PrairieIslandISFSIPEm Resource

From: Chesnutt, Samuel [Samuel.Chesnutt@xenuclear.com]
Sent: Monday, September 22, 2014 3:53 PM
To: Nguyen, John-Chau
Cc: Eckholt, Gene F.
Subject: PI ISFSI LRA, Response to 2nd RAI, Appendix A Rev 1
Attachments: LRA Appendix A revision 2014 07 29.doc

John,

As you requested, here is the MSWord version of Appendix A (Revision 1) to the Prairie Island ISFSI LRA, which includes the Aging Management Program (AMP). A pdf version of the AMP was included with the July 31 RAI Response. This is provided informally for your use in preparation of the SER.

Please note that in order to make this file look like the July 31 submittal, ensure that the Track Changes settings are set to "none" for Insertions, "Hidden" for Deletions, and "Right Border" for Changed Lines. We did not Accept the changes in order to preserve the margin marks.

Please let me know if you have any questions or issues.

Thanks,

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APPENDIX A

AGING MANAGEMENT PROGRAM

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APPENDIX A: AGING MANAGEMENT PROGRAM

A1.0 Introduction

This appendix is a summary of the activities that manage the effects of aging for the Independent Spent fuel Storage Installation (ISFSI) components that have been identified as being subject to Aging Management Review (AMR). The Aging Management Program (AMP) credited for the management of those aging effects and mechanisms identified for the Prairie Island ISFSI is the ISFSI Inspection and Monitoring Activities Program. This program is a subset of the Prairie Island Nuclear Generating Plant (PINGP) Structures Monitoring Program.

The ISFSI Inspection and Monitoring Activities Program is discussed in Section A2.0. That section provides a description of the ISFSI Inspection and Monitoring Activities Program which includes an introduction, an evaluation in terms of the attributes or elements of an effective Aging Management Program, and a summary. The ten elements, which are part of the ISFSI Inspection and Monitoring Activities Program, are also described. The results of an evaluation of each PINGP program element as compared to each NUREG-1927, "Standard Review Plan for Renewal of Independent Spent Fuel Storage Installation Licenses and Dry Cask Storage System Certificates of Compliance" (Subsection 3.6, Aging Management Program) program element are provided to evidence consistency.

Section 3.0, Aging Management Reviews, provides tables that summarize the results of the AMRs. These tables identify the Aging Management Activity (AMA) credited for managing each aging effect and mechanism for each component or subcomponent listed in the AMR. The AMA manages the aging effects and mechanisms, or the relevant conditions that could lead to those aging effects and mechanisms, applicable to each structure or component and provides reasonable assurance that the integrity of the structure or component will be maintained under current licensing basis conditions during the period of extended operation.

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. Reference A5.8 provides a listing of a significant amount of scientific analysis examining the long term performance of high burnup spent fuel. These analyses provide a sound foundation for the technical basis that long term storage of high burnup fuel, i.e., greater than 20 years, may be performed safely and in compliance with regulations. However, it is also recognized that scientific analysis is not a complete substitute for confirmatory operating experience. Therefore, Section A3, High Burnup Fuel Monitoring Program, describes a program to confirm that the high burnup fuel assemblies' intended function(s) are maintained during the period of extended operations. Although the program is a confirmatory program, the description below uses each attribute of an effective AMP as described in NUREG-1927 to the extent possible.

A2.0 ISFSI Inspection and Monitoring Program

The Prairie Island ISFSI provides for long-term dry fuel interim storage for spent fuel assemblies until such time that the spent fuel assemblies may be shipped off-site for final disposition. The casks presently utilized at the Prairie Island ISFSI are the Transnuclear TN-40 and TN-40HT (both of which have a 40 fuel assembly capacity) and are designed for outdoor storage. Accordingly, the exterior materials are capable of withstanding the anticipated effects of “weathering” under normal conditions.

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 casks, concrete pads or earthen berm.

A description of the ISFSI Aging Management Program is provided below using each attribute of an effective AMP as described in NUREG-1927 for the renewal of a site-specific Part 72 license.

A2.1 Scope of Program

A2.1.1 NUREG-1927 Program Element

NUREG-1927 Program Element 1, Scope of the Program, (Reference ~~A4~~A5.1) states “The scope of the program should include the specific structures and components subject to an AMR.”

A2.1.2 PINGP Program Element

The ISFSI Inspection and Monitoring Activities Program requires periodic inspection activities that monitor the condition of structures and components within the scope of License Renewal as the method used to manage aging effects.

The aging effects managed by this program are included in Table A2.1-1. The aging effects/mechanisms applicable to each structure and component are dependent upon their associated material/environment combinations, design, and installation. Those structures and components that have been grouped together for aging management review (~~i.e.~~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), ~~and~~

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.

A2.1.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 1, Scope of the Program.

A2.2 Preventive Actions

A2.2.1 NUREG-1927 Program Element

NUREG-1927 Program Element 2, Preventive Actions, (Reference ~~A4~~A5.1) states "Preventive actions should mitigate or prevent the applicable aging effects."

A2.2.2 PINGP Program Element

The ISFSI Inspection and Monitoring Activities Program consists of visual inspections, condition monitoring, and performance monitoring activities to detect degradation of structures and components before the loss of their intended function(s). No preventive or mitigating attributes are associated with these activities.

Aging effects of concrete due to aggressive chemicals were determined not to be applicable to the ISFSI concrete pads due to the lack of exposure to an aggressive chemical environment. To ensure this potential aging mechanism does not become applicable, monitoring of the ground water chemistry will be relied upon as a mitigation program to prevent aging effects from occurring.

A2.2.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 2, Preventive Actions.

A2.3 Parameters Monitored or Inspected

A2.3.1 NUREG-1927 Program Element

NUREG-1927 Program Element 3, Parameters Monitored or Inspected, (Reference ~~A4~~A5.1) states "Parameters monitored or inspected should be linked to the effects of aging on the intended functions of the particular structure and component."

A2.3.2 PINGP Program Element

The parameters monitored by the ISFSI Inspection and Monitoring Activities Program are consistent with those identified in industry codes and standards including Electric Power Research Institute (EPRI) Report 1002950, "Aging Effects for Structures and Structural Components (Structural Tools)," EPRI Report 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," EPRI Technical Report 1007933 "Aging Assessment Field Guide," and American Concrete Institute (ACI) report 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures". The parameters included in the program ensure degraded conditions are identified and corrected by clearly defining degraded condition criteria and associated corrective action requirements to prevent the loss of intended function. Industry and plant specific operating experience (OE) are also reviewed to ensure that parameters inspected focus on conditions identified during these OE reviews. See Table A2.1-1 for a detailed list of aging effects and mechanisms for structures and components inspected or monitored as required by the ISFSI Inspection and Monitoring Activities Program.

