UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 23, 2016

Mr. Daniel G. Stoddard
Senior Vice President and Chief Nuclear Officer
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060-6711

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR REVIEW OF THE APPLICATION FOR RENEWAL OF THE NORTH ANNA POWER STATION INDEPENDENT SPENT FUEL STORAGE INSTALLATION LICENSE NO. SNM-2507 (CAC NO. L25121)

Dear Mr. Stoddard:

By letter dated May 25, 2016, Virginia Electric and Power Company (Dominion) submitted an application for renewal of License No. SNM-2507 for the North Anna Power Station Independent Spent Fuel Storage Installation (ISFSI) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16153A140). In my letter dated, July 21, 2016, I acknowledged acceptance of your application for a detailed technical review and provided a proposed schedule for U.S. Nuclear Regulatory Commission (NRC) review (ADAMS Accession No. ML16207A104).

In connection with the NRC staff's review, we need the information identified in the enclosed request for additional information (RAI). We request that you provide this information by January 19, 2017. Inform us at your earliest convenience, but no later than January 5, 2017, if you are not able to provide the information by that date. To assist us in re-scheduling your review, you should include a new proposed submittal date and the reasons for the delay. Discussion of the RAIs and RAI response date occurred on November 16, 2016.

The NRC staff is also reviewing a license amendment request from Dominion for authorization to store high-burnup fuel (HBF) in a modified TN-32B cask under License No. SNM-2507, and the staff expects to complete its review in the first quarter of 2017. If the NRC approves the HBF amendment request, the HBF cask would then be a part of the licensing bases for the ISFSI and would need to be addressed in the license renewal application. In the case that NRC approves the HBF amendment request, we request that you address the HBF cask in a supplement to the license renewal application within 30 days following the amendment issuance. This was the subject of a July 14, 2016, meeting (ADAMS Accession No. ML16207A310) and was discussed in the November 16, 2016, teleconference.

Please reference Docket No. 72-16 and CAC No. L25121 in future correspondence related to this request. The staff is available to clarify these questions, and if necessary, to meet and discuss your proposed responses.

If you have any questions regarding this matter, please contact me at (301) 415-7116 or Kristina.Banovac@nrc.gov.

Sincerely,

/RA/

Kristina L. Banovac, Project Manager
Renewals and Materials Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
and Safeguards

Docket No. 72-16
License No. SNM-2507

CAC No. L25121

Enclosure: Request for Additional Information

cc: North Anna Service List
North Anna ISFSI Renewal Service List

If you have any questions regarding this matter, please contact me at (301) 415-7116 or Kristina.Banovac@nrc.gov.

Sincerely,

/RA/

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Docket No. 72-16
License No. SNM-2507

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Enclosure: Request for Additional Information

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North Anna ISFSI Renewal Service List

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OFC	NMSS/DSFM/ RMB	NMSS/DSFM/ RMB	NMSS/DSFM/ RMB	NMSS/DSFM/ CSRAB	NMSS/DSFM/ CSTB
NAME	KBanovac	TAhn	JWise	MCall for ZLi	DTang
DATE	10 / 20 /16	10 / 31 /16	10 / 25 /16	10 / 28 /16	10 / 26 /16
OFC	NMSS/FCSE/ ERB	NMSS/FCSE/ ERB	NMSS/DSFM/ SFLB	NMSS/DSFM/ CSRAB	NMSS/DSFM/ CSTB
NAME	JTrefethen	DDiaz-Toro	WWheatley	TTate	JPiotter
DATE	10/ 28 /16	10 / 28 /16	11 / 3 /16	11 / 14 /16	11 / 8 /16
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Request for Additional Information
Virginia Electric and Power Company (Dominion)
Docket No. 72-16
License No. SNM-2507
License Renewal

By letter dated May 25, 2016, Virginia Electric and Power Company (Dominion) submitted an application for renewal of License No. SNM-2507 for the North Anna Power Station (NAPS) Independent Spent Fuel Storage Installation (ISFSI). This request for additional information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission (NRC) staff in connection with its review of the renewal application. The requested information is listed by chapter number and title in the application. NUREG-1927, Revision 1, "Standard Review Plan for Renewal of Specific Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel" and NUREG-1748, "Environmental Review Guidance for Licensing Actions Associated with NMSS Programs" were used by the staff in its review of the application.

