United States Nuclear Regulatory Commission

Protecting People and the Environment

NUREG-1927

Standard Review Plan for Renewal of Independent Spent Fuel Storage Installation Licenses and Dry Cask Storage System Certificates of Compliance

Draft Report for Comment

Office of Nuclear Material Safety and Safeguards

United States Nuclear Regulatory Commission

Protecting People and the Environment

NUREG-1927

Standard Review Plan for Renewal of Independent Spent Fuel Storage Installation Licenses and Dry Cask Storage System Certificates of Compliance

Draft Report for Comment

Manuscript Completed: September 2009
Date Published: September 2009

Office of Nuclear Material Safety and Safeguards

ABSTRACT

This Standard Review Plan (SRP) is intended for use by the U.S. Nuclear Regulatory Commission (NRC) reviewer. It provides guidance for the safety review of license renewal applications for currently operating independent spent fuel storage installations and holders of a certificate of compliance (CoC) for a dry cask storage system (DCSS), as codified in Title 10 of the *Code of Federal Regulations* (10 CFR) 72.214, "List of Approved Spent Fuel Storage Casks." A license (site specific or general) authorizes a licensee to store spent fuel in an NRC-approved DCSS at a site under the requirements of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste." To renew a specific license, an applicant must submit a license renewal application at least 2 years before the expiration of the license, and not less than 30 days before the expiration date of the CoC, in accordance with the requirements of 10 CFR 72.42(b) and 10 CFR 72.240(b), respectively. The NRC may renew a specific license or a CoC for a term not to exceed 40 years.

The NRC may revise and update this SRP to clarify the content, correct errors, or incorporate modifications approved by the Division of Spent Fuel Storage and Transportation. Comments, suggestions for improvement, and notices of errors or omissions should be sent to the Director, Division of Spent Fuel Storage and Transportation, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

CONTENTS

ABSTRACT iii

CONTENTS v

ABBREVIATIONS vii

DEFINITIONS ix

INTRODUCTION 1

1.0 GENERAL INFORMATION REVIEW 5
- 1.1 Review Objective 5
- 1.2 Areas of Review 5
- 1.3 Regulatory Requirements 5
- 1.4 Review Guidance 6
  - 1.4.1 Licensee/Certificate of Compliance Holder Information 6
  - 1.4.2 Financial Information 6
  - 1.4.3 Environmental Report 7
  - 1.4.4 Application Content 7
- 1.5 Evaluation Findings 8

2.0 SCOPING EVALUATION 9
- 2.1 Review Objective 9
- 2.2 Areas of Review 9
- 2.3 Regulatory Requirements 9
- 2.4 Review Guidance 10
  - 2.4.1 Scoping Process 10
  - 2.4.2 SSCs Within the Scope of License Renewal 12
  - 2.4.3 SSCs Not Within the Scope of License Renewal 13
- 2.5 Evaluation Findings 13

3.0 AGING MANAGEMENT REVIEW 15
- 3.1 Review Objective 15
- 3.2 Areas of Review 15
- 3.3 Regulatory Requirements 15
- 3.4 Materials, Service Environment, Aging Effects, and Aging Management Activities 17
  - 3.4.1 Identification of Materials and Environment 17
  - 3.4.2 Identification of Aging Effects 17
  - 3.4.3 Aging Management Activity 17
  - 3.4.4 Evaluation Findings 18
- 3.5 Time-Limited Aging Management Analyses Evaluation 21
  - 3.5.1 Review Guidance 21
  - 3.5.2 Evaluation Findings 22
- 3.6 Aging Management Program 22
  - 3.6.1 Review Guidance 22

3.6.1.1 Aging Effects Subject to Aging Management 23
3.6.1.2 Prevention, Mitigation, Condition Monitoring, and Performance Monitoring Programs 24
3.6.1.3 Corrective Actions 25
3.6.1.4 Component-Specific Guidance 25
3.6.2 Evaluation Findings 25
3.7 Retrievability 25
3.7.1 Review Guidance 25
3.7.2 Evaluation Findings 25

APPENDIX A NONQUANTIFIABLE PHRASES (TERMS) A-1

APPENDIX B EXAMPLE OF INDEPENDENT SPENT FUEL STORAGE INSTALLATION MATERIALS AND COMPONENTS B-1

APPENDIX C EXAMPLE OF AGING MANAGEMENT REVIEW RESULTS C-1

APPENDIX D AGING EFFECTS TABLE D-1

APPENDIX E COMPONENT-SPECIFIC GUIDANCE E-1

LIST OF FIGURES vi

Figure A Chart of License Renewal Process 2

Figure 2.1 Flow Chart of Scoping Evaluation 11

Figure 3.1 Flow Chart of AMR Process 19

LIST OF TABLES vi

Table 1-1 Relationship of Regulations and General Information Review 6

Table 2-1 Relationship of Regulations and Scoping Review 9

Table 3-1 Relationship of Regulations and AMR 16

Table A-1 Screening Criteria for Nonquantifiable Phrases (Terms) A-2

Table B-1 Example of Materials and Components of Cask System B-2

Table C-1 AMR Results for the HSMs C-2

Table D-1 Aging Effects and Possible Mechanisms D-2

ABBREVIATIONS

AMA	aging management activity
AMP	aging management program
AMR	aging management review
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CC	criticality control
CFR	*Code of Federal Regulations*
CoC	certificate of compliance
DCSS	dry cask storage system
DSC	dry storage canister
ER	environmental report
FSAR	final safety analysis report
GTCC	greater-than-Class-C
HSM	horizontal storage module
HT	heat transfer
ISFSI	independent spent fuel storage installation
ISG	interim staff guidance
KSI	kips per square inch
N/A	not applicable
NRC	U.S. Nuclear Regulatory Commission
PB	pressure boundary
PM	NRC project manager
psig	pounds per square inch, gage
PVC	polyvinyl chloride

RS	radiation shielding
SAR	safety analysis report
SER	safety evaluation report
SRP	Standard Review Plan
SS	structural support
SSC	structure, system, and component
SST	stainless steel
TLAA	time-limited aging analysis
UFSAR	updated final safety analysis report

DEFINITIONS

Accident condition: The extreme level of an event or condition, for which there exist a specified resistance, limit of response, and requirement for a given level of continuing capability, which exceed off-normal events or conditions. Accident conditions include both design-basis accidents and the design basis for events and conditions caused by natural phenomena. **NUREG-1536, NUREG-1567**

Aging management activity (AMA): An application of either the aging management program (AMP) or time-limited aging analysis (TLAA) to provide reasonable assurance that the intended functions of structures, systems, and components (SSCs) of independent spent fuel storage installations (ISFSIs) are maintained under the licensing-basis conditions during the license renewal period.

Aging management program (AMP): A program for addressing aging effects that may include prevention, mitigation, condition monitoring, and performance monitoring.

Aging management review (AMR): An assessment that addresses aging effects that could adversely affect the ability of SSCs to perform their intended important-to-safety functions during the license renewal period.

Canister (in a dry cask storage system for spent nuclear fuel): A metal cylinder that is sealed at both ends and is used to perform the function of confinement, while a separate overpack performs the functions of shielding and protecting the canister from the effects of impact loading. **NUREG-1571**

Cask (in a dry cask storage system for spent nuclear fuel): A stand-alone device that performs the functions of confinement, radiological shielding, and physical protection of spent fuel during normal, offnormal, and accident conditions. See also, "Spent fuel 'storage cask' or 'cask'" below. **NUREG-1571**

Certificate of compliance (CoC) (in a dry cask storage system for spent nuclear fuel): The certificate, issued by the U.S. Nuclear Regulatory Commission (NRC), that approves the design of a spent fuel storage cask, in accordance with the provisions of Subpart L of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste." **10 CFR 72.3**

Confinement (in a dry cask storage system for spent nuclear fuel): The ability to prevent the release of radioactive substances into the environment. **NUREG-1571**

Confinement systems: Those systems, including ventilation, that act as barriers between areas containing radioactive substances and the environment. **10 CFR 72.3**

Controlled area: The area immediately surrounding an ISFSI over which the licensee exercises authority and within which it performs ISFSI operations. **10 CFR 72.3**

Criticality: The condition wherein a system or medium is capable of sustaining a nuclear chain reaction. **ASTM C-859**

Degradation: Any change in the properties of a material that adversely affects the behavior of that material; adverse alteration. **ASTM C-1174**

Design basis: Information that identifies the specific function(s) to be performed by SSCs and the specific values chosen for controlling parameters as reference bounds for design. These values may be: (1) restraints, derived from generally accepted "state-of-the-art" practices for achieving functional goals, or (2) requirements, derived from analysis (based on calculation, experiments, or both) of the effects of a postulated accident, for which SSCs must meet their functional goals. **10 CFR 50.2**

Dry cask storage system: A dry cask storage system (DCSS) is any system that uses a cask or canister as a component in which to store spent nuclear fuel without using water to remove decay heat. A DCSS provides confinement, radiological shielding, physical protection, and inherently passive cooling of its spent nuclear fuel during normal, offnormal, and accident conditions. **NUREG-1571**

Dry storage: The storage of spent nuclear fuel after removal of the water from the fuel, cladding, and all components of a DCSS, and after the atmosphere has been replaced with an inert atmosphere. **ASTM C-1562-03**

General license: A general license authorizes a nuclear power plant licensed under 10 CFR Part 50. "Domestic Licensing of Production and Utilization Facilities," or 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," to store spent nuclear fuel in an ISFSI at a power reactor site. The general license is limited to that spent fuel that the general licensee is authorized to possess at the site under the specific license for the site, and to the storage of spent fuel in NRC-approved casks. **10 CFR 72.210, 10 CFR 72.212, NUREG-1536**

Independent spent fuel storage installation (ISFSI): A complex designed and constructed for the interim storage of spent nuclear fuel, solid reactor-related greater-than-Class-C (GTCC) waste, and other radioactive materials associated with spent fuel and reactor-related GTCC waste storage. **10 CFR 72.3**

Monitoring: Testing and data collection to determine the status of a DCSS, ISFSI, or both, and to verify the continued efficacy of the system, on the basis of measurements of specified parameters, including temperature, radiation, functionality, and characteristics of components of the system. **NUREG-1536**

Normal events or conditions: The maximum level of an event or condition expected to routinely occur. **NUREG-1536**

Offnormal events or conditions: The maximum level of an event that, although not occurring regularly, can be expected to occur with moderate frequency and for which there is a corresponding maximum specified resistance, limit of response, or requirement for a given level of continuing capability (similar to Design Event II of American National Standards Institute/American Nuclear Society 57.9, "Design Criteria for an Independent Spent Fuel Storage. Installation (Dry Type)"). **NUREG-1536**

Radiation shielding: Barriers to radiation that are designed to meet the requirements of 10 CFR 72.104(a), 10 CFR 72.106(b), and 10 CFR 72.128(a)(2).