The ISFSI Inspection and Monitoring Activities Program also contains provisions to inspect the concrete pads whenever inaccessible (buried) areas are excavated, exposed, or modified.

<u>In-service casks inspections</u>

The condition of the exterior of each in-service cask is inspected visually to ensure the intended functions of the cask exterior are not compromised. Visual inspections will look for signs of damage or deterioration of the cask exterior surfaces. Additionally, the inspections will identify debris accumulating on the cask exterior surfaces. Debris may create the potential for localized conditions to support the corrosion process. The aging effect that is monitored by these inspections is loss of material. The intended functions that are monitored for these subcomponents include:

- Provides heat transfer (HT)
- Maintains a pressure boundary (PB)
- Provides radiation shielding (SH)
- Provides structural/functional support (SS)

<u>Interseal pressure monitoring</u>

The pressure of the helium cover gas is monitored to verify the integrity of the seals of the in-service cask lid and that the intended function is not compromised. The aging effect that is monitored by these inspections is loss of material. The intended function that is monitored for this subcomponent is:

- Maintains a pressure boundary (PB)

Radiation surveys

Radiation surveys (gamma and neutron) as well as continuous monitoring via thermoluminescent dosimeters (TLD) at the ISFSI site boundary are used to verify that the radiation levels remain within the specified limits and that the shielding materials in the in-service casks are intact and are effectively performing their intended function. Degradation in the effectiveness of the shielding material would be detected by a corresponding increase in radiation levels. The aging effects that are~~is~~ monitored by this monitoring are the~~is~~ loss of the gamma shielding material and cracking of the neutron shielding material. The intended function that is monitored for this subcomponent is:

- Provides radiation shielding (SH)

Concrete pad inspections

A visual inspection of the accessible areas of the concrete pads is performed to determine that no deterioration has occurred and that the intended function is not compromised. The aging effects that are monitored by these inspections are change in material properties, cracking and loss of material. The intended function that is monitored for this subcomponent is:

- Provides structural/functional support (SS)

Earthen berm inspections

The earthen berm surrounding the ISFSI is visually inspected to determine that no deterioration has occurred and that the intended function is not compromised. The aging effects that are monitored by these inspections are change in material properties, loss of form and loss of material. The intended function that is monitored for this subcomponent is:

- Provides radiation shielding (SH)

Lead cask inspections

Additionally, a visual inspection of an in-service cask bottom ("lead cask") was performed in June 2011, prior to the end of the current ISFSI license period. This visual inspection was performed to primarily ensure that there was no unanticipated degradation and the intended functions were not compromised. This inspection looked for signs of deterioration in the normally inaccessible area underneath the cask to determine the general condition of the cask bottom. This inspection was considered representative of the total population of the in-service casks based on the service period involved, material, and environment. The aging effect that was monitored by these inspections was loss of material.

A visual inspection under two in-service casks protective covers was also performed in June 2011, prior to the end of the current ISFSI license period. This visual inspection was primarily performed to ensure that there was no unanticipated degradation and the intended functions were not compromised. This inspection looked for signs of deterioration in the normally inaccessible area underneath the protective covers. This inspection was considered representative of the total population of the in-service casks based on the service period involved, materials, and environment. The aging effect that is monitored by these inspections was loss of material.

Ground Water Chemistry
Monitoring of ground water chemistry for Chloride, Sulfate, and pH is used to verify that the concrete pads are not being exposed to an aggressive chemical environment, thus preventing aging effects due to aggressive chemicals from occurring. The intended function monitored by this activity is:

- Provides structural/functional support (SS)

A2.3.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 3, Parameters Monitored or Inspected.

A2.4 Detection of Aging Effects

A2.4.1 NUREG-1927 Program Element

NUREG-1927 Program Element 4, Detection of Aging Effects, (Reference ~~A4~~A5.1) states "Detection of aging effects should occur before there is a loss of any structure and component intended function. This includes aspects such as method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection, and timing of new or one-time inspections to ensure timely detection of aging effects."

A2.4.2 PINGP Program Element

A condition examination is an acceptable method used to identify aging effects and is consistent with methods provided in industry codes and standards.

Additionally, the ISFSI Inspection and Monitoring Activities Program requires inspection personnel to be trained and technically qualified to perform these examinations. The personnel evaluating the structural examination results (concrete pads and earthen berm) are degreed engineers with one or more years of structural inspection experience. The personnel evaluating the cask examination results shall be qualified in accordance with PINGP site-specific requirements.

Quarterly visual inspections of the physical condition of the exterior surfaces of all in-service casks provide a means to detect degradation of these components due to potential loss of material and confirm that the intended functions are not compromised. The visual inspections of the casks will be performed with the unaided eye under general lighting conditions; mirrors, flashlights, and magnifiers may be used as an aid to visual inspections but are not required.

Pressure monitoring of all in-service casks is performed as a continuous process and checked daily for alarms. This provides a means to detect metallic O-ring seal degradation due to potential loss of material and confirm that the intended function is not compromised.

Radiation monitoring at the ISFSI boundary and quarterly radiation surveys (gamma and neutron) of the casks provide a means to detect shielding material degradation of the in-service casks and confirm that the intended function is not compromised.

Visual inspections of the accessible areas of the concrete pads every five years, and inspections of opportunity of inaccessible areas (e.g., if a cask is moved or excavation of a below grade portion), provide a means to detect degradation of these areas due to potential change in material properties, cracking, and loss of material. These inspections confirm that the intended function is not compromised.

Visual inspections of the earthen berm on a five-year frequency provide a means to detect degradation due to potential change in material properties, loss of form, and loss of material. These inspections confirm that the intended function is not compromised.

Visual inspections of the bottom of an in-service cask as an inspection of opportunity and, as a minimum, at 20-year intervals for the lead cask, provide a means to detect degradation of the bottom material due to potential loss of material and confirm that the intended functions are not compromised.

Visual inspections underneath the protective cover of an in-service cask as an inspection of opportunity and, as a minimum, at 20-year intervals for the lead cask, provide a means to detect degradation due to potential loss of material and confirm that the intended functions are not compromised.