Each individual RAI describes information needed by the staff for it to complete its review of the application and to determine whether the applicant has demonstrated compliance with the regulatory requirements.

Chapter 1 – General Information

RAI 1-1

Provide the following additional information with respect to cumulative impacts for all resource areas. If no impact is expected please make a statement to that effect.

1. Clarify the amount of spent fuel expected to be generated by NAPS Unit 1 and Unit 2 throughout their license life and the amount of ISFSI storage capacity necessary to accommodate the generated spent fuel.

2. Dominion anticipates expanding the general-licensed ISFSI to store additional spent fuel from Units 1 and 2. Provide a description of the plans to expand the general-licensed ISFSI, including construction of additional pads and their locations. Discuss the potential cumulative impacts of this potential expansion for all resource areas. Provide a description of and quantify, where possible, the factors considered in evaluating the potential cumulative impacts. Provide mitigation measures that have been or would be taken to reduce or avoid potential cumulative impacts.

3. The specific-licensed ISFSI is authorized to store 84 TN-32 sealed surface storage casks on three pads. The general-licensed ISFSI Pad 2 occupies the location identified for a second pad under the specific-licensed ISFSI. Explain the process followed to locate the general-licensed ISFSI Pad 2 here and clarify whether this process would be used to locate any future pads under the general-licensed ISFSI.

4. Discuss the potential cumulative impacts of construction and operation of the proposed third nuclear power unit, designated as Unit 3.

Dominion's Environmental Report (ER) Supplement, submitted as part of the license renewal application, includes a description of the following activities associated with the NAPS, but that are not part of the license renewal request:

- Continued operation of the NAPS Units 1 and 2. These units operate under separate NRC licenses (NPF–4 and NPF–7, respectively) that will expire in 2038 and 2040, respectively. In the ER Supplement, Dominion states it considered the potential cumulative impacts of the ISFSI continued operations with the NAPS Units 1 and 2 operations.

- North Anna Unit 3 Combined License Application (COLA) is currently under review by the NRC. Dominion is proposing to construct and operate a third nuclear power unit, designated as Unit 3. In the ER Supplement, Dominion states it considered the potential cumulative impacts of the ISFSI continued operations with the reasonably foreseeable future action of construction and operation of the proposed Unit 3.

- General-licensed ISFSI Pad 2, which is located adjacent to the specific-licensed ISFSI Pad 1. In the ER Supplement, Dominion explains that it has no plans to expand the pad capacity under the specific-licensed ISFSI beyond Pad 1, but it retains the authority to do so. Dominion further clarifies that the potential environmental impacts of such expansion are considered and discussed in the ER Supplement (see page E-2). Dominion also explains that future dry cask storage of spent fuel at NAPS, including construction of any additional pads, would be anticipated to occur under the general license (see page E-3).

Although the proposed license renewal only applies to the NAPS specific-licensed ISFSI Pad 1, these actions are considered past, present, or reasonably foreseeable future actions that could affect the same resources impacted by the proposed action. The NRC will consider these actions in its cumulative impact analysis of the environmental review.

This information is necessary for the NRC staff to assess the environmental impacts of the proposed action, as required by 10 CFR 51.30.

RAI 1-2

Provide a description of all maintenance or aging management activities that Dominion anticipates carrying out over the proposed 40-year renewal period and discuss the environmental impacts from such activities.

In the ER Supplement, Dominion states that no construction or refurbishment beyond normal maintenance and aging management is currently planned for TN-32 dry cask storage. Dominion further explains that maintenance activities, such as re-coating the casks, are the only activities expected over the proposed 40-year period of extended operation, and that there would be no environmental impacts from refurbishment or construction beyond those analyzed in the original environmental assessment (see page E-28).

This information is necessary for the NRC staff to assess the environmental impacts of the proposed action, as required by 10 CFR 51.30.

RAI 1-3

Describe the NAPS' radiological protection programs that the specific-licensed ISFSI relies on for safe operation. Also, discuss how Dominion plans to maintain those NAPS' radiological protection programs that the specific-licensed ISFSI relies on after the expiration of the license for, or shutdown of, Units 1 and 2 (whichever comes first).