Retrievability: The ability to remove spent nuclear fuel from storage without the release of radioactive materials to the environment or radiation exposures in excess of the limits in 10 CFR Part 20, "Standards for Protection against Radiation"; 10 CFR 72.122(l); and 10 CFR 72.236(m). Additional staff guidance on the subject of fuel retrievability appears in the latest revision of Interim Staff Guidance 2, "Fuel Retrievability," issued by the Division of Spent Fuel Storage and Transportation.

Safety analysis report (SAR): The document that a DCSS vendor or site-specific ISFSI licensee supplies to the NRC for analysis and confirmatory calculations. For site-specific ISFSI license renewals, the SAR must contain information required in 10 CFR 72.24, "Contents of Application; Technical Information." For CoC renewals, the SAR must meet the requirements of 10 CFR 72.240(b). The SAR provides references and drawings of the DCSS, ISFSI, or both; details of construction; materials; and standards to which the device has been designed. **NUREG-1571**

Safety evaluation report (SER): The document that the NRC publishes at the completion of an SAR review. It contains all of the findings and conclusions from the evaluation of the submitted SAR. **NUREG-1571**

Service conditions: Conditions (e.g., time of service, temperatures, environmental conditions, radiation, and loading) that a component experiences during storage. **ASTM C-1562-03**

Site-specific license: A license for the receipt, handling, storage, and transfer of spent fuel or high-level radioactive waste, or reactor-related GTCC waste that is issued to a named person, on an application filed pursuant to regulations in 10 CFR Part 72. **10 CFR 72.6**

Spent fuel "storage cask" or "cask": All the components and systems associated with the container in which spent fuel or other radioactive materials associated with spent fuel are stored in an ISFSI. **10 CFR 72.3**

Spent nuclear fuel or spent fuel: Fuel that has been withdrawn from a nuclear reactor after irradiation, has undergone at least a 1-year decay process since being used as a source of energy in a power reactor, and has not been chemically separated into its constituent elements by reprocessing. Spent fuel includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies. **10 CFR 72.3**

Structures, systems, and components (SSCs) important to safety: Those features of the ISFSI and spent fuel storage cask with one of the following functions:

(1) to maintain the conditions required to safely store spent fuel, high-level radioactive waste, or reactor-related GTCC waste

(2) to prevent damage to the spent fuel, the high-level radioactive waste, or reactor-related GTCC waste container during handling and storage

(3) to provide reasonable assurance that spent fuel, high-level radioactive waste, or reactor-related GTCC waste can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public. **10 CFR 72.3**

Thermal performance: Heat-removal capability having testability and reliability consistent with its importance to safety. **10 CFR 72.128**

Time-limited aging analysis (TLAA): A licensee or CoC holder calculation or analysis that has the following attributes:

(1) involve SSCs within the scope of license or CoC renewal

(2) consider the effects of aging

(3) involve time-limited assumptions defined by the current operating term; for example, 40 years

(4) were determined to be relevant by the licensee or CoC holder in making a safety determination

(5) involve conclusions or provide the basis for conclusions related to the capability of the SSCs to perform their intended functions

(6) are contained or incorporated by reference in the design basis. **10 CFR 54.3**

Transfer cask: A shielded enclosure required to transfer the fuel canister between the spent fuel handling area and the storage area.

INTRODUCTION

This Standard Review Plan (SRP) is intended to provide procedural guidance to the U.S. Nuclear Regulatory Commission (NRC) reviewer conducting the safety review of license renewal applications for currently operating independent spent fuel storage installations (ISFSIs), and holders of certificates of compliance (CoCs) for dry cask storage systems (DCSSs), as codified in Title 10 of the *Code of Federal Regulations* (10 CFR) 72.214, "List of Approved Spent Fuel Storage Casks." A license (site specific or general) authorizes a licensee to store spent fuel in an NRC-approved DCSS at a site under the requirements of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste."

To renew a specific license or a CoC, an applicant must submit a license renewal application before the expiration of the license or the CoC, in accordance with the requirements of 10 CFR Part 72. The NRC may renew a specific license or a CoC for a term not to exceed 40 years. Both the license and the CoC renewal applications must contain revised technical requirements and operating conditions (fuel storage, surveillance and maintenance, and other requirements) for the ISFSI or DCSS that address aging effects that could affect the safe storage of the spent fuel and must specify what the licensee of an ISFSI, or the holder of a CoC for a DCSS, is authorized to store.

The CoCs listed in 10 CFR 72.214 are generic designs that any 10 CFR Part 72 general licensee may use in accordance with 10 CFR 72.212, "Conditions of General License Issued Under § 72.210." If the CoC holder chooses not to apply for the renewal of a particular CoC or is no longer in business, a general licensee may apply for renewal of the CoC in its place.

This SRP defines an acceptable method for satisfying the applicable regulatory requirements; it is not a regulatory requirement. An applicant may propose, for staff review, other means for satisfying the appropriate regulatory requirements. However, deviation from this guidance in whole or in part may result in an extended staff review schedule.

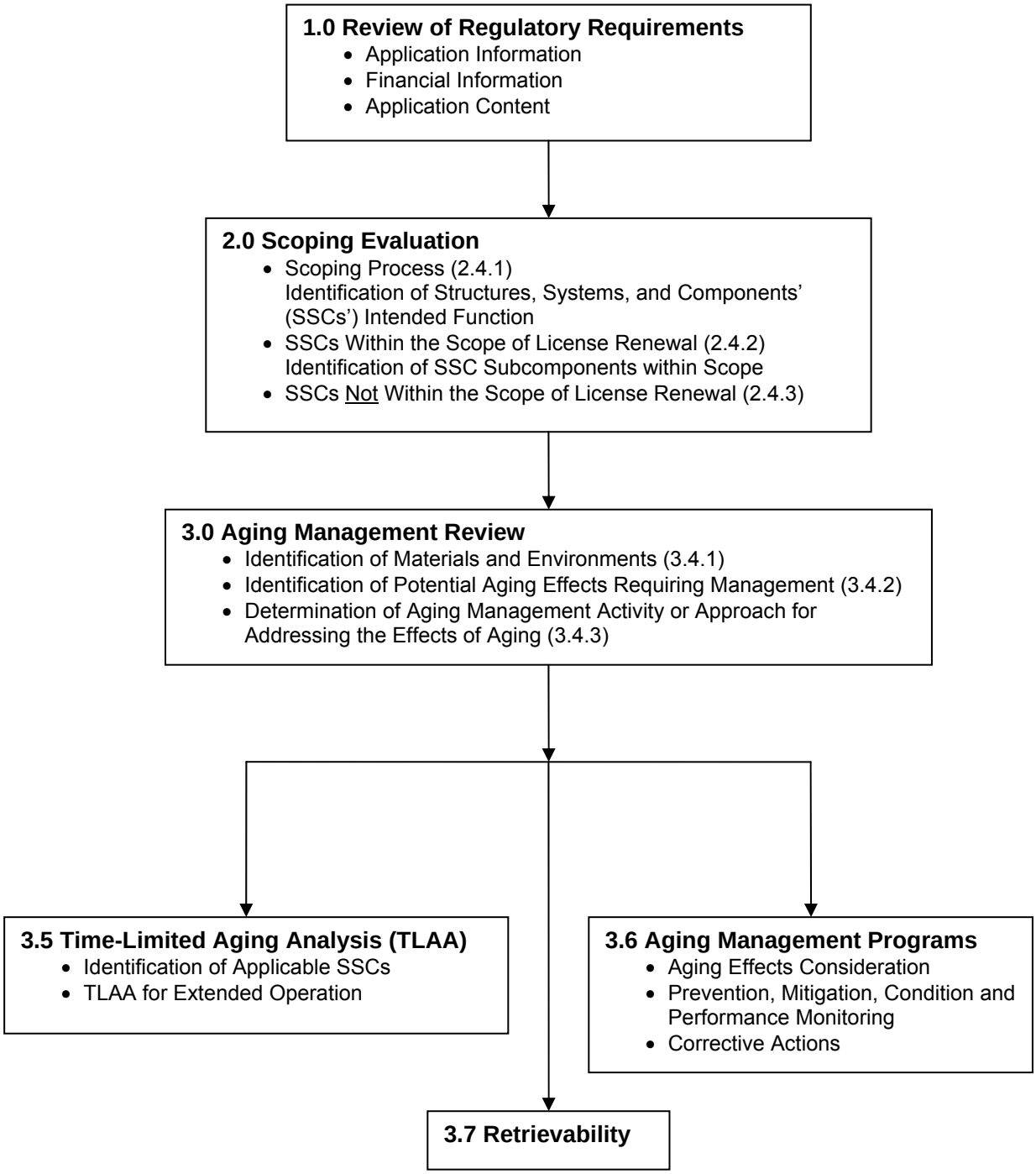
The NRC may revise and update this SRP to clarify the content, correct errors, or incorporate modifications approved by the Division of Spent Fuel Storage and Transportation. Comments, suggestions for improvement, and notices of errors or omissions will be considered by, and should be sent to, the Director, Division of Spent Fuel Storage and Transportation, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

This guidance document is not intended to be used for the review of other 10 CFR Part 72 renewal applications, such as for wet storage facilities or monitored retrievable storage facilities.

The renewal technical review is primarily a materials engineering effort. The materials discipline should coordinate its review of the renewal application with the structural, health physics, thermal, criticality, and quality assurance disciplines, as appropriate, to help ensure that the reviewer has addressed all relevant aspects of the application and review.

Figure A is a flow chart of the license renewal process.

Figure A Chart of license renewal process



Standard Review Plan Structure

Each chapter of this SRP contains the following sections:

Review Objective: This section provides the purpose and scope of the review and establishes the major review objectives for the chapter. It also discusses the information needed, or coordination expected, from other NRC reviewers to complete the technical review.

Areas of Review: This section describes the SSCs, analyses, data, or other information, and their sequence in the discussion of acceptance criteria.

Regulatory Requirements: This section summarizes the regulatory requirements in 10 CFR Part 72 pertaining to the scoping process, aging management review (AMR), and aging management activities, and they include the time-limited aging analyses (TLAA) review. This list is not all-inclusive, since some parts of the regulations, such as 10 CFR Part 20, "Standards for Protection against Radiation," are assumed to apply to all chapters of the safety analysis report (SAR). The reviewer should read the complete language of the current version of 10 CFR Part 72, as well as applicable interim staff guidance (ISG) documents, to determine the proper set of regulations for the section being reviewed.