Visual inspections of the ISFSI structures and components provide reasonable assurance that any degradation of the in-service casks, concrete pads, or earthen berm is identified and confirm that the structure or component intended function(s) is not compromised.

A review of plant-specific operating experience and industry operating experience for plants with similar materials and site conditions found that aging degradation occurs slowly over time and that an inspection frequency of once every five years was sufficient for the detection of aging effects before any loss of intended function for the concrete pads and earthen berm. This has also been confirmed by this same performance frequency of once every five years for those structures and components within the scope of the Maintenance Rule (10 CFR 50.65) such as the Reactor Containment Vessels, Shield Buildings, Auxiliary Buildings, etc. The ISFSI Inspection and Monitoring Activities Program contains provisions to accelerate the frequency of the examinations based on inspection results.

Monitoring of ground water chemistry is a mitigation activity and does not provide for detection of aging effects. Sampling well water and river water every six months for Chloride, Sulfate and pH provides a means to confirm that the concrete pads are not exposed to an aggressive chemical environment.

A2.4.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 4, Detection of Aging Effect.

A2.5 Monitoring and Trending

A2.5.1 NUREG-1927 Program Element

NUREG-1927 Program Element 5, Monitoring and Trending, (Reference ~~A4~~A5.1) states "Monitoring and trending should provide for prediction of the extent of the effects of aging and timely corrective or mitigative actions."

A2.5.2 PINGP Program Element

The ISFSI Inspection and Monitoring Activities Program, as a subset of the PINGP Structures Monitoring Program, requires monitoring the condition of structures and components using current and historical operating experience along with industry operating experience to detect, evaluate, and trend degraded conditions. When degraded conditions are detected and all associated corrective actions are complete, the structures and components are again monitored against established performance goals. The program ensures the original design basis for the structures and components is maintained by effectively managing the applicable aging effects.

Periodic visual inspections determine the potential existence of loss of material for the in-service cask exterior surfaces and accumulation of debris. The inspection frequency is quarterly. Pressure monitoring of each in-service cask to detect potential loss of material is provided as a continuous process and checked daily for alarms. Radiation levels at the ISFSI site are continuously monitored and are evaluated and recorded quarterly to detect the potential for shielding material degradation. Surveys associated with facility entry and/or cask placement are performed as required and supplement the overall radiation monitoring program. The concrete pads are visually inspected at least once every five years for any evidence of change in material properties, cracking, or loss of material. The earthen berm is visually inspected at least once every five years for any evidence of change in material properties, loss of form, and loss of material. A visual inspection of an in-service cask bottom and a visual inspection of the area underneath an in-service cask protective cover were performed in June 2011. Subsequent inspections of normally inaccessible areas of the cask bottoms and area underneath the protective cover will be performed on an inspection of opportunity basis and, as a minimum, at 20-year intervals for the lead cask.

All observations regarding the material condition of the ISFSI are recorded in inspection procedures. The ISFSI Inspection and Monitoring Activities Program includes a process used to evaluate past and current conditions of structures and components and to determine whether they represent an adverse trend or random deficiency indicative of normal aging. If degradation exceeds or appears that it will exceed that expected of a properly maintained structure or component, a corrective action is generated requiring further engineering evaluation. All degraded conditions that result in a corrective action are trended in accordance with the Corrective Action Program.

A2.5.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 5, Monitoring and Trending

A2.6 Acceptance Criteria

A2.6.1 NUREG-1927 Program Element

NUREG-1927 Program Element 6, Acceptance Criteria, (Reference ~~A4~~A5.1) states “Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the particular structure and component intended functions are maintained under the existing licensing-basis design conditions during the period of extended operation.”

A2.6.2 PINGP Program Element

The ISFSI Inspection and Monitoring Activities Program includes acceptance criteria for when the condition is to be entered into the Corrective Action Program ~~to evaluate the extent of a degraded condition and the need for corrective action~~ before ~~the~~ there is a loss of intended function. The acceptance criteria include sufficient detail to ensure timely detection of any degraded condition, followed by an evaluation in the Corrective Action Program to ensure that the particular structure or component intended function(s) is maintained under the existing licensing basis design conditions. Industry and plant-specific OE are also reviewed to ensure that the ISFSI Inspection and Monitoring Activities Program’s acceptance criteria focus on conditions identified during these OE reviews.

The acceptance criteria for all visual inspections of an in-service cask are the absence of any of the aging effects listed in Table A2.1-1, i.e., no observable indications of corrosion.

The acceptance criterion for interseal pressure monitoring is the absence of an alarmed condition. The alarm setpoint is higher than the interseal pressure specified in the Prairie Island ISFSI Technical Specification 3.1.5.

The acceptance criterion for radiation dose monitoring of an in-service cask is the absence of an increasing trend.

The acceptance criteria for all visual inspections of the concrete pads are consistent with, or more restrictive than, those contained in Section 5.2.1 of ACI 349.3R (Reference A5.6), i.e., the second-tier criteria.

The acceptance criteria for all visual inspections of the earthen berm are the absence of any of the aging effects listed in Table A2.1-1.

The acceptance criteria for the ground water chemistry monitoring are Chloride ≤ 500 ppm, Sulfate ≤ 1500 ppm, and a pH ≥ 5.5.

The “Structures Monitoring Program,” which invokes the ISFSI Inspection and Monitoring Activities Program, includes a three tiered classification of inspection findings, namely, “Acceptable,” “Acceptable with Deficiencies,” and “Unacceptable.” An “Acceptable” condition is described as a structure or component capable of performing its intended function free of unexpected deficiencies or degradation. The “Acceptable with Deficiencies” condition is described as a structure or component considered capable of performing its intended function, but has accelerated degradation or unexpected deficiencies which, without special attention, could shorten its design life. An “Unacceptable” condition refers to a structure or component that has been damaged or degraded such that it may not be capable of performing its intended function.

A2.6.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 6, Acceptance Criteria.

A2.7 Corrective Actions

A2.7.1 NUREG-1927 Program Element

NUREG-1927 Program Element 7, Corrective Actions, (Reference ~~A4~~A5.1) states “Corrective actions, including root cause determination and prevention of recurrence, should be timely.”

A2.7.2 PINGP Program Element

Northern States Power Company – Minnesota (NSPM) has a single Corrective Action Program that is applied regardless of the safety classification of the structure or component. The Corrective Action Program requirements are established in accordance with the requirements of the NSPM Quality Assurance Topical Report and 10 CFR 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.”