In the ER Supplement, Dominion states that the design and operational features of the TN-32 dry storage casks, along with the NAPS' radiological protection program, mitigate radiological impacts (see page E-28). If the specific-licensed ISFSI license renewal request is approved, the license would expire in 2058. The NAPS Units 1 and 2 licenses, however, expire in 2038 and 2040, respectively.

This information is necessary for the NRC staff to assess the environmental impacts of the proposed action, as required by 10 CFR 51.30.

Finally, the information the NRC uses to conduct and inform its National Environmental Policy Act environmental reviews, including the information in the ER Supplement, must be publicly available, as appropriate. Therefore, please ensure that the information included in response to RAIs 1-1 to 1-3 can be made publicly available.

Chapter 2 – Scoping Evaluation

RAI 2-1

Provide justification for excluding the lift beam and cask lid handling tools from the scope of renewal. Alternatively, include these components in the renewal scope, provide an aging management review, and describe the aging management activities used to manage the identified aging effects.

Table 2.3-2 of the renewal application states that the lift beam and lid handling tools are important to safety; however, these components were excluded from the scope of renewal based on the existence of inspection activities already performed to meet the requirements of the reactor operating license. However, NUREG-1927, Revision 1, states that all important-to-safety structures, systems, and components (SSCs) should be within the scope of renewal and should be addressed with an aging management review. Also, 10 CFR 72.42(a) states that renewal applications should include descriptions of aging management programs (AMPs) for the management of aging issues for SSCs important to safety.

The staff notes that the existence of current site monitoring and inspection procedures is not recognized in the NRC regulations and guidance as a basis for excluding SSCs from the scope of renewal. It is the staff's expectation that an aging management review be performed on all important-to-safety SCCs and, if appropriate, any existing activities that address aging management be incorporated by reference into the ISFSI renewal documentation.

This information is required to determine compliance with 10 CFR 72.42(a).

RAI 2-2

Provide information to show that the earth berm is not credited in the calculations of dose at the controlled area boundary and justify that the berm should not be included in the renewal scope. Alternatively, include the berm in the scope of renewal and provide an aging management review and adequate aging management program for managing the aging effects of the berm.

In Table 2.3-2, Scoping Results, of the license renewal application for the NAPS specific-licensed ISFSI, the licensee states, "The ISFSI SAR Section 7.3.2 states: 'An earth berm was constructed inside the north and east perimeter fences of the ISFSI to reduce direct radiation.' The berm is not addressed in Technical Specifications or the Safety Evaluation Report. Additionally, the 10 CFR Parts 20, 72.104 and 72.106 dose analyses do not credit the berm as providing shielding."

Appendix A.1 of the "North Anna Power Station Units 1 & 2, Independent Spent Fuel Storage Installation (ISFSI), Safety Analysis Report" (ISFSI SAR) states, "The North Anna ISFSI Technical Specifications, and the TSAR, Revision 9A, however will govern the use of TN-32, Revision 0, casks at the North Anna ISFSI, except to the extent that specific analyses (e.g., criticality or thermal performance) from the FSAR, Revision 0, have been added to the ISFSI SAR."

Section 7.3.2.1 of the ISFSI SAR states that the shielding analyses performed for the TN-32 cask is described in "TN-32 Dry Storage Cask Final Safety Analysis Report, Revision 0, January 2000," (FSAR, Revision 0), listed as reference 1 in Section 7.3.4 of the ISFSI SAR. The staff did not find any other referenced analysis or discussion on the modeling of the earth berm within the shielding analysis and therefore assumes that the analysis used for shielding is that of FSAR, Revision 0.

However the modeling assumptions within FSAR, Revision 0 with respect to the earth berm are not consistent with the statement that the berm is not credited in the 10 CFR Parts 20, 72.104 and 72.106 dose analyses. For example, page 10.2-2 of the FSAR, Revision 0, states, "For the skyshine analyses, an earthen berm was added to the basic long distance models. The berm was modeled as 4.2 meters high and was located 20 meters from the cask centerline." In addition, on page 10.2-2 of the same document, it states, "The dose rates from a typical ISFSI are evaluated based on the sky shine results from a single cask (without inserts) and assuming the presence of a berm." Also, from the MCNP input file on pages 5.5-26 to 5.5-29, it appears that the earth berm is included in the MCNP model (particularly cells 740, 780, 800, etc.), though the note on the input file states that there is no berm. Page 10.2-2 of the FSAR, Revision 0, also states that dose rates at the site boundary will depend on specific parameters, such as the presence of the berm; however, the staff did not find detailed information on how this is done at NAPS.

