PrairieIslandISFSINPEm Resource

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Subject: Prairie Island ISFSI LRA Appendix C Revision
Attachments: PI ISFSI LRA Appendix C Revision 1_ 8-11-2014.pdf

Al,

Based on our discussions last week, attached is an updated draft of Appendix C, "Safety Analysis Report Supplement and Changes," Revision 1, for the Prairie Island ISFSI License Renewal Application (LRA).

This version of Appendix C has been updated to refer to the High Burnup Fuel Monitoring Program, both in Section 9.8.1 and in a new Section 9.8.4. The new section addresses the scope of the program and the assessments that NSPM will perform based on the industry's surrogate program (HDRP). We felt that adding a new section to discuss the High Burnup Fuel Monitoring Program would be more consistent with the organization and presentation in the Aging Management Program, LRA Appendix A, Revision 1, which was included with the July 31 RAI response letter.

We believe the attached file addresses the concerns discussed last week, and are open to any feedback that you and your reviewers can provide. We are available for telephone discussions if you have issues with the attached or other information related to the LRA. Please feel free to call my cell number 303-358-5235 any time.

Best regards,

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APPENDIX C

SAFETY ANALYSIS REPORT SUPPLEMENT AND CHANGES

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APPENDIX C: SAFETY ANALYSIS REPORT SUPPLEMENT AND CHANGES

C1.0 Introduction

This appendix identifies pertinent changes to the Prairie Island Independent Spent Fuel Storage Installation (ISFSI) Safety Analysis Report (SAR). Section C2.0 of this appendix contains proposed changes to the existing Prairie Island ISFSI SAR information. Section C3.0 of this appendix contains two new proposed sections to be added to SAR Sections 9 and A9. The new sections provide a summarized description of the activities for managing the effects of aging of ISFSI structures and components, and a description of the time-limited aging analyses review for the period of extended operation.

C2.0 Changes to Existing Prairie Island ISFSI SAR Information

Section A4.2.3.5 – Material Durability

- Change the design life of the TN-40HT cask in the first sentence to 60 years. The proposed sentence would read:

  Materials must maintain the ability to perform their safety functions over **~~at least~~** the cask's **~~25~~ 60**-year licensed period under the cask's thermal, radiological, corrosion, and stress environment.

- Modify the first paragraph under the metallic components subsection to reflect the disposition of the neutron damage of the cask metallic components TLAA. The proposed paragraph would read:

  Gamma radiation has no significant effect on metals. The effect of fast neutron irradiation of metals is a function of the integrated fast neutron flux, which is on the order of 10^{14} n/cm^2 inside the TN-40HT cask after 25 years. **The integrated fast neutron flux at the end of a 60-year period is projected by conservatively assuming that the average fast neutron flux over the period is the same as that during the first 25 years of storage. Thus, the integrated fast neutron flux for the entire 60-year period is on the order of 2.4E14 n/cm^2.** Studies on fast neutron damage in aluminum, stainless steel, and low alloy steels rarely evaluate damage below 10^{17} n/cm^2 because it is not significant (Reference 14). Therefore, there will be virtually no neutron damage to any of the TN-40HT cask metallic components.

C3.0 New Prairie Island ISFSI SAR Sections

The following information will be integrated into ISFSI SAR Sections 9 and A9 to document aging management programs credited in the PI ISFSI license renewal review and the results of the TLAA evaluations. The information will be located in new ISFSI SAR Sections 9.8 and A9.8. The existing references in ISFSI SAR Sections 9.7 and A9.8 will be re-numbered to reflect the addition of the new Aging Management sections. Following the issuance of the renewed materials license, NSPM makes a commitment to incorporate the summary descriptions of the ISFSI aging management program and Time-Limited Aging Analyses into the

Prairie Island ISFSI Safety Analysis Report (SAR) as part of a periodic SAR update in accordance with 10 CFR 72.70(c).

9.8 Aging Management

9.8.1 Aging Management Review

An aging management review (AMR) of the ISFSI systems, structures, and components (SSC) was conducted as part of the ISFSI License Renewal process. The AMR addresses aging effects/mechanisms that could adversely affect the ability of the structures or components to perform their intended functions during the period of extended operation. The results of the AMR determined that there were aging effects that require aging management activities for the casks, concrete pads, and earthen berm. Although the AMR did not identify any aging effects for the spent fuel assemblies that could lead to a loss of intended function, a High Burnup Fuel Monitoring Program as described in Section A9.8.4 will be used to confirm that the intended function(s) of high burnup fuel stored in TN-40HT casks are maintained during the period of extended operation. The potential aging effects for the casks, concrete pads, and earthen berm are addressed in the ISFSI Inspection and Monitoring Activities Program and the Time-Limited Aging Analyses.