The Corrective Action Program procedures require the initiation of an Action Request for actual or potential problems including failures, malfunctions, discrepancies, deviations, defective material and equipment, nonconformances, and administrative control discrepancies, to ensure that conditions adverse to quality, operability, functionality, and reportability issues are promptly identified, evaluated if necessary, and corrected as appropriate. Guidance on establishing priority and timely resolution of issues is contained within the Corrective Action Program procedure.

All corrective actions for deviating conditions that are adverse to quality are performed in accordance with the requirements of the Quality Assurance Program which complies with the requirements of 10 CFR 50, Appendix B. Any resultant maintenance, repair/replacement activities, or special handling requirements are performed in accordance with approved procedures. Corrective actions provide reasonable assurance that deficiencies adverse to quality are either promptly corrected or are evaluated to be acceptable. Where evaluations are performed without repair or replacement, engineering analysis reasonably assures that the intended function is maintained consistent with the current licensing basis. If the deviating condition is assessed to be significantly adverse to quality, the cause of the condition is determined and an action plan is developed to preclude recurrence. Corrective actions identify recurring discrepancies and initiate additional corrective actions including root cause analysis to preclude recurrence.

Degraded conditions identified by the AMP inspections will be entered into the Corrective Action Program. Actions required to resolve inspection findings will be tracked to completion and trended within the Corrective Action Program.

A2.7.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 7, Corrective Actions.

A2.8 Confirmation Process

A2.8.1 NUREG-1927 Program Element

NUREG-1927 Program Element 8, Confirmation Process, (Reference ~~A4~~A5.1) states "The confirmation process should ensure that preventive actions are adequate and appropriate corrective actions have been completed and are effective."

A2.8.2 PINGP Program Element

The confirmation process is part of the NSPM Corrective Action Program and ensures that the corrective actions taken are adequate and appropriate, have been completed, and are effective. The focus of the confirmation process is on the follow-up actions that must be taken to verify effective implementation of corrective actions. The measure of effectiveness is in terms of correcting the adverse condition and precluding repetition of significant conditions adverse to quality. Procedures include provisions for timely evaluation of adverse conditions and implementation of any corrective actions required, including root cause evaluations and prevention of recurrence where appropriate. These procedures provide for tracking, coordinating, monitoring, reviewing, verifying, validating, and approving corrective actions, to ensure effective corrective actions are taken.

The Corrective Action Program is also monitored for potentially adverse trends. The existence of an adverse trend due to recurring or repetitive adverse conditions will result in the initiation of an Action Request. The AMP or AMAs will also uncover unsatisfactory conditions resulting from ineffective corrective action.

A2.8.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 8, Confirmation Process.

A2.9 Administrative Controls

A2.9.1 NUREG-1927 Program Element 9, Administrative Controls

NUREG-1927 Program Element 9, Administrative Controls, (Reference ~~A4~~A5.1) states "Administrative controls should provide a formal review and approval process."

A2.9.2 PINGP Program Element

The NSPM Quality Assurance Program, associated formal review and approval processes, and administrative controls applicable to the AMP and Aging Management Activities, are implemented in accordance with the requirements of the NSPM Quality Assurance Topical Report and 10 CFR Part 50, Appendix B. The administrative controls that govern AMAs at PINGP are established in accordance with the PINGP Administrative Control Program and associated Fleet Procedures.

A2.9.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 9, Administrative Controls.

A2.10 Operating Experience

A2.10.1 NUREG-1927 Program Element

NUREG-1927 Program Element 10, Operating Experience, (Reference ~~A4~~A5.1) states "Operating experience involving the AMP, including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support a determination that the effects of aging will be adequately managed so that the structure and component intended functions will be maintained during the period of extended operation."

A2.10.2 PINGP Program Element

The ISFSI Inspection and Monitoring Activities Program has been effective in maintaining plant structures and components. A review of ISFSI operating history provides evidence that any potential aging effects have been identified, evaluated, and managed effectively, ensuring that structures and components remain capable of performing their intended functions. It can be concluded that there is reasonable assurance that these structures and components will continue to perform their intended functions during the period of extended operation.

Routine Inspections

The Prairie Island ISFSI has been in operation since May of 1995. Visual inspections of the in-service casks, concrete pads, and earthen berm are performed in accordance with existing PINGP procedures. Inspections of the in-service casks to date have identified only minor cases of coating degradation which are corrected by touching-up of the existing coating material. There has been no evidence of loss of material under the degraded coating. No anomalies have been identified for the earthen berm. No anomalies of consequence have been identified for the concrete pads.

Lead Cask Inspections

Additional visual inspections of the normally inaccessible external surfaces of the in-service casks were evaluated for performance during a baseline inspection. The need and scope for these inspections were based on the above OE issues discussed below and the guidance in NUREG-1927 Appendix E – Component-Specific Aging Management (Reference ~~A4~~A5.1). NUREG-1927 Appendix E states "A staff-accepted way to verify canister condition at an independent spent fuel storage installation is by remote visual inspection of one or more canisters ("lead canisters"). A lead canister is selected on the basis of longest time in service, or hottest thermal load, and/or other parameters that contribute to degradation" (Reference ~~A4~~A5.1). Following this guidance, NSPM selected Cask TN-40 01 (Cask 01) as the lead cask because it had the longest in-service time of 16 years. The baseline inspection included inspection of the bottom of the cask (cask area in direct contact with the concrete pad) and underneath the protective cover. Due to industry OE concerning the area underneath the protective covers (water intrusion and bolt torque issues), this portion of the baseline inspection was expanded to include the inspection of a second in-service cask. As a result, Cask TN-40 13 (Cask 13) was also selected for inspection of the area underneath the protective cover.

The results of the cask bottom inspection revealed that approximately 25% of the protective coating on the bottom of Cask 01 exhibited loss of adhesion (peeling). In areas with loss of adhesion, the base metal did not exhibit any degradation that would affect the cask's intended function. The majority of the base metal was clean, however some corrosion and corrosion product stains were observed, mainly in areas where the epoxy coating itself was cracking. In those areas, the base metal did not have observable loss of material (no depth)~~measurable loss of material~~. Additionally, the concrete under the cask exhibited no visual signs of degradation. Therefore, the evaluation in the Corrective Action Program concluded that no corrective action was necessary.