Review Guidance: The review guidance identifies the type and level of information that the application should include. ISGs contain supplemental information that clarifies important aspects of the regulatory requirements and may specify review procedures. For this reason, the reviewer should use the ISGs to enhance the review procedures specified in this SRP.

Evaluation Findings: This section provides sample summary statements for evaluation findings to be incorporated into the safety evaluation report (SER) for each area of review. The reviewer prepares the evaluation findings based on the satisfaction of the regulatory requirements. The NRC publishes the findings in the SER.

Paperwork Reduction Act Statement

This NUREG contains information collection requirements that are subjected to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). The Office of Management and Budget (OMB) approved these information collections under OMB control numbers 3150-0132.

Public Protection Notification

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

1. GENERAL INFORMATION REVIEW

1.1 Review Objective

The purpose of the general information review is to ensure that the license or CoC renewal application meets the requirements of Section 1.3 below.

1.2 Areas of Review

The NRC project manager (PM) should review the general description to ensure that the applicant has included information regarding the description of the licensee or CoC holder, the financial standing of the licensee or CoC holder, the application content, and an environmental assessment. Areas of review addressed in this chapter include the following:

- licensee/CoC holder information
- financial information
- application content
- environmental assessment

Areas specifically excluded from the renewal review include the following:

- SSCs associated with physical protection of the ISFSI or DCSS, pursuant to 10 CFR Part 72, Subpart H, “Physical Protection”

- SSCs associated with the ISFSI emergency plan, pursuant to 10 CFR 72.32, “Emergency Plan”

1.3 Regulatory Requirements

The applicant and the NRC reviewer should consult the most current edition of 10 CFR Part 72 to verify that the application complies with the most current regulatory requirements. Table 1-1 presents a matrix that identifies the specific regulatory requirements pertaining to application content, licensee information, financial information, and the environmental report (ER).

Table 1-1 Relationship of Regulations and General Information Review

Areas of Review	10 CFR Part 72 Regulations[1]						
	72.2 (a)(1)	72.22 (a), (b), (c), (d)	72.22 (e)	72.34	772.48	72.122	72.240 (b), (c)
Application Content	●				●		●
Licensee Information		●					
Financial Information			●				
Environmental Report				●		●	

[1] The requirements of 10 CFR 72.22, "Contents of Application: General and Financial Information," and 10 CFR 72.34, "Environmental Report," apply only to site-specific license renewals. The requirements of 10 CFR 72.240, "Conditions for Spent Fuel Storage Cask Reapproval," apply only to CoC renewals.

1.4 Review Guidance

The following subsections contain review procedures. Sections 1.4.1 to 1.4.3 below apply only to site-specific ISFSI licenses.

1.4.1 Licensee/Certificate of Compliance Holder Information

The PM should ensure that the licensee has provided information pursuant to 10 CFR 72.22, including the licensee's full name, address, and description of the business or occupation. If the licensee is an individual, the application should specify the licensee's citizenship and age. If the licensee is a partnership, the application should identify the name, citizenship, and address of each partner and the principal location at which the partnership does business. If the licensee is a corporation or an unincorporated association, the application should specify the State in which it is incorporated or organized and the principal location at which it does business, along with the names, addresses, and citizenships of its directors and principal officers. If the licensee is acting as an agent or representative of another person in filing the application, the application should provide the above information for the principal. If the licensee is the U.S. Department of Energy, then the application should specify the organization responsible for the construction and operation of the ISFSI and describe any delegations of authority and assignments of responsibilities.

1.4.2 Financial Information

The scope of this SRP does not include specific guidance for reviewing financial information. Financial reviews should be coordinated with the Office of Nuclear Reactor Regulation.

The PM should ensure that the renewal application contains financial data, pursuant to 10 CFR 72.22(e), which show that the licensee can carry out the activities being sought for the requested duration. Information should state where the activity will be performed, the general plan for carrying out the activity, and the period of time for which the license is requested. The PM should ensure that the renewal application is based on the current design basis only and

does not include additional construction costs beyond the current design basis. The application should identify other costs related to activities associated with managing aging effects, and it should identify operating and decommissioning costs, for an ISFSI, that have been revised from those specified in the original license application for construction, operation, and decommissioning.

1.4.3 Environmental Report

The PM should ensure that license renewal application contains an ER, as required by 10 CFR 51.60, "Environmental Report—Materials Licenses," and 10 CFR 72.34. The supplemental report may be limited to incorporating, by reference, updates, or supplements to the information previously submitted to reflect any significant environmental changes, including those that may result from operating experience, a change in operations, or proposed decommissioning activities. If applicable, the ER should include operating experience during the initial licensing period, as well as reasonable assurance that SSCs that are important to safety performed their intended functions under postulated extreme loading events.

As required by 10 CFR 51.45(c), the ER should contain sufficient data to aid the Commission in its development of an independent analysis.

The technical review of the ER should be coordinated with the Office of Federal and State Materials and Environmental Management Programs and, if necessary, the Office of Nuclear Reactor Regulation.

1.4.4 Application Content

The PM or reviewer should verify that the renewal application contains all of the following sections:

- General Information
- Scoping Evaluation
- Aging Management Review
- Time-Limited Aging Analyses
- Aging Management Program
- additional information related to the updated final safety analysis report (UFSAR) and changes or additions to technical specifications

If size reduction of drawings has made any information unclear or illegible, the PM should ask the applicant for larger or full-size drawings. Particular attention should be devoted to ensuring that dimensions, materials, and other details on the drawings are consistent with those described in both the text of the SAR supplement and those used in supplementary analyses. All dimensions indicated on drawings should include tolerances that are consistent with the evaluation.

If changes have occurred in the design of the SSCs (i.e., through the application of 10 CFR 72.48, "Changes, Tests, and Experiments") of the ISFSI or DCSS, then the reviewer should verify that the applicant has updated the appropriate drawings to reflect these changes. Reviewers should be familiar with NUREG/CR-5502, "Engineering Drawings for 10 CFR Part 71 Package Approvals," issued May 1998. Although NUREG/CR-5502 was developed for transportation packages, the criteria for drawings can be applied to the renewal of an ISFSI license or DCSS CoC.

If the applicant provided drawings and descriptions as proprietary information in the application and requested them to be withheld from the public, these sketches, drawings, diagrams, and information must be annotated as proprietary, in accordance with the requirements of 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding."

A license or CoC renewal request should not include any changes to the current design basis. Changes to the design basis must be requested through a separate license or CoC amendment process.

1.5 Evaluation Findings

The reviewer prepares the evaluation findings based on satisfaction of the regulatory requirements in Section 1.4. The evaluation findings should be similar in wording to the following examples:

F1.1 The staff finds that the information presented in the renewal application satisfies the requirements of 10 CFR 72.2, 72.22; 72.48, and 72.240; as applicable.

F1.2 The staff finds that a tabulation of all supporting information and docketed material incorporated by reference has been provided, in compliance with 10 CFR 72.42 or 10 CFR 72.240, as applicable.

The reviewer should make a summary statement similar to the following:

> The staff has reviewed the ISFSI or DCSS descriptions presented in Chapter I of the SAR and supplemental documentation and finds that there is sufficient detail to meet the requirements of 10 CFR Part 72.

2. SCOPING EVALUATION

2.1 Review Objective

The scoping process should identify the SSCs of the ISFSI or DCSS that should be reviewed for aging effects.

2.2 Areas of Review

The reviewer should ensure that the licensee has included information about the following areas of review:

- scoping process
- SSCs within the scope of license renewal
- SSCs not within the scope of license renewal

2.3 Regulatory Requirements

The NRC bases a license or CoC renewal on the continuation of the existing design basis throughout the period of extended operation and on the maintenance of the intended functions of the SSCs. The NRC does not intend a license or CoC renewal to be a vehicle for imposing new regulatory requirements, unless it identifies new safety-related deficiencies. In this case, the NRC may require changes to the design basis, which would be dispositioned through the license or CoC amendment process. The renewal process cannot be used to facilitate approval of design changes.

Table 2-1 presents a matrix of regulatory requirements for license renewal.

Table 2-1 Relationship of Regulations and Scoping Review

Areas of Review	10 CFR Part 72 Regulations[2]						
	72.3	72.24 (g)	72.24 (b), (c), (d)	72.42 (b)	72.120 (a), (d)	72.122 Applicable Sections	72.236 Applicable Sections
Scoping Process		●		●			●
SSCs Within the Scope of License/CoC Renewal	●	●	●		●	●	●
SSCs Not Within the Scope of License Renewal		●	●		●	●	

[2] The requirements of 10 CFR 72.24, "Contents of Application: Technical Information"; 10 CFR 72.42, "Duration of License; Renewal"; and 10 CFR 72.120, "General Considerations," apply only to site-specific license renewals. The requirements of 10 CFR 72.236, "Specific Requirements for Spent Fuel Storage Cask Approval and Fabrication," apply only to CoC renewals.

2.4 Review Guidance

The following subsections contain review procedures.

Refer to Appendix A for assessing nonquantifiable phrases and terms.

2.4.1 Scoping Process

Figure 2.1 provides a flow chart of the scoping evaluation process. The reviewer should ensure that the application provides documentation of the scoping process (usually performed as a scoping study) that includes the following:

- a description of the scoping process and methodology for the inclusion of SSCs in the renewal scope
- a list of the SSCs (and appropriate subcomponents) that are identified as within the scope of renewal, their intended function, and safety classification or basis for inclusion in the renewal scope (see Appendix B for typical SSC classification)
- a list of the sources of information used
- any discussion needed to clarify the process, SSC designations, or sources of information used

Sources that may support the scoping process may include the following:

- SARs (including final SARs (FSARs), UFSARs, and topical SARs)
- technical specifications
- operating procedures
- regulatory compliance reports, including SERs
- design-basis documents
- drawings
- quality assurance plan or program
- docketed correspondence
- operating experience reports
- 10 CFR 72.48 evaluations
- vendor information

NUREG/CR-6407, "Classification of Transportation Packaging and Dry Spent Fuel Storage System Components According to Importance to Safety," issued February 1996, contains additional guidance describing SSCs that may be included within the scope of license renewal. Section 3 defines the classification categories, and Section 6 discusses the classification of storage components. Note that the design basis for an ISFSI or DCSS may provide for classifications of SSCs that differ from those in NUREG/CR-6407.