9.8.2 ISFSI Inspection and Monitoring Activities Program

The purpose of the ISFSI Inspection and Monitoring Activities Program is to ensure that the structure's or component's intended function(s) is not degraded for the in-service dry fuel storage casks, reinforced concrete storage pads or earthen berm.

The ISFSI Inspection and Monitoring Activities Program will perform periodic inspection activities that monitor the condition of ISFSI structures and subcomponents that are classified as Safety Related (or Important To Safety for the TN-40HT casks) or whose failure could prevent fulfillment of a function that is important to safety, or its failure as a support structure or component could prevent fulfillment of a function that is important to safety.

The aging effects managed by this program are included in Table 9.8-1. The aging effects/mechanisms applicable to each structure and component are dependent upon the associated material/environment combinations, design, and installation. Those structures and components that have been grouped together for aging management review (e.g., Carbon Steel in Atmosphere/Weather) have been evaluated and based upon the materials of construction, design, installation, and environments, will have the same aging effects.

The scope of the ISFSI Inspection and Monitoring Activities Program includes:

1) Visual inspection of the exterior of the in-service casks,

2) Monitoring of the interseal pressure of the in-service casks,
3) Radiation monitoring and associated surveillance activities of the in-service casks,
4) Visual inspection of the concrete pads,
5) Visual inspection of the earthen berm,
6) Visual inspection of an in-service cask bottom prior to the end of the current ISFSI license period,
7) Visual inspection under an in-service cask protective cover (surfaces normally not visible or accessible with the cover in-place) prior to the end of the current ISFSI license period,
8) Visual inspection of the cask bottom in the event an in-service cask is lifted in preparation for movement (inspections of opportunity),
9) Visual inspection under the protective cover (surfaces normally not visible or accessible with the cover in-place) of an in-service cask in the event the cover is removed for maintenance (inspections of opportunity),
10) Visual inspection of the bottom and under the protective cover of the lead cask at least every 20 years, and
11) Monitoring of ground water chemistry.

TABLE 9.8-1
Managed Aging Effects

Material	Environment	Aging Effect	Aging Mechanism
Aluminum	Atmosphere/Weather	Loss of Material	Crevice Corrosion
Aluminum	Atmosphere/Weather	Loss of Material	Galvanic Corrosion
Aluminum	Atmosphere/Weather	Loss of Material	Pitting Corrosion
Carbon Steel	Atmosphere/Weather	Loss of Material	Crevice Corrosion
Carbon Steel	Atmosphere/Weather	Loss of Material	Galvanic Corrosion
Carbon Steel	Atmosphere/Weather	Loss of Material	General Corrosion
Carbon Steel	Atmosphere/Weather	Loss of Material	Pitting Corrosion
Polypropylene	Air/Gas	Cracking	Material property changes from radiation exposure
Borated Polyester	Air/Gas	Cracking	Material property changes from radiation exposure
Stainless steel	Atmosphere/Weather	Loss of Material	Crevice Corrosion
Stainless steel	Atmosphere/Weather	Loss of Material	Pitting Corrosion
Concrete	Atmosphere/Weather	Change in Material Properties	Leaching of $Ca(OH)_2$
Concrete	Atmosphere/Weather	Cracking	Freeze-Thaw
Concrete	Atmosphere/Weather	Cracking	Reaction with Aggregates
Concrete	Atmosphere/Weather	Loss of Material	Freeze-Thaw
Concrete	Soil	Change in Material Properties	Leaching of $Ca(OH)_2$
Concrete	Soil	Cracking	Reaction with Aggregates
Concrete	Soil	Cracking	Settlement
Earthen Structures	Atmosphere/Weather	Change in Material Properties	Desiccation
Earthen Structures	Atmosphere/Weather	Loss of Form	Settlement
Earthen Structures	Atmosphere/Weather	Loss of Form	Frost Action
Earthen Structures	Atmosphere/Weather	Loss of Material	Erosion (Wind/Rain Impact)

9.8.3 Time-Limited Aging Analyses

A review of time-limited aging analyses (TLAA) involving the TN-40 cask design, spent fuel assemblies stored in a TN-40 cask, concrete pads, and earthen berm was performed as a part of the ISFSI license renewal. TLAAs are defined as those licensee calculations or analyses that have all of the following attributes:

1. Involves a Structure System or Component (SSC) within the scope of license renewal,
2. Considers the effects of aging,
3. Involves time-limited assumptions defined by the current operating term,
4. Was determined to be relevant in making a safety determination,
5. Involves conclusions or provides the basis for conclusions related to the capability of the SSC to perform its intended functions, and
6. Is contained or incorporated by reference in the licensing basis.