With the protective cover removed, inspection of the area underneath the cover of Cask 01 was performed. During this inspection, no subcomponents within the scope of License Renewal exhibited any evidence of degradation. The observable area of the lid and lid bolt heads had no indication of corrosion. A coating of rust was found on the cask flange at the protective cover interface. This rust coating originated on the carbon steel protective cover, was deposited on the cask flange, and was easily removed. The removal of this coating revealed no degradation to the stainless steel overlay surface of the cask flange and no corrosion between the lid and flange in the main lid seal area. The neutron shield bolts were removed, inspected, and observed to have no indication of corrosion with the N-5000 lubricant still intact on the threads. The neutron shield protective coating exhibited no signs of corrosion.

The protective cover was found to have uniform corrosion on the flange sealing surface outside (external side) of the O-ring seal. There was minor corrosion around the protective cover bolt holes where the bolt heads had broken the epoxy coating due to friction upon installation. The underside of the protective cover dome had no signs of degradation. The protective cover O-ring seal remained in acceptable condition with the exterior coating on the protective cover exhibiting checking on approximately 15% to 20% of the surface area.

Inspection of the area underneath the protective cover of Cask 13 was also performed with the protective cover removed. During this inspection, no subcomponents within the scope of License Renewal exhibited any evidence of degradation. The observable area of the lid and lid bolt heads had no indication of corrosion. The stainless steel flange overlay had only small stains where rust from the protective cover was deposited. The stains were removed and there was no indication of corrosion on the observable area of the flange and no corrosion was observed between the lid and flange near the main lid seal area. The neutron shield bolts were removed and inspected with no indication of corrosion and also had the N-5000 lubricant still intact on the threads. The neutron shield had two rust stains on the protective coating directly below the access cover with one stain approximately six inches in diameter and the other approximately two inches in diameter. The protective cover was found to have corrosion on the interior. The corrosion appears to have started at the interior face of the access cover opening where the stainless steel overpressure system piping welded to the access plate made contact with the protective cover. The protective cover dome had evidence of corrosion in the area where it connected to the access plate. The access plate itself had corrosion on the entire interior surface excluding the area that was covered by the rubber gasket. However, none of these subcomponents exhibiting corrosion are within the scope of License Renewal.

The inspections performed for Cask 01 and Cask 13 with the protective covers removed were performed on those subcomponents not normally accessible and included the protective covers, access plates, neutron shields, neutron shield bolts, lid bolts, etc. Additionally, the torque values for the lid bolts were verified to address the industry OE discussed above. No degradation of any of the subcomponents within the scope of License Renewal were identified that would affect their intended function(s). Furthermore, the as-found lid bolt torque value met the original 1995 as-left torque value of 930 ft-lbs.

During the baseline inspections of Casks 01 and 13, the accessible areas of the casks were also inspected. The upper trunnions of Cask 01 exhibited some corrosion product stains on the top of the trunnion shaft. There was no indication of corrosion on all other areas inspected on Cask 01 and Cask 13.

A work order to repair the epoxy coating on Cask 01 upper trunnions, and additional cask coating surfaces was initiated. Based on the results of the above inspections, it was concluded that these structures and components remain capable of performing their intended functions throughout the period of extended operation.

Cask Interseal Pressure Monitoring

Trending of the in-service cask interseal helium pressures has revealed no issues with the seals or age related issues with the pressure monitoring system leak-tight integrity on any of the 29 in-service casks. However, there have been instances during extreme cold weather conditions when a low pressure alarm was received requiring the pressure monitoring system to be charged and the fittings tightened. These event-driven issues were a function of extreme temperature conditions and not age-related.

Radiation Surveys

NSPM performs periodic radiation surveys of the in-service casks. Trending of these surveys results shows no evidence that the shielding is degrading. Figure A2.10-1 provides the gamma dose rates at two meters from the three casks that have been in-service the longest. Figure A2.10-2 provides the neutron dose rates at two meters from the three casks that have been in-service the longest.

Corrective Action Program

A review of items in the Corrective Action Program and the "Structures Monitoring Program Quarterly Inspection Reports" was also performed. Minor maintenance items such as cleaning and painting of pull-box covers and transmitter base plates were identified for components which are not within the scope of License Renewal.

As previously discussed, inspections of the in-service casks identified minor cases of coating degradation. Touch-up of the coating material corrected this condition with no evidence of loss of material on the casks. There have been instances during extreme cold weather conditions, as previously discussed (last instance was January of 2010 with an ambient temperature of -20^{0}F), when a low pressure alarm was received on casks requiring the pressure monitoring system to be charged and the fittings tightened. These event-driven issues were a function of extreme temperature conditions and not age-related.

No other issues or findings were noted in the Corrective Action Program database relative to aging of the in-scope ISFSI structures and components.

Program Health Status Reports

The ISFSI Inspection and Monitoring Activities Program is a subset of the PINGP Structures Monitoring Program. A summary of the last two Structures Monitoring Program Inspection Reports that included ISFSI structures is provided below:

- Structures Monitoring Program, Quarterly Inspection Report Third Quarter 2001

  Shallow surface spalls were identified around the base plates of three of the monitor stands adjacent to the casks. These spalls were considered acceptable. It was recommended that monitoring be continued at the specified seven-year frequency.

Four shrinkage cracks were identified on the floor slab of the Equipment Storage Building (not within the scope of License Renewal). This condition was considered acceptable. It was recommended that monitoring be continued at the seven-year frequency. Abraded coatings and surface corrosion were also identified on the pull box frames, door frames and sills in addition to loose or missing nuts and washers at the building columns. A Work Request was initiated to correct these deficient conditions. Corrosion of the interseal pressure transmitter frames and supports, including pull box frames, pull box covers, ground clamps, and Environmental Monitor supports (not within the scope of License Renewal) was also identified. A Work Request was initiated to correct these deficient conditions.

- Structures Monitoring Program, Quarterly Inspection Report Second Quarter 2008

  A Work Request was initiated to excavate to sound material the spalled concrete identified in the 3Q01 inspection and then patch the area to prevent further degradation for the shallow surface spalls identified around the base plates of three of the monitor stands.

  Significant holes were found along the foundation of the Alarm Monitoring Building (not within the scope of License Renewal). A Work Request was initiated to correct these deficient conditions by filling these holes and compacting the affected soil.

  Although the inspections identified above noted minor issues that did not pose any challenges and were adequately monitored by existing PINGP procedures which required a seven-year inspection frequency, this frequency was subsequently changed to a five-year frequency in February of 2011. This change was performed to be consistent with the requirements of the Structures Monitoring Program and the Maintenance Rule and, as a result, increased the ISFSI inspection frequency from a seven year interval to a five year interval.