The applicant should clarify the licensing basis for the shielding and radiation protection evaluation for the NAPS specific-licensed ISFSI. If it is FSAR, Revision 0, the applicant should provide details on how the berm is excluded from the model. If the berm is credited in the shielding model, the applicant needs to justify why the earth berm is scoped out of the renewal. Otherwise, the berm should be scoped into the renewal and an aging management review conducted and adequate aging management program provided for the berm.

The NRC staff needs this information to determine compliance with 10 CFR 72.42(a), 10 CFR 72.104, 10 CFR 72.106, and 10 CFR 20.1301(a) and (b).

RAI 2-3

If the NRC issues the license amendment for authorization to store high-burnup fuel (HBF) in a modified TN-32B cask under License No. SNM-2507, the staff requests Dominion, within 30 days following the amendment issuance, provide information on the HBF cask and whether the HBF itself, or any new SSCs that make up the cask modifications, are within the scope of license renewal and subject to an aging management review. The staff also requests updated application documents, as appropriate, to address the HBF cask.

Dominion has submitted a license amendment request for authorization to store HBF in a modified TN-32B cask under License No. SNM-2507, which is still under review by the staff in a separate licensing action. If the NRC approves the HBF amendment request, the HBF cask would then be a part of the licensing bases for the NAPS ISFSI and would need to be addressed in the license renewal application. Due to the concurrent timing of two review activities (i.e. the license amendment request to store HBF and the license renewal) and in order to ensure proper consideration of the two reviews, the NRC requests clarification on how Dominion will address the HBF cask in the renewal application.

This information is needed to determine compliance with 10 CFR 72.42(a).

RAI 2-4

Clarify how the licensing basis for the shielding and radiation protection evaluation for the NAPS specific-licensed ISFSI is maintained during the requested period of extended operation, considering storage of additional radioactive materials at the NAPS under different licenses (e.g., general-licensed ISFSI).

The NAPS ISFSI SAR includes dose analyses to demonstrate that the specific-licensed ISFSI meets the regulatory requirements of 10 CFR 72.104(a), which requires inclusion of dose contributions from other facilities (including new ISFSIs under different licenses) near the specific-licensed ISFSI. The NAPS ISFSI SAR discusses the assumptions used in the dose analyses, such as three storage pads filled with 84 TN-32 sealed surface storage casks (SSSCs), each pad having 28 SSSCs. However, in addition to the site's reactors, the specific-licensed ISFSI is co-located with an ISFSI under a different license (i.e., a general license) that uses a different storage system design and may continue to increase in storage capacity over the period of extended operation of the specific-licensed ISFSI. Therefore, it is not clear that the SAR dose analyses will remain valid for the duration of the requested period of extended operation of the specific-licensed ISFSI, considering storage of additional radioactive materials at the NAPS in different storage systems and higher number of storage systems per pad under different licenses.

This information is required to determine compliance with 10 CFR 72.42(a) and 10 CFR 72.104(a).

Chapter 3 – Aging Management Reviews

RAI 3-1

Clarify the material designation for the vent and drain port cover bolts in the TN-32 cask.

Table 1.2-2 of the TN-32 Topical Safety Analysis Report, Revision 9A, states that the vent and drain port cover bolts are constructed of stainless steel. In the renewal application, the aging management review (AMR) results table and the TN-32 Dry Storage Cask aging management program (page A-6) defines the subject bolts as being constructed of low-alloy steel.

If the material designation as a low-alloy steel is correct, provide a reference to the applicable design basis information. If the material designation is not correct, provide the AMR for the corrected material and revise the material designation in other areas of the application, as appropriate.

This information is required to determine compliance with 10 CFR 72.24(c) and 10 CFR 72.42(a).

RAI 3-2

Justify why microbial degradation, salt scaling, and corrosion of reinforcing steel are not included as aging mechanisms for concrete. Alternatively, include these aging mechanisms in the aging management review and revise the Table of Aging Effects in the ISFSI SAR supplement.