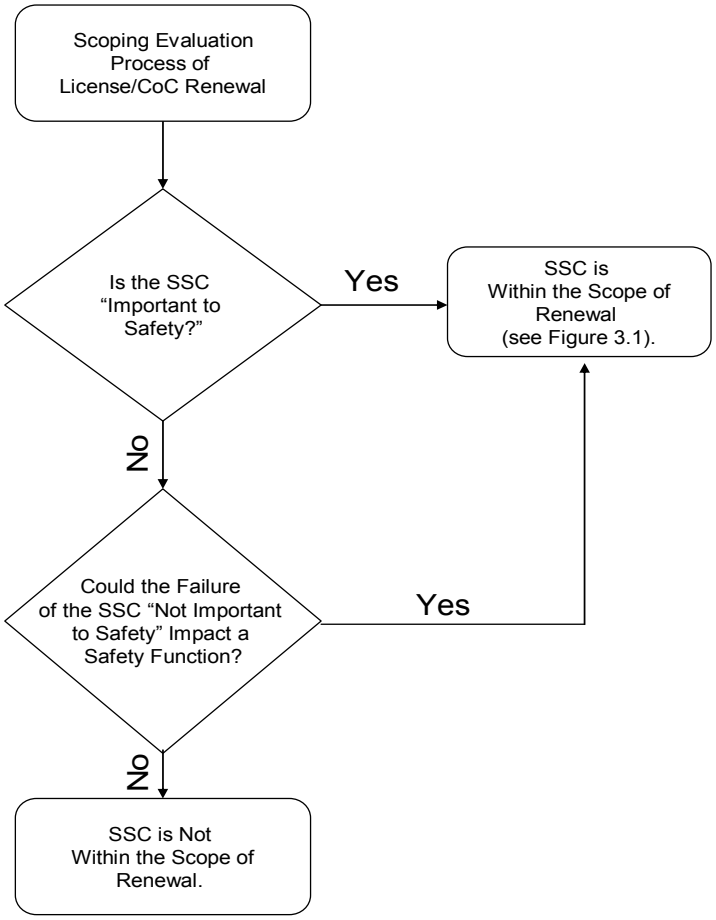


Figure 2.1 Flow chart of scoping evaluation

2.4.2 SSCs Within the Scope of License Renewal

The reviewer should verify that the SSCs within the scope of renewal fall into the following scoping categories:

(1) They are classified as important to safety, as they are relied on to do one of the following:

– Maintain the conditions required by the regulations, license, or CoC to store spent fuel safely.

– Prevent damage to the spent fuel during handling and storage.

– Provide reasonable assurance that spent fuel can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public, as identified in the design basis.

These SSCs ensure that important safety functions are met for: (1) criticality, (2) shielding, (3) confinement, (4) heat transfer, (5) structural integrity, and (6) retrievability.

(2) They are classified as not important to safety but, according to the design basis, their failure could prevent fulfillment of a function that is important to safety, or their failure as support SSCs could prevent fulfillment of a function that is important to safety.

(3) They are identified as in-scope subcomponents.

The in-scope SSCs are further reviewed to identify and describe the subcomponents that support the intended function(s) of the SSCs. The intended function(s) of the subcomponents are the specific function(s) that support the safety function(s) of SSCs of which they are a part. The intended function(s) of subcomponents may include the following:

- providing criticality control of spent fuel
- providing heat transfer
- directly or indirectly maintaining a pressure boundary
- providing radiation shielding
- providing structural support, functional support, or both, to SSCs that are important to safety

It should be noted that the fuel pellet is not within the scope of renewal.

Most storage pads are not within the scope of license renewal because they are not important to safety. For storage pads considered within the scope of license renewal, the staff should review

the applicant's assessment that the inspection program considers the effects of aging, as identified in Table C-1 in Appendix C.
Table B-1 in Appendix B provides an example of SSCs that the scoping evaluation may consider.

2.4.3 SSCs Not Within the Scope of License Renewal

For those SSCs that are not within the scope of renewal, the reviewer should verify that these SSCs do not fall into either of the categories shown in Section 2.4.2, above. SSCs that perform support or nonsafety-related functions are generally not within the scope of renewal.

The following nonsafety-related SSCs may be eliminated from the scope, provided they do not meet scoping Category 2 in Section 2.4.2, above:

- equipment associated with cask loading and unloading, such as: (1) welding and sealing equipment; (2) lifting rigs and slings; (3) vacuum-drying equipment; (4) transfer cask and transporter devices; (5) portable radiation survey equipment; and (6) other tools, fittings, hoses, and gauges associated with cask loading and unloading

- SSCs associated with physical protection of the ISFSI, pursuant to 10 CFR Part 72, Subpart H

- SSCs associated with the ISFSI emergency plan, pursuant to 10 CFR 72.32

- miscellaneous hardware that does not support or perform any function that is important to safety

- the ISFSI concrete pad, which is generally not within scope unless the pad provides a safety function during a seismic event

2.5 Evaluation Findings

The reviewer prepares the evaluation findings based on satisfaction of the regulatory requirements described in Section 2.4. The evaluation findings should be similar in wording to the following examples:

F2.1 The staff finds that the applicant has identified all SSCs important to safety and SSCs, the failure of which could prevent a function that is important to safety from being fulfilled, per the requirements of 10 CFR 72.3, 10 CFR 72.24, 10 CFR 72.120, 10 CFR 72.122, and 10 CFR 72.236, as applicable.

F2.2 The staff finds that the justification for any SSC determined not to be within the scope of the license renewal is reasonable and acceptable.

3. AGING MANAGEMENT REVIEW

3.1 Review Objective

The purpose of the AMR is to assess the SSCs determined to be within the scope of renewal. The AMR addresses aging effects that could adversely affect the ability of the SSCs to perform their intended functions during the renewal period. The reviewer should verify that the renewal application includes specific information that clearly describes the AMR performed on the in-scope SSCs.

An ISFSI or DCSS is composed of passive SSCs. The degradation of passive SSCs may not be as readily apparent as the degradation of active SSCs. Therefore, to manage the effects of aging, an AMR must be conducted to identify adverse effects that could affect SSCs during the renewal period.

3.2 Areas of Review

The AMR in the renewal application should be reviewed in the context of the following areas:

- identification of materials and environments for those SSCs and associated subcomponents determined to be within scope
- identification of aging effects requiring management
- determination of the type of program for managing the effects of aging
- review of TLAAs

Figure 3.1 contains a flow chart for the AMR process. The UFSAR and supporting documents related to the design are the primary documents that describe the safety classification, intended function, materials, and environmental conditions for SSCs of ISFSIs DCSSs, or both, identified as in scope for renewal. Examples of other documents that are used for the AMR process are drawings, technical reports, vendor manuals, and procedures. Industry reports, reference books, and codes and standards can be consulted, as appropriate, to evaluate aging effects.

Appendix C, Table C-1, provides an example of an AMR for a horizontal storage module.

The reviewer should consult American Society for Testing and Materials C 1562, “Standard Guide for Evaluation of Materials Used in Extended Service of Interim Spent Nuclear Fuel Dry Storage Systems,” which may provide additional technical guidance, such as degradation mechanisms of materials.

3.3 Regulatory Requirements

Table 3-1 presents a matrix of regulatory requirements for license and CoC renewal. Other parts of 10 CFR Part 72 may also be applicable.

Table 3-1 Relationship of Regulations and AMR

Areas of Review	10 CFR Part 72 Regulations[3]						
	72.24 (d)	72.82 (d)	72.104 (a)	72.106 (b)	72.120 (a), (d)	72.122 (a), (b), (c), (h)(1), (h)(5), (l)	72.122 (f), (h)(4), (i)
Aging Effects	●		●	●	●	●	
Aging Management, Maintenance, or Surveillance Programs		●					●
TLAAs	●		●	●	●	●	●
Retrievability						●	

Areas of Review	10 CFR Part 72 Regulations[3]							
	72.124	72.128 (a)	72.162	72.168 (a)	72.170	72.172	72.236 (g), (m)	72.236 Applicable Sections
Aging Effects	●		●					●
Aging Management, Maintenance, or Surveillance Programs		●	●	●	●	●	●	●
TLAAs	●	●			●			
Retrievability							●	

[3] The regulations in 10 CFR 72.24, 10 CFR 72.120, and 10 CFR 72.128, "Criteria for Spent Fuel, High-Level Radioactive Waste, and Other Radioactive Waste Storage and Handling," apply only to site specific license renewals. The regulations in 10 CFR 72.236 apply only to CoC renewals.

3.4 Materials, Service Environment, Aging Effects, and Aging Management Activities

3.4.1 Identification of Materials and Environments

The AMR process includes the identification of the materials of construction and the environments to which these materials are exposed. Appendix B provides an example of the typical SSC material description(s), operating environment, and intended function an applicant should provide. The reviewer should ensure that the renewal applicant has provided environmental data that include temperature, wind, relative humidity, exposure to rain or water, radiation field, and gaseous environment (e.g., external: air, internal: inert gas such as helium), such that the operating and service conditions of the SSCs can be determined.

3.4.2 Identification of Aging Effects

The renewal applicant should evaluate potential aging effects, in terms of material and environment combinations. The reviewer should ensure that the applicant provided an analysis and documentation that identified all the potential and actual aging effects pertinent to the SSCs determined to be within the scope of renewal. The applicant should include aging effects that may theoretically occur, as well as aging effects that have actually occurred, based on industry and site operating experience(s).

Identification of applicable aging effects may be through review of site maintenance records; inspection of an SSC condition at the time of renewal (see Appendix E), maintenance and inspection records from ISFSI sites with similar SSC materials and operating environments, research review of industry records, or other methods for determining if an aging effect should be managed for the renewal period. If an SCC is determined to be within scope and is found to have no potential aging effects for the renewal term, then the applicant need not take further action. The reviewer should ensure that the SAR supplement documents these SSCs requiring no further review.

The staff should review any root cause evaluations, repair or modification history, and maintenance activities identified under a corrective action program, including both site-specific and industrywide experience. This information may indicate repetitive or periodic conditions that may require an aging management program (AMP). One-time events should be evaluated for possible mitigating measures during the renewal period.

3.4.3 Aging Management Activity

The reviewer should ensure that the applicant has identified those aging effects requiring either an AMP or TLAA. Figure 3.1 illustrates the process for dispositioning those SSCs, determined to be within the scope of renewal, that are subject to a potential aging effect. The aging management activity (AMA) defines two methods for addressing potential aging effects: TLAA, discussed in Section 3.5; and AMP, discussed in Section 3.6. Figure 3.1 provides a flow chart depicting the logic sequence.

Since the DCSS interior and cladding cannot reasonably be inspected, the reviewer relies on lessons learned from NUREG/CR-6745, “Dry Cask Storage Characterization Project-Phase 1; CASTOR V/21 Cask Opening and Examination,” issued September 2001; and

NUREG/CR-6831, "Examination of Spent PWR Fuel Rods after 15 Years in Dry Storage," issued September 2003. This research demonstrated that a DCSS interior and low-burnup fuel cladding had no deleterious effects after 15 years of storage. This research formed the basis for ISG-11, "Cladding Considerations for the Transportation and Storage of Spent Fuel," issued November 2003. ISG 11, Revision 3, limits the temperature and stresses in the cladding during canister loading. These research results suggest that low-burnup fuel-cladding degradation should not occur during extended storage, provided that the design-basis internal environment has been maintained.