No TLAAs were identified for the TN-40 cask design, spent fuel assemblies stored in a TN-40 cask, concrete pads, or earthen berm.

A9.8 Aging Management

A9.8.1 Aging Management Review

The information in Section 9.8.1 is applicable to the TN-40HT casks.

A9.8.2 ISFSI Inspection and Monitoring Activities Program

The information in Section 9.8.2 is applicable to the TN-40HT casks.

A9.8.3 Time-Limited Aging Analyses

A review of time-limited aging analyses (TLAA) involving the TN-40HT cask design and spent fuel assemblies stored in a TN-40HT cask was performed as a part of the ISFSI license renewal. TLAAs are defined as those licensee calculations or analyses that have all of the attributes listed in Section 9.8.3.

No TLAAs were identified for the spent fuel assemblies stored in a TN-40HT cask. Two analyses for the TN-40HT cask design were identified as having all six attributes of a TLAA. The first TLAA is an analysis of the basket aluminum components deadweight compressive stresses taking into account the effects of material creep. The second TLAA is an evaluation of neutron damage of the cask metallic components due to fast neutron irradiation.

The evaluation of basket aluminum components for long term storage deadweight is documented in Section A4B.1.5.6. The evaluation of the effect of fast neutron irradiation of the metals inside a TN-40HT cask is documented in Section A4.2.3.5. These sections demonstrate that the TLAAs are valid for the period of extended operation.

A9.8.4 High Burnup Fuel Monitoring Program

The Aging Management Review of the high burnup fuel spent fuel assemblies in a dry inert environment did not identify any aging effects/mechanisms that could lead to a loss of intended function. However, it is recognized that there has been relatively little operating experience, to date, with dry storage of high burnup fuel. Therefore, a High Burnup Fuel Monitoring Program will be used to confirm that the high burnup fuel assemblies' intended function(s) are maintained during the period of extended operations.

The High Burnup Fuel Monitoring Program relies upon the joint Electric Power Research Institute (EPRI) and Department of Energy (DOE) "High Burnup Dry Storage Cask Research and Development Project" (HDRP) (Reference 20) or an alternative program meeting the guidance in Interim Staff Guidance (ISG) 24, Reference 21, as a surrogate program to monitor the condition of high burnup spent fuel assemblies in dry storage.

Formal evaluations of the aggregate feedback from the HDRP and other sources of information will be performed at the specific points in time during the period of extended operation delineated in the table below. These evaluations will include an assessment of the continued ability of the high burnup fuel assemblies to continue to perform their intended function(s) at each point.

Toll Gate	Year *	Assessment
1	2028	Evaluate information obtained from the HDRP loading and initial period of storage along with other available sources of information. If the HDRP NDE (i.e., cask gas sampling, temperature data) has not been obtained at this point and no other information is available then NSPM has to provide evidence to the NRC that no more than 1% of the HBF has failed.

Toll Gate	Year *	Assessment
2	2038	Evaluate, if available, information obtained from the destructive (DE) and non-destructive (NDE) examination of the fuel placed into storage in the HDRP along with other available sources of information. If the aggregate of this information confirms the ability of the high burnup fuel assemblies to continue to perform intended function(s) for the remainder of the period of extended operations, subsequent assessments may be cancelled. If the HDRP DE of the fuel has not been examined at this point and no other information is available then NSPM has to provide evidence to the NRC by opening a cask or single effects surrogate experiments that the fuel performance acceptance criteria 1-4 in element 6 continue to be met.
3	2048	Evaluate any other new information.

* Assessments are due by April 4 of the year identified in the table

The above assessments are not, by definition, stopping points. No particular action other than performing an assessment is required to continue cask operation. To proceed, an assessment of aggregated available operating experience (both domestic and international), including data from monitoring and inspection programs, NRC-generated communications, and other information will be performed. The evaluation will include an assessment of the ability of the high burnup fuel assemblies to continue to perform their intended function(s).

A9.9 References

20. High Burnup Dry Storage Cask Research and Demonstration Project Final Test Plan, February 27, 2014, DOE Contract No.: DE-NE-0000593.

21. NRC Interim Staff Guidance 24, “The Use of a Demonstration Program as a Surveillance Tool for Confirmation of Integrity for Continued Storage of High Burnup Fuel Beyond 20 Years,” Revision 0, July 11, 2014.