The application excludes three aging mechanisms in the Monitoring of Structures Aging Management Program, Aging Management Review Results (Table AMR Results-3) and the Table of Aging Effects (Table C2.1-1; New ISFSI SAR Table 9.7-1):

(i) Microbial Degradation
(ii) Salt Scaling
(iii) Corrosion of Reinforcing Steel

Chloride attack of the reinforcing steels within concrete structures is a well-known phenomenon. The alkaline environment of the concrete typically results in a metal-adherent oxide film on the reinforcing steel bar surface, which passivates the steel. However, chloride ions can break down the passive layer, triggering corrosion that leads to cracking and spalling of the concrete. The applicant provided the limit of less than 500 ppm of chloride concentration and pH greater than 5.5 in groundwater to prevent the corrosion. However, some data suggests the limit of 300 ppm (ASME, 1995). Chlorides may already exist at low levels within the base mix constitutes, and chlorides can be concentrated in damp or dry environments.

Biodeterioration (Microbial Degradation) is caused by colonization of microbes and microorganisms that grow on concrete surfaces that offer favorable environmental conditions (e.g., available moisture, near neutral pH, presence of nutrients). Conducive environments may have elevated relative humidity (i.e., greater than about 60 percent), long cycles of humidification and drying, freezing and thawing, high carbon dioxide concentrations, high concentrations of chloride ions or other salts, or high concentrations of sulfates and small amounts of acids (Wei et al., 2013). Biodeterioration may lead to reduction of the protective cover depth, and increase both concrete porosity and the transport of aggressive chemicals (Sanchez-Silva and Rosowsky, 2008), and this degradation mode can promote a reduction in concrete pH, loss of concrete strength, and spalling/scaling.

Salt scaling is defined as superficial damage caused by freezing a saline solution on the surface of a concrete body. The damage is progressive and consists of the removal of small chips or

flakes of material. Similar to freeze and thaw damage, salt scaling takes place when concrete is exposed to freezing temperatures, moisture, and dissolved salts.

The staff requests the bases for this exclusion. If the applicant determines that these aging mechanisms are credible, the aging mechanisms should be included in the aging management review and in the Table of Aging Effects (Table C2.1-1; New ISFSI SAR Table 9.7-1). This information is needed to determine if the aging management review is comprehensive in identifying all pertinent aging mechanisms and effects applicable to the SSCs within the scope of renewal and that a summary of the information is included in the renewal application and FSAR supplement.

This information is needed to determine compliance with the requirements of 10 CFR 72.42(a).

References:

ASME. "ASME Boiler and Pressure Vessel Code, Section XI, Subsection IWL." New York, New York: American Society of Mechanical Engineers. 1995.

Sanchez-Silva, M. and D. Rosowsky. "Biodeterioration of Construction Materials: State of the Art and Future Challenges." Journal of Materials in Civil Engineering. Vol. 20. pp. 352-365. 2008.

Wei, S., Z. Jiang, H. Liu, and M. Sanchez-Silva. "Microbiologically Induced Deterioration of Concrete–A Review." Brazilian Journal of Microscopy. Vol.44. pp. 1,001-1,007. 2013.

RAI 3-3

Clarify the TN-32 cask aging management review results for the silver lid seal, which is stated to be subject to loss of material, but no aging mechanism or aging management program is cited.

Table AMR Results – 1, "Transnuclear TN-32 Dry Storage Cask," of the renewal application includes loss of material as an aging effect for the silver lid seal in the atmosphere/weather environment. However, the table does not include an associated aging mechanism or aging management program. In addition, Table C2.1-1, "Table of Aging Effects (New ISFSI SAR Table 9.7-1)," of the renewal application does not identify any aging effects for silver.

If loss of material is a credible aging mechanism for the silver lid seal, provide an aging management activity that will ensure that the seal's pressure boundary function will be maintained in the period of extended operation.

This information is required to determine compliance with 10 CFR 72.42(a).

RAI 3-4

Justify why effects due to thermal and radiation exposure (e.g., cracking) and loss of shielding due to boron depletion are not included as aging effects/mechanisms for the neutron shields in the TN-32 cask. Alternatively, revise the aging management review tables and address these aging effects with an aging management program or time-limited aging analysis (TLAA).