The applicant should assess the most recent revision to ISG-11 and research results in this area, especially with respect to high-burnup fuel. Research into fuel performance in storage is ongoing. Applicants should monitor these developments to ensure that they have identified potential degradation effects. There are presently no data regarding potential long-term degradation of high-burnup fuel cladding. Thus, the applicant should provide any new supporting data demonstrating high-burnup fuel performance during extended storage. Should an opportunity for a DCSS interior and cladding inspection arise, the licensee should inform the NRC and industry, for potential participation in the inspection effort.

The NRC may condition the approval of a CoC renewal on the requirements of a given AMA being met during the renewal term. The cask user, the general licensee, would ordinarily carry out such an AMA. According to 10 CFR 72.212(b)(7) and 10 CFR 72.240, the NRC would make the AMA applicable to the general licensee by adding the appropriate condition or technical specification requirement to the renewed CoC.

3.4.4 Evaluation Findings

The reviewer prepares the evaluation findings based on satisfaction of the regulatory requirements in Sections 3.4.1, 3.4.2, and 3.4.3. The evaluation findings should be similar in wording to the following examples:

F3.1 The staff finds the applicant's review process to be comprehensive in identifying the materials of construction and associated operating environmental conditions for those SSCs within the scope of renewal and has provided a summary of the information in the application and SAR supplement.

F3.2 The staff finds the applicant's review process to be comprehensive in identifying all potential and actual aging effects on the SSCs within the scope of renewal and has provided a summary of the information in the application and SAR supplement.

The reviewer should make a summary statement similar to the following:

> The staff concludes that the information presented in Chapter XX of the SAR supplement satisfies the requirements of 10 CFR Part 72.

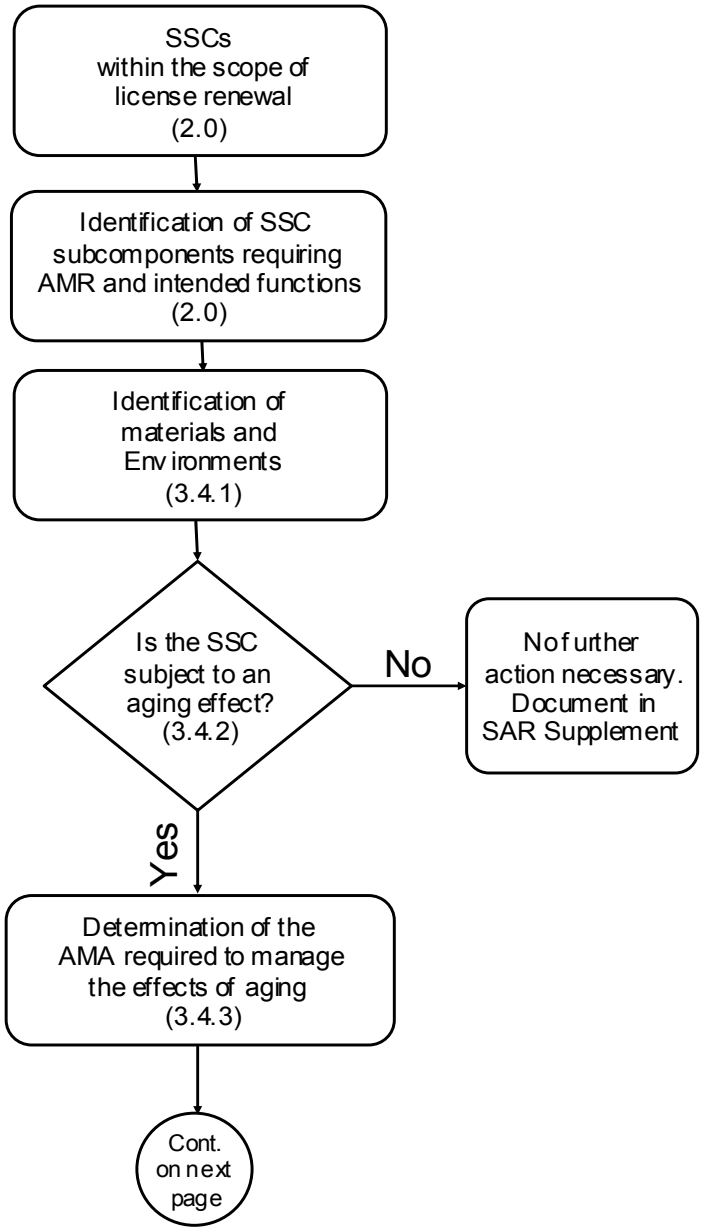


Figure 3.1 Flow chart of AMR process

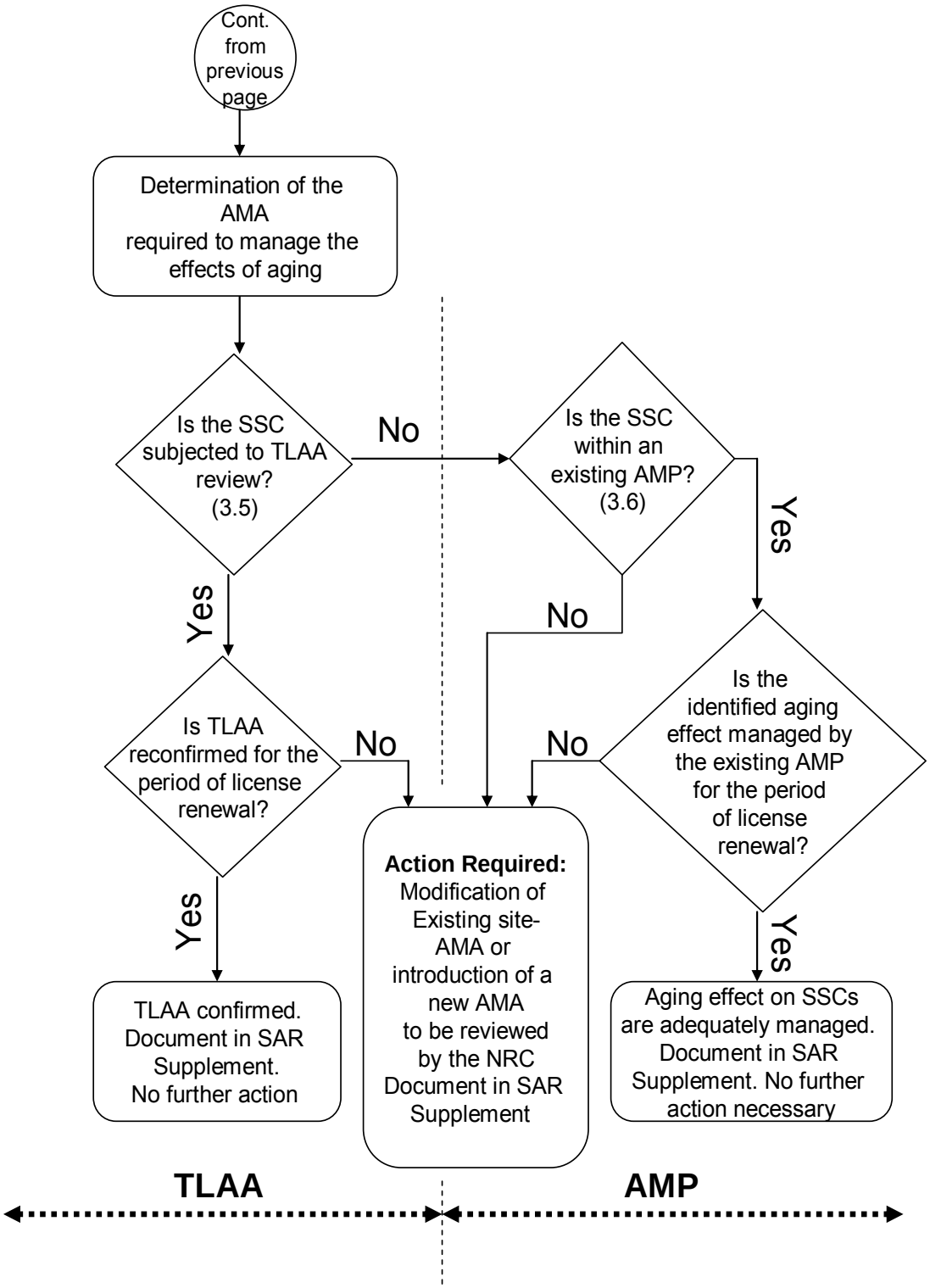


Figure 3.1 Flow chart of AMR process (continued)

3.5 Time-Limited Aging Management Analysis Evaluation

A TLAA is a process to assess SSCs that have a time-dependent operating life, as defined by the design basis. Time dependency may be fatigue life (number of cycles to predicted failure) or time limited (number of operating hours until replacement). At the end of the identified operating period, the component is typically replaced or renewed. Examples of possible TLAAs are: (1) fluence level that causes embrittlement of metallic components, (2) depletion of neutron absorber material, and (3) thermal fatigue of the canister shell.

The reviewer should ensure that the applicant has provided appropriate analyses of all SSCs with a time-dependent operating life, as defined by the design basis, and that the applicant has concluded that continued operation of the SSC is acceptable for the renewal period.

The reviewer should verify if the applicant has considered future monitoring of the potential aging effects analyzed in the TLAAs. If the applicant has recommended future inspection(s) or examination(s), then the reviewer should assess the adequacy of these proposed action(s). Such proposed actions may need to be reduced to license conditions, for site-specific license renewals, or conditions or technical specifications, for CoC renewals. If there are no proposed action(s), the reviewer should determine the adequacy of that approach.

3.5.1 Review Guidance

The reviewer should ensure that the applicant has appropriately identified TLAAs, by applying the five criteria described below for existing or newly identified SSCs with a time-dependent operating life:

(1) The TLAA should involve time-limited assumptions defined by the current operating term (e.g., 20 years). The defined operating term should be explicit in the analyses. Simply asserting that the SSC is designed for a service life or ISFSI life is not sufficient. The assertions should be supported by a calculation, analyses, or testing that explicitly includes a time limit.

(2) The TLAA should already be contained or incorporated by reference in the design basis. Such documentation includes: (1) SAR, (2) SER, (3) technical specifications, (4) fire protection plan and hazards analysis, (5) correspondence to and from the NRC, (6) quality assurance plan, and (7) topical reports included as references in the SAR.

(3) The TLAA must address SSCs within the scope of license renewal and with a predetermined life span.

(4) The TLAA must consider the extended operational lifetime of any SSC materials that have a defined lifetime limit (e.g., thermal fatigue condition).