<u>System Health and Status Reports</u>
The actual status of the ISFSI is evaluated under the Prairie Island ISFSI System Monitoring and Reporting Tool, "Health and Status Report." As of July 2011, overall ISFSI performance was "Green" based on no operability concerns, no open corrective work orders and no overdue preventive maintenance work orders. There have not been any Licensee Event Reports associated with the Prairie Island ISFSI.

No issues or findings were noted relative to the ISFSI structures and components.

<u>NRC Inspection Reports</u>
NRC inspection reports issued during the period of February 28, 2005 through April 29, 2010 were reviewed for the ISFSI site.

No issues or findings were noted relative to the ISFSI structures and components.

Industry OE

EPRI Report 1002882, “Dry Cask Storage Characterization Project - Final Report” (Reference ~~A4~~A5.2), indicated the possibility of corrosion of the stainless steel fasteners for the rear breech plate which is located on the bottom of the CASTOR V/21 casks. Although NSPM does not utilize the CASTOR V/21 cask design, the concern was addressed as part of the baseline inspections discussed earlier in this section.

Virginia Electric and Power Company (Dominion) identified in the Surry ISFSI License Renewal Application (Reference ~~A4~~A5.3) corrosion of their Transnuclear TN-32 lid bolts and outer metallic lid seals. Dominion stated that the corrosion of the lid bolts and outer metallic seal was the result of external water intrusion in the vicinity of the bolts and seal. It was determined that the Conax connector seal for the electrical connector in the cask protective cover was leaking due to improper installation of the connector. This degradation was a function of improper installation and not age-related. However, as a result of this experience, the vendor, Transnuclear (TN), issued an Information Bulletin (Reference ~~A4~~A5.4) on these findings. The TN Information Bulletin informed all TN storage cask users of two issues that occurred at Dominion’s Surry Power Station involving the TN-32 Storage Casks.

The first issue concerned the Helicoflex metallic seals utilized in the cask lid. Beginning in December 1999, five low-pressure alarms occurred over a six month period. These alarms were investigated and attributed to loose or leaking pressure switches. The installed Ashcroft pressure switches were replaced with Wasco pressure switches for both Surry and North Anna. Future TN casks use the new Wasco pressure switch. This issue was a design and installation issue and not age-related.

As a result of this issue, Dominion brought five casks back to the fuel pool area from the ISFSI for lid removal. The lid seals were removed and examined both visually and microscopically and revealed that the outer metallic seal contained small thru-wall holes caused by corrosion of the outer aluminum seal jacket. No corrosion was observed on the inner containment seal nor was any leakage detected past the inner seal; therefore, containment of the cask was never compromised. Corrosion was also observed on two of the five casks’ lid edges where metallic spray and/or paint did not fully cover the surface. The casks showed evidence of water intrusion and/or high humidity inside the protective cover. In some cases, residue from standing/pooling water under the lid was observed. In the presence of water, the galvanic couple between aluminum and stainless steel is sufficient to cause corrosion. It had been concluded that theTN-32 design with aluminum metallic seals is sensitive to galvanic corrosion occurring if standing water or humid conditions near saturation are experienced under the protective cover.

The TN-32 casks at Surry were a unique design in terms of the protective cover and the overpressure (OP) system. The OP system utilized pressure switches attached directly to the OP tank with electrical wires emerging from the top of the protective cover through a Conax fitting. Water entered the protective cover through the Conax fitting at the apex of the dome, due to the Conax connectors not being properly installed on the casks. This issue was a design and installation issue and not age-related. A new protective cover and OP system was retrofitted to the existing casks consistent with other TN metal storage casks with tubing to the OP tank through a bolted and gasketed cover plate located on the protective cover (similar to the TN-40 and TN-40HT cask design). Thus, the potential leak path through the Conax connection at the top of the cover was eliminated.

TN stated that the Surry site location may have exacerbated the corrosion issue due to the brackish environment and the presence of chlorides in the water from precipitation or humidity which would accelerate a galvanic reaction. Although the Prairie Island ISFSI site is not located in an area that is exposed to a brackish environment, NSPM has conservatively included loss of material due to galvanic corrosion for aluminum as a potential aging mechanism in the ISFSI Atmosphere/Weather environment.

The second issue discussed in the TN bulletin was identified upon returning the Surry casks to the fuel pool area to remove the lid. It was discovered that some lid bolts on three casks did not have the original torque value applied prior to placement of the casks at the ISFSI. Lid bolts could be removed by hand on two casks. However, in all cases there was no evidence that the lid metallic O-rings lost their seal due to the reduced bolt torque. A majority of the hand-tight bolts were identified at locations that are tightened early in the “star” torquing sequence. Evaluations by TN confirmed that the lid seals would remain compressed and containment would be maintained.

Consensus was that a change in bolt torquing sequence methodology should be taken to mitigate the possibility of thermal expansion causing the bolting problems. TN stated that it was common practice for the final torque on the lid bolts to be applied after thermal equilibrium of the cask was obtained. This would translate into using an intermediate lid bolt torque value during the draining and vacuum drying operations. A minimum of two passes should be utilized in the star pattern and additional passes made as necessary until there is no further movement of the bolts. Additionally, lubricant should be applied to the bolts and special attention paid to the calibration of the bolt torquing equipment. TN recommended the use of Neolube or Loc-Tite N-5000 as the lubricant. Additional information on this subject may be found in the TN Information Bulletin.

Similar operating experience was identified with the TN-68 casks utilized at the Peach Bottom Atomic Power Station (Reference ~~A4~~A5.5). This information was evaluated in NSPM’s review of the operating experience.

In response to the bolting issues, the vendor recommended a bolt torquing sequence methodology and application of Loc-Tite N-5000, as stated above.

These recommendations have been addressed at PINGP and are incorporated in the applicable existing PINGP maintenance procedures.

Precedent License Renewal Applications OE
A review of precedent ISFSI license renewal applications was performed to evaluate any relevant operating experience. ISFSIs included in this review were Calvert Cliffs Nuclear Power Plant, H. B. Robinson Steam Electric Station, and Surry Power Station. The results of these reviews concluded that the Prairie Island ISFSI Inspection and Monitoring Activities Program is effective in monitoring and detecting degradation and taking effective corrective actions as needed to preclude loss of intended function.

Conclusion
The OE, reviews, and monitoring described above confirm that any potential aging effects will be identified, evaluated, and managed effectively, ensuring that these structures and components remain capable of performing their intended functions.

A2.10.3 Comparison to NUREG-1927 Program Element

This PINGP program element is consistent with NUREG-1927, Element 10, Operating Experience.