Heat and radiation can induce changes in polymers that include embrittlement, decomposition, and changes in physical configuration (e.g., loss of hydrogen or water) (EPRI, 2002; McManus

and Chamis, 1996; Cota, 2007; Fu, 1988). Shrinkage and embrittlement can result in (localized) losses of shielding material and lead to cracking. In addition, if the borated radial neutron shield material is exposed to sufficient neutron fluence over time, the consumption of B-10 atoms could impact the material's shielding function.

This information is required to determine compliance with 10 CFR 72.42(a), 10 CFR 72.104, 10 CFR 72.106, and 10 CFR 20.1301(a) and (b).

References:

EPRI. "Technical Bases for Extended Dry Storage of Spent Nuclear Fuel." TR-1003416. Palo Alto, California: Electric Power Research Institute. 2002.

McManus, H.L. and C.C. Chamis. "Stress and Damage in Polymer Matrix Composite Materials Due to Material Degradation at High Temperatures." NASA Technical Memorandum 4682. Cambridge, Massachusetts: Massachusetts Institute of Technology. 1996

Cota, S.S., V. Vasconcelos, M. Senne, Jr., L.OL. Carvalho, D.B. Rezende, and R.F. Cõrrea. "Changes in Mechanical Properties Due to Gamma Irradiation of High-Density Polyethylene." Brazilian Journal of Chemical Engineering. Volume 24, No. 02. pp. 259–265. 2007

Fu, L., R.A. Fouracre, and H.M. Banford. "An Investigation of Radiation Damage in Cured Epoxy Resin System Using Regression Experiment Design, Electrical Insulation and Dielectric Phenomena." 1988 Annual Report, Conference on Electrical Insulation and Dielectric Phenomena. IEEE Dielectrics and Electrical Insulation Society. October 1988

RAI 3-5

Discuss how the buildup of flammable gas generated in the radial neutron shield is managed in the period of extended operation.

TN-32 cask design uses polymer material or borated polymer material as neutron shields. Radiation degradation of polymer materials releases hydrogen or low-molecular weight hydrocarbons, which may reach flammable concentrations over extended periods of time. To alleviate this problem, a hole is made in the top of the lid neutron shield to provide a vent path for the buildup of gases. However, the application does not include discussion of flammable gas buildup in the radial neutron shield in the period of extended operation. The licensee needs to address how the potential flammable gas buildup aging effect in the radial neutron shield will be managed during the period of extended operation, including any means used to alleviate flammable gas buildup.

This information is required to determine compliance with 10 CFR 72.120(d).

RAI 3-6

Provide the technical basis for the proposed change to ISFSI SAR Section A.1.3, "Criticality Evaluation," where the stated time of the neutron poison effectiveness is proposed to be revised to 60 years.

The revisiting of a design-basis analysis to show that it is still valid for the period of extended operation typically would be considered a TLAA. As recommended in NUREG-1927, Revision 1, the renewal application should address a TLAA by either (1) demonstrating that the SSC will continue to perform its intended function or (2) managing the effects of aging through an aging management program.

No basis was provided in the renewal application for extending the time for which the poison material will continue to remain effective.

This information is required to determine compliance with 10 CFR 72.42(a) and 10 CFR 72.124.

RAI 3-7

Clarify the basis for the proposed change to ISFSI SAR Section A.1.4, "Thermal Evaluation," where the stated time of safe storage of the spent fuel, based on the thermal design, is proposed to be revised from 20 to 60 years.

It is not clear whether this SAR statement is a summary statement of the thermal evaluation in general, or if the timeframe in the SAR statement is associated with a specific time-related aspect of the design-basis thermal evaluation. The revisiting of a design-basis analysis to show that it is still valid for the period of extended operation typically would be considered a TLAA. As recommended in NUREG-1927, Revision 1, the renewal applicant should address a TLAA by either (1) demonstrating that the SSC will continue to perform its intended function or (2) managing the effects of aging through an aging management program.

This information is required to determine compliance with 10 CFR 72.42(a) and 10 CFR 72.128(a).

RAI 3-8

Considering the effects of age on concrete strength, perform an analysis of the ISFSI pad to estimate the concrete compressive strength (fc') and modulus of elasticity (E) at the end of the requested period of extended operation. For any increase in the concrete modulus of elasticity, determine the applicable deceleration g-loads and re-evaluate the TN-32 SSSC structural capability to withstand the design basis cask tip-over and bottom-end drop accidents. Also revise, as appropriate, Appendix C, "ISFSI Safety Analysis Report Supplement."