(5) The TLAA should provide conclusions or a basis for conclusions regarding the capability of the SSC to perform its intended function through the license renewal period. The TLAAs must show either one of the following:

- The analyses have been projected to the end of the period of extended operation.

- The effects of aging on the intended function(s) of the SSC will be adequately managed for the period of extended operation. Component replacement is an acceptable option for managing the TLAA.

This review will ensure that the licensee has provided a justification and basis for dispositioning each SSC, with a predetermined life span, determined to be within the scope of renewal.

3.5.2 Evaluation Findings

The reviewer prepares the evaluation findings based on satisfaction of the regulatory requirements in Section 3.5.1. The evaluation findings should be similar in wording to the following example:

F3.3 The staff finds that the applicant's review is comprehensive in identifying in-scope SSCs, associated time-limited aging effects, and respective analyses. Some analyses were revised by the applicant and found to be appropriate as revised. Thus, the staff finds that the applicant's TLAAs provide reasonable assurance that the SSCs will maintain their intended function(s) for the term of the renewal period, require no further action, and meet the requirements for renewal.

3.6 Aging Management Program

The purpose of the AMP is to ensure that no aging effects result in a loss of intended function of the SSCs that are within the scope of renewal, for the term of the renewal.

3.6.1 Review Guidance

The elements of an AMP or inspection may vary, depending on the specific SSC. However, the reviewer should consider the following elements of an AMP, to determine the adequacy and applicability of the applicant's proposed method for managing an aging effect:

- Scope: The scope of the AMP may be for a specific SSC or a group of SSCs. If one AMP is selected to manage a group of SSCs, then the AMP must consider the similarity of materials of construction, design, installation, operating environments, and aging effects.

- Parameters Monitored or Inspected: This AMP element must describe what is being monitored or inspected. These descriptions include observable parameters or indicators to be monitored or inspected for each aging effect managed. The observable parameters must be linked to the degradation of the intended functions of the SSCs in the renewal period.

- Detection of Aging Effects: By performing the monitoring and trending, as described below, the AMP will detect the aging effect(s) before the SSCs lose their intended function(s).

- Monitoring and Trending: The AMP or inspection should describe a method that is capable of either: (1) detecting the effects of aging before the SSC would lose the ability to perform its intended function under design conditions, or (2) demonstrate that the

intended function of the SSC will be maintained during the renewal, without the need for an AMP. The AMP or inspection should include a methodology for analyzing the results of the inspection against applicable acceptance criteria. The methodology should be capable of determining the ability of the SSC to perform its intended function for the renewal period under the design conditions required by the ISFSI license or DCSS CoC.

When an inspection is necessary, sampling may be used to evaluate a group of SSCs. If sampling is used, a program should be developed that describes and justifies the methods used for selecting the population and the sample size. A sample may consist of one or more SSCs drawn from the scope. The applicant must determine a sample size that is adequate to provide reasonable assurance that the effects of aging on the SSC will not prevent the performance of its intended function during the renewal period. The size of the sample should include, for example, consideration of the specific aging effect(s), location, existing technical information, materials of construction, service environment, and previous failure history. The sample should be biased toward locations most susceptible to the specific aging effect(s) of concern. The results of the inspection should also be evaluated to assess whether the sample size is adequate or if it needs to be expanded.

An inspection for renewal (as described in Appendix E) may be performed at various times. It may be performed before submittal of the renewal application. The renewal application may include a commitment to perform an inspection before the beginning of the period of extended operation. There may also be justification for performing the inspection during the period of extended operation. Trending is the comparison of the current monitoring results with previous monitoring results, to make predictions for the future. Trending is not applicable for one-time new inspections.

- Acceptance Criteria: The acceptance criteria for the AMP or inspection may be based on design-basis information, as well as established industry codes and standards. The acceptance criteria should be sufficient to ensure maintenance of the intended function of the SSC during the renewal period.

- Corrective Action Program Review: The corrective action database should be examined for potential aging issues. Considerations should be given to root cause analysis, actions to prevent recurrence, and repair or replacement.

- Operating Experience: Operating experience should be considered when developing a new AMP or inspection program. A review of previous applications and NRC SERs issued in support of renewed licenses may provide supporting experience for new programs or inspections.

The AMP should be reviewed in the context of the areas described below.

3.6.1.1 Aging Effects Subject to Aging Management

The reviewer should ensure that the applicant has identified all potential aging effects for all SSCs, within the scope of license renewal, for the duration of the renewal term (Section 3.4.2).

Regardless of the specific aging effects, only aging effects that lead to degraded performance or cause a condition affecting an SSC's intended function during the period of extended operation is of principal concern for license or CoC renewal.

Appendix D, Table D-1, lists potential aging effects and possible aging mechanisms that the AMP should consider.

It is important to recognize that implementing confirmatory inspection or monitoring and surveillance is essential to resolving conflicting information or indications of the presence of a specific potential aging effect or degraded condition.

3.6.1.2 Prevention, Mitigation, Condition Monitoring, and Performance Monitoring Programs

The reviewer should ensure the following:

- Each SSC with an identified aging effect that requires management should have an associated AMP.

- Each AMP can effectively manage or monitor that aging effect, using the elements of an adequate AMP, described above in Section 3.6.1.

AMPs generally are of four types: prevention, mitigation, condition monitoring, and performance monitoring:

(1) Prevention programs keep the aging effect from occurring (e.g., coating programs to prevent external corrosion of a tank).

(2) Mitigation programs attempt to slow the effects of aging (e.g., cathodic protection systems, which are used to minimize corrosion of buried metallic components).

(3) Condition monitoring programs search for the presence and extent of aging effects (e.g., visual inspection of concrete structures for cracking).

(4) Performance monitoring tests verify the ability of the SSCs to perform their intended functions (e.g., periodic radiation monitoring).

As an example of a condition monitoring assessment, the reviewer should ensure that, for each DCSS design subject to renewal, there is an analysis of historic radiation survey data. The applicant should provide the results of this analysis in the renewal application and examine them for trends. The reviewer should ensure that the applicant, either through analysis or through implementation of an appropriate AMP, adequately assesses trending from historical measures or deviations from calculated radiation levels that could be indicative of shielding degradation. This assessment is primarily directed at polymeric neutron-shield materials, since the organic resins incorporated in these materials are subject to thermal and radiation-induced degradation.

3.6.1.3 Corrective Actions

The reviewer should ensure that corrective actions described by the applicant include root cause determinations for SSCs that are important to safety, and that the actions to be taken can prevent recurrence in a timely manner.

The operating history, including corrective actions and design modifications, is an important source of information for evaluating the ongoing condition of in-scope SSCs. Applicants should provide detailed discussions of such history. Applicants may consider both site-specific and industrywide experience, as relevant, as part of the overall condition assessment of in-scope SSCs.

Appendix C contains an example of an AMR discussion.

3.6.1.4 Component-Specific Guidance

Appendix E provides specific guidance for selected SSCs.

3.6.2 Evaluation Findings

The reviewer prepares the evaluation findings based on satisfaction of the regulatory requirements in Section 3.6.1. These statements should be similar to the following examples:

F3.4 The staff finds that the applicant considered potential aging effects, maintenance and operating history, modifications, root cause determinations, analyses or calculations, and inspections that provide reasonable assurance for continued safe operation of the ISFSI or DCSS for the renewal period.

F3.5 The staff finds that the applicant has identified maintenance and surveillance programs that will provide reasonable assurance that aging effects would be managed during the renewal period, in accordance with 10 CFR Part 72.

3.7 Retrievability

Storage systems must be designed to allow ready retrieval of spent fuel for further processing or disposal for the duration of the licensing period, according to 10 CFR 72.122(l) and 10 CFR 72.236(m). The latest revision of ISG-2, “Fuel Retrievability,” issued by the Division of Spent Fuel Storage and Transportation, provides additional guidance regarding retrievability.

3.7.1 Review Guidance

An example of the possible long-term effect may be a galling effect causing a seizure between the cask shell and support structure rails during the canister retrieval process. The reviewer should ensure that the applicant has addressed any potential retrievability issue and provided justification for continued operation during the renewal period.

3.7.2 Evaluation Findings

The reviewer prepares the evaluation findings based on satisfaction of the regulatory requirements in Section 3.7. These statements should be similar to the following example,

provided the application supports positive findings for each of the regulatory requirements (the finding number is for convenience in referencing within the SRP and SER):

F3.6 The staff finds that the applicant has adequately determined that long-term degradation effects on SSCs would not prevent ready retrieval of spent fuel for further processing or transfer for ultimate disposition by the U.S. Department of Energy, as required by 10 CFR 236(m).

APPENDIX A
NONQUANTIFIABLE PHRASES (TERMS)

The following nonquantifiable phrases, as well as others, may appear in the safety analysis report (SAR) (renewal application) and updated final safety analysis report (UFSAR):

- large
- small
- slight
- slightly
- significant
- significance
- moderate
- moderately
- low
- minor
- many
- few
- little
- routine

Table A-1 may be used as guidance for the terms listed above, for additional consideration, to provide quantitative measures or information.

Table A-1 Screening Criteria for Nonquantifiable Phrases (Terms)

	Terms	Actions
Screened In	**The term requires additional consideration if it is used for one of the following:** • characterizing an aging effect (e.g., degradation, cracking, fatigue, corrosion, loss of material, change in properties) • providing important information about the operations, functions, or other characteristics of an in-scope SSC • describing dose, environmental impact, or other hazard, such as combustible material, dust	**If the term screens in, one of the following must be provided:** • quantitative information, if it is available • additional descriptions • definition of the meaning of the term (e.g., "insignificant" means the function of the SSC is not impaired)
Screened Out	**The term is considered not material to the SAR and ISFSI UFSAR for one of the following reasons:** • The term is included in the title of reference document. • The term is included in a quote. • The term is explained by adjacent quantitative information (e.g., small: less than 20 percent). • Use of the term is NOT related to any of the following: – in-scope SSCs per AMR results – aging effect – dose, environment impact, or other hazard (e.g., combustible material) • Use of term does not provide important information. It is merely descriptive and the meaning of the statement is not changed if the term were deleted (e.g., the word "small" could be deleted from the following statement without altering the meaning: "Water in the grapple ring is drained through a small hole.").	No action

APPENDIX B
EXAMPLE OF INDEPENDENT SPENT FUEL STORAGE INSTALLATION MATERIALS AND COMPONENTS

Table B-1 provides an example of independent spent fuel storage installation (ISFSI) or dry cask storage system (DCSS) components and materials for one style of cask design. The components on this list are among those considered in the scoping evaluation. Such data sheets should be part of an application for ISFSI or DCSS license renewal, since this information aids in identifying systems, structures, and components that are within the scope of license renewal.