A3.0 HIGH BURNUP FUEL MONITORING PROGRAM

The Prairie Island ISFSI provides for long-term dry fuel interim storage for high burnup spent fuel assemblies, i.e., fuel assemblies with discharge burnups greater than 45 GWD/MTU, until such time that the spent fuel assemblies may be shipped off-site for final disposition. The cask system presently utilized at the Prairie Island ISFSI for the storage of high burnup spent fuel is the Transnuclear TN-40HT which has a 40 fuel assembly capacity and is designed for outdoor storage.

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. Reference A5.8 provides a listing of a significant amount of scientific analysis examining the long term performance of high burnup spent fuel. These analyses provide a sound foundation for the technical basis that long term storage of high burnup fuel, i.e., greater than 20 years, may be performed safely and in compliance with regulations. However, it is also recognized that scientific analysis is not a complete substitute for confirmatory operating experience. Therefore, the purpose of the High Burnup Fuel Monitoring Program is to confirm that the high burnup fuel assemblies' intended function(s) are maintained during the period of extended operations.

A description of the High Burnup Fuel Monitoring Program is provided below. Although the program is a confirmatory program, the description below uses each attribute of an effective AMP as described in NUREG-1927 for the renewal of a site-specific Part 72 license to the extent possible.

A3.1 AMP Element 1: Scope of the Program

Fuel Stored in a TN-40HT Cask is limited to an assembly average burnup of 60 GWd/MTU (note that the nominal burnup value is lower to account for uncertainties). The cladding materials for the Prairie Island high burnup fuel are Zircaloy-4 and Zirlo™, and the fuel is stored in a dry helium environment. High burnup fuel was first placed into dry storage in a TN-40 HT cask on April 4, 2013.

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 A5.9) or an alternative program meeting the guidance in Interim Staff Guidance (ISG) 24, Reference A5.10, as a surrogate program to monitor the condition of high burnup spent fuel assemblies in dry storage.

The HDRP is a program designed to collect data from a spent nuclear fuel storage system containing high burnup fuel in a dry helium environment. The program entails loading and storing a TN-32 bolted lid cask (the Research Project Cask) at Dominion Virginia Power's North Anna Power Station with intact high burnup spent nuclear fuel (with nominal burnups ranging between 53 GWd/MTU and 58 GWd/MTU). The fuel assemblies to be used in the program include four different kinds of cladding (Zircaloy-4, low-tin Zircaloy-4, Zirlo™, and M5™). The Research Project Cask is to be licensed to the temperature limits contained in ISG-11, Reference A5.7, and loaded such that the fuel cladding temperature is as close to the limit as practicable. Aging effects will be determined for material/environment combinations per ISG-24 Rev. 0 or the "High Burnup Dry Storage Cask Research and Development Project" (HDRP).

A3.2 AMP Element 2: Preventive Actions

The High Burnup Fuel Monitoring Program consists of condition monitoring to confirm there is no degradation of a high burnup fuel assembly that would result in a loss of intended function(s). Other than the initial design limits placed on loading operations, no preventive or mitigating attributes are associated with these activities.

During the initial loading operations of the TN-40HT casks, the design and ISFSI Technical Specifications (TS) require that the fuel be stored in a dry inert environment. TS 3.1.1, "Cask Cavity Vacuum Drying," demonstrates that the cask cavity is dry by maintaining a cavity absolute pressure less than or equal to 10 mbar for a 30 minute period with the cask isolated from the vacuum pump. TS 3.1.2, "Cask Helium Backfill Pressure," requires that the cask then be backfilled with helium. These two TS requirements ensure that the high burnup fuel is stored in an inert environment thus preventing cladding degradation due to oxidation mechanisms. TS 3.1.2 also requires that the helium environment be established within 34 hours of commencing cask draining. This time requirement ensures that the peak cladding temperature remains below 752°F (i.e., the temperature specified in ISG-11), thus mitigating degradation due to cladding creep.

A3.3 AMP Element 3: Parameters Monitored/ Inspected

Either the surveillance demonstration program as described in the HDRP or an alternative program should meet the guidance of ISG-24, Rev. 0.

A3.4 AMP Element 4: Detection of Aging Effects

Either the surveillance demonstration program as described in the HDRP or an alternative program should meet the guidance of ISG-24, Rev. 0.

A3.5 AMP Element 5: Monitoring & Trending

As information/data from a fuel performance surveillance demonstration program becomes available, NSPM will monitor, evaluate, and trend the information via its Operating Experience Program and/or the Corrective Action Program to determine what actions should be taken to manage fuel and cladding performance, if any.

Similarly, NSPM will use its Operating Experience Program and/or Corrective Action Program to determine what actions should be taken if it receives information/ data from other sources than the demonstration program on fuel performance.

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, unless noted in this AMP, 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).

A3.6 AMP Element 6: Acceptance Criteria

- The HDRP or any other demonstration used to provide fuel performance data should meet the acceptance criteria guidance of ISG-24 Rev 0.
- If any of the following fuel performance criteria are exceeded in the HDRP or alternative program, a corrective action is required[1]:
    1. Cladding Creep: total creep strain extrapolated to the total approved storage duration based on the best fit to the data, accounting for initial condition uncertainty shall be less than 1%
    2. Hydrogen – maximum hydrogen content of the cover gas over the approved storage period shall be extrapolated from the gas measurements to be less than 5%
    3. Drying – The moisture content in the cask , accounting for measurement uncertainty, shall indicate no greater than one liter of residual water after the drying process is complete

[1] While it is not a fuel performance criteria, the spatial distribution and time history of the temperature must be known to evaluate the relationship between the performance of the rods in the HDRP and the HBF rod behavior expected in the TN-40HT cask.

4. Fuel rod breach – fission gas analysis shall not indicate more than 1% of the fuel rod cladding breaches

A3.7 AMP Element 7: Corrective Actions

The NSPM Corrective Action Program commensurate with 10 CFR 50 Appendix B will be followed.

In addition, at each of the assessments in AMP Section 5, the impact of the aggregate feedback will be assessed and actions taken when warranted. These evaluations will address any lessons learned and take appropriate corrective actions, including:

- Perform repairs or replacements
- Modify this confirmatory program in a timely manner
- Adjust age-related degradation monitoring and inspection programs (e.g., scope, ~~0~~frequency)
- Actions to prevent reoccurrence
- An evaluation of the DCSS to perform it's safety and retrievability functions
- Evaluation of the effect of the corrective actions on this component to other safety components.

