance Criteria, Review Procedures, and Evaluation Findings as necessary to incorporate the guidance of the proposed draft Regulatory Guide CE-913 (proposed revision 2 to RG 1.13).	This is a placeholder integrated impact.

REGULATORY GUIDE 1.13

SPENT FUEL STORAGE FACILITY DESIGN BASIS

A. INTRODUCTION

General Design Criterion 61, "Fuel Storage and Handling Criteria for Nuclear Power Plants," of Appendix A, "General Design for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that fuel storage and handling systems be designed to assure adequate safety under normal and postulated accident conditions. It also requires that these systems be designed with appropriate containment, confinement, and filtering systems and be designed to prevent significant reduction in the coolant inventory of the storage facility under accident conditions. This guide describes a method acceptable to the NRC staff for implementing this criterion.

B. DISCUSSION

It is important that fuel handling and storage facilities be designed to:

a. Prevent loss of water from the fuel pool that would uncover fuel.

b. Protect the fuel from mechanical damage.

c. Provide the capability for limiting the potential offsite exposures in the event of significant release of radioactivity from the fuel.

If spent fuel storage facilities are not located within the primary reactor containment or provided with adequate protective features, radioactive materials could be released to the environs as a result of either loss of water from the storage pool or mechanical damage to fuel within the pool.

1. Loss of Water from Storage Pool

Unless protective measures are taken, loss of water from a fuel storage pool could cause overheating of the spent fuel and resultant damage to fuel adding integrity and could result in release of radioactive materials to the environment. Natural events, such as earthquakes or high winds, could damage the _____ either directly or by the generation of mis_____es. Earthquakes or high winds could also cause structures, cranes, etc., to fall into the pool. Designing the facility to withstand these occurrences without significant loss of watertight integrity would alleviate these concerns.

Dropping of heavy loads, such as a 100-ton fuel cask, _____ of low probability, cannot be ruled out in plant arrangements where such loads are positioned or moved in or over the fuel pool. Possible solutions to this potential problem include (1) preventing, preferably by design rather than interlocks, heavy loads from being lifted over the pool; (2) using a highly reliable handling system designed to prevent dropping of heavy loads as a result of any single failure; or (3) designing the pool to withstand dropping of the load without significant leakage from the pool area in which fuel is stored.

Even if the measures described above to prevent loss of leak-tight integrity are followed, small leaks may still occur as a result of structural failure or other unforeseen events. For example, equipment failures in systems connected to the pool could result in loss of water from

the pool if such loss is not prevented by design. A permanent fuel-pool-coolant makeup system with a moderate capability, and with suitable redundancy or backup, could prevent the fuel from being uncovered if such leaks should occur. Early detection of pool leakage and fuel damage could be provided by pool-water-level monitors and radiation monitors designed to alarm both locally and in a continuously manned location. Timely operation of building filtration systems can be assured by actuating these systems by a signal from local radiation monitors.

2. Mechanical Damage to Fuel

The release of radioactive material from fuel may occur during the refueling process, and at other times, as a result of fuel-cladding failures or mechanical damage caused by the dropping of fuel elements or the dropping of objects onto fuel elements.

Missiles generated by high winds can also be a potential cause of mechanical damage to fuel. Designing the fuel storage facility to prevent such missiles from contacting the fuel would eliminate this concern.

A relatively small amount of mechanical damage to the fuel might cause significant offsite doses if no dose reduction features are provided. Use of a controlled leakage building surrounding the fuel storatge pool, with associated capability to limit releases of radioactive material resulting from a refueling accident, appears feasible and would do much to eliminate this concern.

C. REGULATORY POSITION

1. The Spent fuel storage facility (including its structures and equipment except as noted in paragraph 6 below) should be designed to Category I seismic requirements.

2. The facility should be designed (a) to keep tornadic winds and missiles generated by these winds from causing significant loss of watertight integrity of the fuel storage pool and (b) to keep missiles generated by tornadic winds from contacting fuel within the pool.

3. Interlocks should be provided to prevent cranes from passing over stored fuel (or near stored fuel in a manner such that if a crane failed, the load could tip over on stored fuel) when fuel handling is not in progress. During fuel handling operations, the interlocks may be bypassed and administrative control used to prevent the crane from carrying loads that are not necessary for fuel handling over the stored fuel or other prohibited areas. The facility should be designed to minimize the need for bypassing such interlocks.

4. A controlled leakage building should enclose the fuel pool. The building should be equipped with an appropriate ventilation and filtration system to limit the potential release of radioactive iodine and other radioactive materials. The building need not be designed to withstand extremely high winds, but leakage should be suitably controlled during refueling operations. The design of the ventilation and filtration system should be based on the assumption that the cladding of all of the fuel rods in one fuel bundle might be breached. The inventory of radioactive materials available for leakage from the building should be based on the assumptions given in Regulatory Guide 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors" (Safety Guide 25).

5. The spent fuel storage facility should have at least one of the following provisions with respect to the handling of heavy loads, including the refueling cask:

a. Cranes capable of carrying heavy loads should be prevented, preferably by design rather than by interlocks, from moving into the vicinity of the pool; or

b. Cranes should be designed to provide single-failure-proof handling of heavy loads, so that a single failure will not result in loss of capability of the crane-handling system to perform its safety function; or

c. The fuel pool should be designed to withstand, without leakage that could uncover the fuel, the impact of the heaviest load to be carried by the crane from the maximum height to which it can be lifted. If this approach is used, design provisions should be made to prevent the crane, when carrying heavy loads, from moving in the vicinity of stored fuel.

6. Drains, permanently connected mechanical or hydraulic systems, and other features that by maloperation or failure could cause loss of coolant that would uncover fuel should not be installed or included in the design. Systems for maintaining water quality and quantity should be designed so that any maloperation or failure of such systems (including failures resulting from the Safe Shutdown Earthquake) will not cause fuel to be uncovered. These systems need not otherwise meet Category I seismic requirements.

7. Reliable and frequently tested monitoring equipment should be provided to alarm both locally and in a continuously manned location if the water level in the fuel storage pool falls below a predetermined level or if high local-radiation levels are experienced. The high-radiation-level instrumentation should also actuate the filtration system.

8. A seismic Category I makeup system should be provided to add coolant to the pool. Appropriate redundancy of a backup system for filling the pool from a reliable source, such as a lake, river, or onsite seismic Category I water-storage facility, should be provided. If a backup system is used, it need not be a permanently installed system. The capacity of the makeup systems should be such that water can be supplied at a rate determined by consideration of the leakage rate that would be expected as the result of damage to the fuel storage pool from the dropping of loads, from earthquakes, or from missiles originating in high winds.*

D. IMPLEMENTATION

Any of the alternatives in Regulatory Position C.5 of Revision 1 may be applied at the option of applicants for construction permits and operating licenses for all plants, regardless of the date of application.

*The staff is considering the development of additional guidance concerning protection against missiles that might be generated by plant failures such as turbine failures. For the present, the protection of the fuel pool against such missiles will be evaluated on a case-by-case basis.