Table B-1 Example of Materials and Components of Cask System

Primary Function	Component	Drawing	Safety Class	Codes/Standards	Material
Containment	Lid	972-70-2 It 2	A	ASME Subsection NB	SA-350, LF3 or SA-203 Gr. E
	Inner Containment	972-70-2 It 3	A	ASME Subsection NB	SA-203 Gr E
	Bottom Cont.	972-70-2 1t.5	A	ASME Subsection NB	SA-203 Gr. E
	Flange	972-70-2 1t.35	A	ASME Subsection NB	SA-350, LF3
	Lid Bolt (48)	972-70-2 It. 14	A	ASME Subsection NB	SA-540 Gr. B24 Cl. I
	Lid Seal	972-70-2 It. 16	A		Double Metallic O-Ring
	Drain Port Cover	972-70-2 It.22	A	ASME Subsection NB	SA-240, Type 304
	Vent Port Cover	972-70-2 It.23	A	ASME Subsection NB	SA-240, Type 304
	Threaded Insert	972-70-2 It.45	A		304 SST
	Vent & Drain Port Cover Seal	972-70-2 11.24	A		Double Metallic O-Ring
	Vent & Drain Port Cover Bolts	972-70-2 1t.25	A	ASME Subsection NB	SA-193 Gr. B7
Criticality Control	Poison Plates	972-70-2 It33	A		Borated Aluminum or Carbide/Aluminum Metal Matrix Composite
	Basket Rail Type 1	972-70-2 It28	A		B221, 6061-T6 Aluminum
	Basket Rail Type 2	972-70-2 It.29	A		B221, 6061-T6 Aluminum
	Basket Rail Type 3	972-70-2 It 30	A		B221, 6061-T6 Aluminum
	Fuel Compartment	972-70-2 132	A	ASME Subsection NG	SA-240 Type 304
	Structural Plates	972-70-2 It.34	A	ASME Subsection NG	SA-240 Type 304
	Basket Holddown	972-70-2 It39	A	ASME Subsection NG	SA-240 Type 304
Shielding	Gamma Shield	972-70-2 It. I	A	ASME Subsection NF	SA-266 Class 2
	Shield Plate	972-70-2 It 8	B	ASME Subsection NF	SA-105 or SA-516, Gr. 70
	Bottom	972-70-2 ht.4	A	ASME Subsection NF	SA-516 Gr. 70 or SA-266 Cl. 2
	Radial Neutron Shield	972-70-2 It.9	B		Borated Polyester Resin
	Outer Shell	972-70-2 Itý 10	B		SA-516 Gr. 70
	Soc. Head Cap Screw	972-70-2 It.47	B		30i SST
	Shim	972-70-2 ht36	A		SA-S16 Gr. 70
	Top Neutron Shield	972-70-2 It. 12	B		Polypropylene
Heat Transfer	Radial Neutron Shield Box	972-70-2 It. 13	B		6063-TS Aluminum
	Poison Plates	972-70-2 Ilt33	A		Borated Aluminum or Boron Carbide/Aluminum
	Basket Rail Shim	972-70-2 It 31	B		6061-T6 Aluminum
	Basket Rail Type 1	972-70-2 It.28	A		B221, 6061-T6 Aluminum
	Basket Rail Type 2	972-70-2 11.29	A		B221, 6061-T6 Aluminum
	Basket Rail Type 3	972-70-2 It.30	A		B221, 6061-T6 Aluminum
Structural Integrity	Gamma Shield	972-70-2 It. I	A	ASME Subsection NF	SA-266 Class 2
	Bottom	972-70-2 Ilt4	A	ASME Subsection NF	SA-5 16 Gr. 70 or SA-266 Cl. 2
Operations Support	Upper Trunnion	972-70-2 It.6	A	ANSI N14.6	SA-182 Gr. F6NM
	Lower Trunnion	972-70-2 Ilt7	B		SA-105
	Protective Covet	972-70-2 It. I I	C		SA-516 Gr. 70
	Protective Cover Bolt	972-70-2 It. 15	C		SA-193 Gr B7
	Protective Cover Seal	972-70-2 It. 17	C		Elastomer
	Top Neutron Shield Bolt	972-70-2 Ilt.20	C		SA-193 Gr B7
	Trunnion Bolt	972-70-2 1t.37	A		SA-320 L43
	Fuel Spacer	972-70-2 lit38	C		Aluminum
	Shear Key	972-70-2 It40	A		SA-203 Gr E
	Pressure Relief Valve	972-70-2 It.41	C		SST
	Security Wire	972-70-2 It.42	C		304 SST
	Security Wire Seal	972-70-2 It.43	C		Lead
	Flat Washer	972-70-2 It.46	C		SST
	Threaded Insert	972-70-2 It,44	C		304 SST
	Quick Disconnect Couplings	972-70-3	C		SST
	Lid Alignment Pin	972-70-2 It.27	C		A479, Type 316
Leakage Monitoring Secondary Seal	Overpressure Port Cover	972-70-2 It. 18	C		SA-240 Type 304
	Overpressure Port Cover Seal	972-70-2 It. 19	C		Single Metallic O-Ring
	Pressure Monitoring System	972-70-2 h21	C		Carbon Steel/SST
	Overpressure Port Cover Ports	972-70-2 It.26	C		SA-193 Gr. B7

Table B-1 Examples of Materials and Components of Cask System (Continued)

Primary Function	Component	Strength (ksi)	Coating	Welding/Weld Filler
Containment	Lid	70	SST Cladding on Sealing Surfaces	ASME Section III, NB and Section IX
	Inner Containment	70	None	ASME Section III, NB and Section IX
	Bottom Containment	70	None	ASME Section III. NB and Section IX
	Flange	70	SST Cladding on Sealing Surfaces	ASME Section III, NB and Section IX
	Lid Bolt (48)	165	Nuclear-Grade Neolube	N/A
	Lid Seal		None	N/A
	Drain Port Cover	75	None	N/A
	Vent Port Cover	75	None	N/A
	Threaded Insert	300	None	N/A
	Vent and Drain Port Cover Seal		None	N/A
	Vent and Drain Port Cover Bolts		Nuclear-Grade Neolube	N/A
Criticality Control	Poison Plates		None	N/A
	Basket Rail Type 1	38	None	N/A
	Basket Rail Type 2	38	None	N/A
	Basket Rail Type 3	38	None	N/A
	Fuel Compartment	75	None	ASME Section III, NB and Section IX
	Structural Plates	75	None	ASME Section III, NB and Section IX
	Basket Holddown	75	None	ASME Section III, NB and Section IX
Shielding	Gamma Shield	70	Epoxy Paint on Exterior	ASME Section IX
	Shield Plate	70	None	ASME Section IX
	Bottom	70	Epoxy Paint on Exterior	ASME Section IX
	Radial Neutron Shield		None	
	Outer Shell	70	Epoxy Paint on Exterior	
	Soc. Head Cap Screw	70	None	
	Shim	70	None	
	Top Neutron Shield		None	
Heat Transfer	Radial Neutron Shield Box		None	
	Poison Plates		None	
	Basket Rail Shim	38	None	
	Basket Rail Type 1	38	None	
	Basket Rail Type 2	38	None	
	Basket Rail Type 3	38	None	
Structural Integrity	Gamma Shield	70	Epoxy Paint on Exterior	
	Bottom	70	Epoxy Paint on Exterior	
Operations Support	Upper Trunnion	115	Nuclear-Grade Neolobe	
	Lower Trunnion	70	Epoxy Paint on Exterior	
	Protective Cover	70	Epoxy Paint on Exterior	
	Protective Cover Bolt		Nuclear-Grade Neolube	
	Protective Cover Seal		None	
	Top Neutron Shield Bolt		None	
	Trunnion Bolt	125	Nuclear-Grade Neolube	
	Fuel Spacer		None	
	Shear Key	70	None	
	Pressure Relief Valve		None	
	Security Wire		None	
	Security Wire Seal		None	
	Flat Washer		None	
	Threaded Insert		None	
	Quick-Disconnect Couplings		None	
	Lid Alignment Pin		None	
Leakage Monitoring Secondary Seal	Overpressure Port Cover	75	None	
	Overpressure Port Cover Seal		None	
	Pressure-Monitoring System		Epoxy Paint on Exterior	
	Overpressure Port Cover Ports		Nuclear-Grade Neolube	

Table B-1 Example of Materials and Components of Cask System (Continued)

Primary Function	Component	Stress Normal (ksi)	Stress Accident (ksi)	Temp. Min (°F)	Temp Max (°F)	Temp 0 Year Storage (°F)	Temp XX Year Storage (°F)	Press Min (psig)	Press Max (psig)	Gas (Type)
Containment	Lid	4.5	5.3	-20	247	247	204	0	100	Helium
	Inner Containment	25.8	53.3	-20	277	277	223	0	100	Helium
	Bottom Containment			-20	289	289	218	0	100	Helium
	Flange	3.1	29.6	-20	247	247	204	0	100	Helium
	Lid Bolt (48)	40.7	25	-20	247	247	204	0	100	Helium
	Lid Seal			-20	247	247	204	0	100	Helium
	Drain Port Cover			-20	247	247	204	0	100	Helium
	Vent Port Cover			-20	247	247	204	0	100	Helium
	Threaded Insert			-20	247	247	204	0	100	Helium
	Vent and Drain Port Cover Seal			-20	247	247	204	0	100	Helium
	Vent and Drain Port Cover Bolts	26	47.4	-20	237	237	204	0	100	Helium
Criticality Control	Poison Plates			-20	462	462	359			
	Basket Rail Type 1	0.15	1	-20	330	330	258			
	Basket Rail Type 2	0.15	1	-20	330	330	258			
	Basket Rail Type 3	0.15	1	-20	30	30	258			
	Fuel Compartment			-20	482	482	359			
	Structural Plates	0.56	6.03	-20	482	482	359			
	Basket Holddown			-20	482	482	359			
Shielding	Gamma Shield	25.3	55.3	-20	258	258	211			
	Shield Plate	2.8	5.4	-20	247	247	204			
	Bottom			-20	269	269	218	3	5	Air
	Radial Neutron Shield			-20	258	258	211			
	Outer Shell	4.3	9.1	-20	218	218	185	3	5	Air
	Soc. Head Cap Screw			-20	218	218	185			
	Shim			-20	247	247	204			
	Top Neutron Shield			-20	247	247	204			
Heat Transfer	Radial Neutron Shield Box			-20	258	258	211			
	Poison Plates			-20	482	482	359			
	Basket Rail Shim			-20	330	330	258			
	Basket Rail Type 1	0 15	1	-20	330	330	258			
	Basket Rail Type 2	0.15	1	-20	330	330	258			
	Basket Rail Type 3	0.15	1	-20	330	330	258			
Structural Integrity	Gamma Shield			-20	258	258	211			
	Bottom			-20	269	269	218	3	5	Air
Operations Support	Upper Trunnion	10.65		-20	277	277	223	3	5	Air
	Lower Trunnion			-20	277	277	223	3	5	Air
	Protective Cover			-20	216	218	185	3	5	Air
	Protective Cover Bolt	17		-20	247	247	204	3	5	Air
	Protective Cover Seal			-20	247	247	204			
	Top Neutron Shield Bolt			-20	247	247	204			
	Trunnion Bolt			-20	277	277	223			
	Fuel Spacer			-20	330	330	258			
	Shear Key			-20	330	330	258			
	Pressure Relief Valve			-20	258	258	211			
	Security Wire			-20	247	247	204			
	Security Wire Seal			-20	247	247	204			
	Flat Washer			-20	247	247	204			
	Threaded Insert			-20	247	247	204			
	Quick Disconnect Couplings			-20	247	247	204			
	Lid Alignment Pin			-20	247	247	204			
Leakage Monitoring Secondary Seal	Overpressure Port Cover			-20	247	247	204			
	Overpressure Port Cover Seal			-20	247	247	204			
	Pressure Monitoring System			-20	216	218	185	3	5	Air
	Overpressure Port Cover Ports			-20	247	247	204			