A3.8 AMP Element 8: Confirmation Process

The confirmation process is part of the NSPM Corrective Action Program and ensures that the corrective actions taken are adequate and appropriate, have been completed, and are effective. The focus of the confirmation process is on the follow-up actions that must be taken to verify effective implementation of corrective actions. The measure of effectiveness is in terms of correcting the adverse condition and precluding repetition of significant conditions adverse to quality. Procedures include provisions for timely evaluation of adverse conditions and implementation of any corrective actions required, including root cause evaluations and prevention of recurrence where appropriate. These procedures provide for tracking, coordinating, monitoring, reviewing, verifying, validating, and approving corrective actions, to ensure effective corrective actions are taken.

A3.9 AMP Element 9: Administrative Controls

The NSPM Quality Assurance Program, associated formal review and approval processes, and administrative controls applicable to this program and Aging Management Activities, are implemented in accordance with the requirements of the NSPM Quality Assurance Topical Report and 10 CFR Part 50, Appendix B. The administrative controls that govern AMAs at PINGP are established in accordance with the PINGP Administrative Control Program and associated Fleet Procedures.

A3.10 AMP Element 10: Operating Experience

Surrogate surveillance demonstration programs with storage conditions and fuel types similar to those in the dry storage system that satisfies the ISG-24 acceptance criteria are a viable method to obtain operating experience. NSPM intends to rely on the information from the HDRP with similar types of HBU fuel. The HDRP is viable as a surrogate surveillance program. Additional data/research to assess fuel performance from both domestic and international sources that are relevant to the fuel in the NSPM casks will also be used.

A~~3~~4.0 Summary

The review of operating experience identified a number of incidents related to dry fuel storage. Although many of these were event-driven and most were not age-related, for those that did involve credible aging effects and mechanisms, evaluations were conducted to assess potential susceptibility. These evaluations indicated that the aging effects and mechanisms that were identified at the Prairie Island ISFSI are bounded by the Aging Management Reviews that were performed for those structures and components identified as within the scope of License Renewal.

Operating experience to date has not indicated any degradation that would affect the structures or component intended function(s). Inspections, monitoring, and surveillances continue to be conducted that would identify deficiencies. The Corrective Action Program is in place to track and correct deficiencies in a timely manner. Corrective actions have been effectively implemented when inspection and monitoring results have indicated degradation. Continued implementation of the ISFSI Inspection and Monitoring Activities Program and the High Burnup Fuel Monitoring Program provide~~s~~ reasonable assurance that the aging effects will be managed such that the intended functions will be maintained during the period of extended operation.

~~A4~~A5.0 References (Appendix A, Aging Management Program)

~~A4~~A5.1 NUREG-1927, *Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance*, March 2011.

~~A4~~A5.2 EPRI Report 1002882, *Dry Cask Storage Characterization Project, Final Report*, September 2002.

~~A4~~A5.3 Letter from D.A. Christian, Virginia Electric and Power Company to D.A. Cool (NRC), *Surry Independent Spent Fuel Storage Installation License Renewal Application*, dated April 29, 2002, ADAMS Accession Number ML021290068.

~~A4~~A5.4 Transnuclear Information Bulletin, April 2001.

~~A4~~A5.5 Letter from G. L. Stathes, Exelon Generation Company to Director Spent Fuel Project Office (NRC), *Submittal of Independent Spent Fuel Storage Installation (ISFSI) Cask Event Report*, dated December 01, 2010, ADAMS Accession Number ML110060275.

A5.6 American Concrete Institute, ACI 349.3R-96, *Evaluation of Existing Nuclear Safety-Related Concrete Structures*, January 1996.

A5.7 NRC Interim Staff Guidance 11, *Cladding Considerations for the Transportation and Storage of Spent Fuel*, Revision 3, November 17, 2003.

A5.8 Letter from R. McCullum (NEI) to M. Lombard (NRC), dated March 22, 2013, *Industry Analysis and Confirmatory Information Gathering Program* *to Support the Long-Term Storage of High Burnup Fuel (HBF)*, (ADAMS Accession No. ML13084A045).

A5.9 High Burnup Dry Storage Cask Research and Development Project Final Test Plan, February 27, 2014, DOE Contract No.: DE-NE-0000593.

A5.10 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.

TABLE A2.1-1
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	Cracking5	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)

Figure A2.10-1
Two Meter Gamma Dose Rates

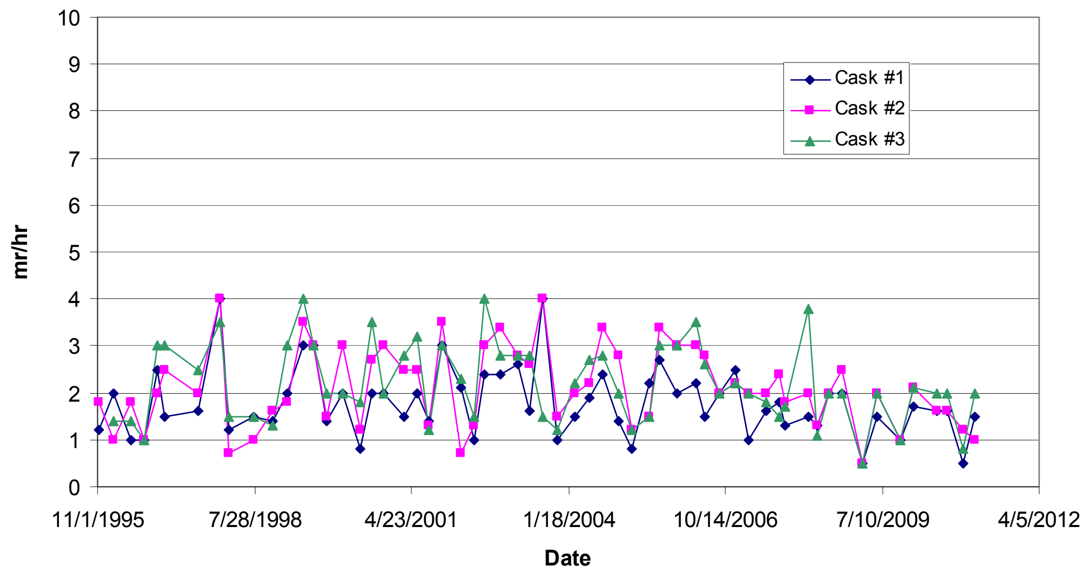

Figure A2.10-2
Two Meter Neutron Dose Rates