Appendix 3A of TN-32 Dry Storage Cask Topical Safety Analysis Report (TSAR), Revision 9A, considered a concrete compressive strength of 3,000 psi in the target hardness method, per the EPRI Report NP-4830, to determine the maximum cask side impact deceleration. A design basis cask deceleration was then selected for the cask body and basket structural analyses in Appendices 3A and 3B, respectively. However, in Appendix 3C of the TSAR, Revision 9A, a design basis deceleration with a different value was introduced in demonstrating the structural capability of the TN-32 SSSC basket undergoing inelastic response.

Concrete compressive strength is known to increase with age. As noted in NUREG/CR-6424, "Report on Aging of Nuclear Power Plant Reinforced concrete Structures," after a 20-year placement, the average compressive strength can realize an increase of 67% with respect to the nominal, 28-day design basis strength. Also, given that the as-built concrete could have a higher than nominal strength, the applicant should use the as-built concrete for the analysis.

This information is needed to determine compliance with the requirements of 10 CFR 72.42(a).

RAI 3-9

Clarify the extent of coverage for the periodic visual inspections of the TN-32 dry storage cask and the concrete pad. Revise Appendix C of the renewal application to provide these details in the ISFSI SAR supplement.

Neither the TN-32 Dry Storage Cask Aging Management Program nor the Monitoring of Structures Aging Management Program explicitly define the extent of coverage for the periodic visual inspections. For the concrete pad, the staff noted that Section 3.5.1 of American Concrete Institute (ACI) 349.3R-02 states that "[t]he scope of the visual inspection should include all exposed surfaces of the structure…."

If 100 percent of all accessible surfaces of both the casks and pad will not be inspected, provide the justification for the extent and location of the inspected areas.

This information is required to determine compliance with 10 CFR 72.42(a).

RAI 3-10

Clarify and provide the justification for the timing of the initial 20 ± 5-year scheduled inspection of the TN-32 dry storage cask bottom and under the protective cover and the first 5-year periodic visual inspection of the concrete pad. Revise Appendix C of the renewal application, as appropriate.

Neither the TN-32 Dry Storage Cask AMP nor the Monitoring of Structures AMP explicitly defines when the initial inspections of the normally inaccessible cask components and the concrete pad will occur. The inspection timing and its justification should be clear to support the licensee's development of the implementation procedures and NRC oversight of inspection activities.

This information is required to determine compliance with 10 CFR 72.42(a).

RAI 3-11

Provide details on the thermoluminescent dosimeter (TLD) measurements and perimeter fence radiation surveys that support their capability to detect neutron shield degradation, including localized degradation (e.g., shrinkage, cracking) of the individual casks. Specifically,

1. Demonstrate that the combination of TLD monitoring and perimeter radiation surveys will be capable of detecting neutron shield degradation of each individual cask.

2. For the perimeter surveys, provide details on the locations where radiation will be measured and recorded.

3. Provide the acceptance criteria that will be used to determine the upward trend of dose rates that indicates a loss of intended function of the neutron shield, including a description of how the criteria account for decay of the spent fuel source term.

4. Provide details regarding the trending of the TLD dose measurements and perimeter radiation surveys, including the specific method and procedures of the engineering evaluation used for determining trends in the dose rates.

5. Add the details of the perimeter surveys to Appendix C of the renewal application (proposed ISFSI SAR supplement).

The renewal application indicates that TLDs located along the ISFSI perimeter fence will be used to ensure the casks' neutron shielding continues to perform its function during the period of extended operation. Section A.2.1 of the renewal application, "TN-32 Dry Storage Cask Aging Management Program," states that TLD radiation monitoring is supplemented by quarterly gamma and neutron radiation surveys at the ISFSI perimeter fence. The Acceptance Criteria program element states:

> The aging management program [TN-32 Dry Storage Cask Aging Management Program] will be enhanced to include annual trending of TLD neutron and gamma radiation measurements at the ISFSI perimeter fence. The acceptance criterion for radiation monitoring is the absence of an increasing trend (as determined by Engineering evaluation) in neutron and gamma quarterly TLD readings at the ISFSI perimeter fence.