APPENDIX C
EXAMPLE OF AGING MANAGEMENT REVIEW RESULTS

Table C-1 provides an example of the results of an aging management review (AMR) for the various components of an independent spent fuel storage installation (ISFSI) with a horizontal storage module (HSM) design. It should be noted that Table C-1 does not include all the systems, structures, and components (SSCs) associated with the HSM design. It merely illustrates one possible method of presenting AMR process results in the safety analysis report for license renewal. The evaluation should identify: (1) the in-scope SSC, (2) the intended function of the SSC that caused it to be considered within scope, (3) material(s) of construction, (4) environmental operating conditions, and (5) potential aging effects requiring management and a determination of the type of program for managing the effects of aging.

The table uses the following intended function codes for brevity:

CC	provides criticality control of spent fuel
HT	provides heat transfer
PB	directly or indirectly maintains a pressure boundary
RS	provides radiation shielding
SS	provides structural support, functional support, or both, for equipment that is important to safety equipment
None	does not have a function that is important to safety, but its failure could affect performance of a safety-related SSC

Table C-1 AMR Results for the HSM

Component [1]	Intended Function	Material	Environment	Aging Effects Requiring Management	Aging Management Activity
Concrete (Above Grade)	HT, RS, SS	Concrete	Yard	Loss of Material Cracking Change in Material Properties	Site-Specific ISFSI Aging Management Program
Concrete (Below Grade)	HT, RS	Concrete	Underground	None Identified	None Required
Anchorages/ Embedments/ Rebar	SS	Carbon Steel	Embedded	None Identified	None Required
Anchorages/ Transfer Cask Restraints (Exposed)	SS	Carbon Steel	Yard	Loss of Material	Site-Specific ISFSI Aging Management Program
			Sheltered	Loss of Material	Site-Specific ISFSI Aging Management Program
Expansion Anchors	SS	Carbon Steel	Sheltered	Loss of Material	Site-Specific ISFSI Aging Management Program
		Stainless Steel	Sheltered	None Identified	None Required
		Stainless Steel	Yard	None Identified	None Required
DSC Support Assembly	SS	Carbon Steel	Sheltered	Loss of Material	Site-Specific ISFSI Aging Management Program
		Stainless Steel	Sheltered	None Identified	None Required
HSM Access Ring (Exposed Embedment)	SS	Carbon Steel	Sheltered	Loss of Material	Site-Specific ISFSI Aging Management Program
Inlet/Outlet Screens and Frames	HT	Stainless Steel	Yard	None Identified	None Required

Table C-1 AMR Results for the HSM (Continued)

HSM Access Door Support Frame	SS	Carbon Steel	Yard	Loss of Material	Site-Specific ISFSI Aging Management Program
HSM Access Door	RS, SS	Carbon Steel	Yard	Loss of Material	Site-Specific ISFSI Aging Management Program
		Polymeric Neutron Shield Material	Embedded	None Identified	None Required
		Concrete (Phase 2)	Embedded	None Identified	None Required
Heat Shield	HT	Stainless Steel	Sheltered	None Identified	None Required
Seismic Restraint Assembly for DSC	SS	Carbon Steel	Sheltered	Loss of Material	Site-Specific ISFSI Aging Management Program
Fasteners	SS	Carbon Steel	Sheltered	Loss of Material	Site-Specific ISFSI Aging Management Program
Connectors(2)	SS	Bronze	Yard	Loss of Material	Site-Specific ISFSI Aging Management Program
			Embedded	None Identified	None Required
			Underground	None Identified	None Required
		Stainless Steel	Yard	None Identified	None Required
Cable(2)	SS	Copper	Yard	None Identified	None Required
			Embedded	None Identified	None Required
			Underground	None Identified	None Required
Lead Sheathing(2)	SS	Lead	Yard	None Identified	None Required
Ground Rod(2)	SS	Copper		None Identified	None Required
Handrail and Bracing(2)	SS	Carbon Steel	Yard	Loss of Material	Site-Specific ISFSI Aging Management Program
Galvanized Flashing/ConcreteNails	None	N/A	N/A	N/A	N/A

Table C-1 AMR Results for the HSM (Continued)

Ladder and Attachments	None	N/A	N/A	N/A	N/A
Caulk, Sealants, Expansion Joint Fillers	None	N/A	N/A	N/A	N/A
Lubricants (Permaslik RN and Everlube 823)	None	N/A	N/A	N/A	N/A
PVC Drain Pipe/PVC Electrical Conduit (Embedded)	None	N/A	N/A	N/A	N/A
Electrical Conduit, Boxes, and Cable	None	N/A	N/A	N/A	N/A
Alignment Targets	None	N/A	N/A	N/A	N/A

(1) Each individual HSM contains the listed subcomponents, unless indicated otherwise.
(2) Lightning protection system only.

APPENDIX D
AGING EFFECTS TABLE

Table D-1 lists potential aging effects and possible aging mechanisms. Table D-1 is an excerpt from a table in Appendix C to NUREG-1557, “Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal,” issued October 1996. It should be noted that the intent of the aging management review is to identify potential aging effects and address those effects through an effective aging management program.

Table D-1 Aging Effects and Possible Mechanisms

Aging Effects of SSCs	Possible Aging Mechanism
Concrete Structures:	
1. Scaling, cracking, and spalling	Freeze-Thaw
2. Increase in porosity and permeability	Leaching of Calcium Hydroxide
3. Increase in porosity and permeability, cracking	Aggressive Chemical Attack
4. Expansion and cracking	Reaction with Aggregates
5. Loss of strength and modulus	Elevated Temperature
6. Loss of strength and modulus	Irradiation of Concrete
7. Deformation	Creep
8. Cracking	Shrinkage
9. Loss of material	Corrosion
10. Loss of material	Abrasion and Cavitation
11. Cracking	Restrain, Shrinkage, Creep and Aggressive
12. Loss of strength	Concrete Interaction with Aluminum
13. Cathodic protection effect on bond strength	Cathodic Protection Current
Structural Steel:	
1. Loss of material	Corrosion Local or Atmospheric
2. Loss of strength and modulus	Elevated Temperature
3. Loss of fracture toughness	Irradiation
4. Crack initiation and growth	Stress-Corrosion Cracking
Reinforcing Steel (Rebar):	
1. Cracking, spalling, loss of bond and material	Corrosion of Embedded Steel
2. Loss of strength and modulus	Elevated Temperature
3. Loss of strength and modulus	Irradiation
Miscellaneous:	
1. Cracking, distortion, increase in component stress	Settlement
2. Loss of fracture toughness	Strain Aging (of Carbon Steel)
3. Reduction in design margin	Loss of Prestress
4. Loss of material	Corrosion of Steel Piles
5. Loss of material	Corrosion of Tendons
Cask Internals:	
1. Loss of material	Corrosion, Boric-Acid Corrosion
2. Change in dimension	Creep
3. Wall thinning	Erosion/Corrosion
4. Crack initiation and growth	Stress-Corrosion Cracking
5. Loss of fracture toughness	Neutron Irradiation Embrittlement
6. Loss of preload	Stress Relaxation
7. Loss of fracture toughness	Thermal Embrittlement
8. Attrition	Wear

APPENDIX E
COMPONENT-SPECIFIC GUIDANCE

20-Year Interval "Lead" Dry Cask Storage System Inspection

A "lead" cask or canister and overpack is one or more dry cask storage systems (DCSSs) selected for additional inspections, on the basis of longest time in service, or hottest thermal load, or other parameter(s) that contribute to aging. The reviewer should ensure that the applicant's selection of the lead DCSS considers the environment, operating conditions, materials, operating history, industry experience, and any other factor(s) that may affect the DCSS condition. Inspection of such selected DCSS major components (e.g., cask(s), canister(s), or overpack) would serve as a "lead" structure for assessing the condition of other loaded DCSSs. The lead cask inspection does not have to be performed at the independent spent fuel storage installation (ISFSI) site seeking renewal, as long as the applicant can demonstrate that the parameters for the DCSS being inspected are bounding for the DCSS to be renewed.

The reviewer should ensure that the applicant's inspection program justifies the number of individual canisters to receive visual inspection by their removal from the concrete overpack, so that selected surfaces of the various components exposed to the ambient air environment are examined (including the canister bottom, for vertical systems). This examination is performed to detect unanticipated degradation, in areas of the DCSS that are not normally accessible or observable. In lieu of canister removal from overpacks or similar structures, remote inspection methods may be acceptable, with justification. The applicant should indicate that it will also inspect the interior of the overpack. A DCSS can have portions or areas that are not normally observable, which should also be inspected (e.g., the cask bottom).

Those who hold a current 20-year license and certificate of compliance (CoC) should perform this inspection before the end of the operating period, as it is part of the basis for renewal. They should repeat the inspection at 20-year intervals, thereafter. The licensee and CoC holder may propose alternative inspection intervals for staff approval.

If the inspection demonstrates no adverse condition(s), the licensing basis is met. If adverse conditions are discovered that cannot be corrected within the licensing basis, a license or CoC amendment or other licensing action may be required to meet the design basis.

If two or more different DCSS designs are in service at a common ISFSI site, then the licensee should justify the number of different designs to be inspected. This does not imply that <u>all</u> DCSS designs at an ISFSI site must be so inspected. If one design can be shown to envelope the conditions of another design(s), the licensee would need to inspect only one design. The licensee should demonstrate that the results of the lead inspection reflect the conditions of all the other DCSSs at its site.