However, it is not clear from the information presented in the application, how the TLD measurements, perimeter radiation surveys, and the trending evaluations will be able to identify degradation of the neutron shields of individual casks.

This information is required to determine compliance with 10 CFR 72.42(a), 10 CFR 72.104(a), 10 CFR 72.106, and 10 CFR 20.1301(a) and (b).

RAI 3-12

For the TN-32 Dry Storage Cask AMP and the Monitoring of Structures AMP, clarify the criteria for when a visual inspection result is entered into the Corrective Action Program.

The renewal application contains some ambiguities regarding the criteria for writing a corrective action report.

In some cases, the application states that a condition report is written when AMP acceptance criteria are not met, including:

- Section A2.1, Element 7, "Corrective Actions"
- Section C2.1.1.1
- Section A2.2, Element 7, "Corrective Actions"
- Section C2.1.1.2

In other cases, the threshold for writing a condition report is stated to be conditions or indications "adverse to quality," including:

- Section A2.1, Element 5, "Monitoring and Trending"
- Section A2.1, Element 6, "Acceptance Criteria"
- Section A2.2, Element 5, "Monitoring and Trending"

Finally, in one case, the threshold for writing a condition report is stated to be "unacceptable results"

- Section A2.2, Element 6, "Acceptance Criteria" (for cracking)

The staff notes that inspection results that do not meet the AMP acceptance criteria may not necessarily be considered conditions adverse to quality. As a result, the language in various parts of the AMPs discussed above could be interpreted differently. NUREG-1927, Revision 1 states that all conditions that do not meet the AMP acceptance criteria should be entered into the Corrective Action Program.

The staff requests clarification in all areas of the renewal application of whether all inspection results that do not meet AMP acceptance criteria will be entered in the Correction Action Program. If not, state the threshold for which an inspection result will be entered into the Corrective Action Program.

This information is required to determine compliance with 10 CFR 72.42(a).

RAI 3-13

Clarify the concrete inspection acceptance criteria in Appendices A and C of the renewal application.

The description of the Monitoring of Structures Aging Management Program in Section A2.2 of the renewal application provides a list of acceptance criteria for the concrete pad inspections. However, that list is stated to apply to "...cracking of concrete surfaces…" It is unclear as to whether that list is also meant to apply to the other identified aging effects: loss of material and change in material properties.

Revise the acceptance criteria to clearly address all of the identified aging effects.

This information is required to determine compliance with 10 CFR 72.42(a).

RAI 3-14

Provide justification for the use of the Institute of Nuclear Power Operations (INPO) Consolidated Event System (ICES) for share operating experience to ensure continued AMP effectiveness.

Sections A2.1 and A2.2 of the renewal application, Element 10, "Operating Experience," state that operating experience will be identified and reported via the Institute of Nuclear Power Operations Consolidated Event System.

NUREG-1927, Revision 1 recommends that, to confirm the effectiveness of an AMP or to identify the need to enhance an AMP, renewal applicants should reference the specific system for sharing operating experience. However, it is unclear to the staff whether the ICES is capable of effectively obtaining and sharing dry storage operating experience.

NEI 14-03, Revision 1, "Format, Content and Implementation Guidance for Dry Cask Storage Operations-Based Aging Management," recommends the use of the new Aging Management INPO Database (AMID) system to collect and disseminate dry cask storage aging management information. In addition, NEI 14-03 recommends that licensees document and share their

periodic assessments of AMP effectiveness (“tollgates”) through AMID. NUREG-1927 references the AMID system as one means of sharing operating experience within the industry to ensure AMP effectiveness.

The staff notes that a unique feature of the AMID system is the lower threshold for sharing information in comparison to the ICES. For example, NEI 14-03, Section 4.5.2 recommends that aging-related conditions are reported if any of the following are found: new or unexpected aging effects, new or unexpected trends, unexpected inspection results, aging mechanisms found through new or improved tests methods, and when deficiencies are found that indicate an AMP is not effective. These categories of inspection findings would not necessarily be expected to be reported under the ICES (absent a more significant associated deficiency), so it is not clear if the use of this system is appropriate.

This information is required to determine compliance with 10 CFR 72.42(a).