072-00002

VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

October 6, 2003

10CFR72.42

Director, Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards
United States Nuclear Regulatory Commission
Washington, D.C. 20555

Serial No.	03-385
LR/DWL,MAE	R1
Docket No.	72-2
License No.	SNM-2501

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY INDEPENDENT SPENT FUEL STORAGE INSTALLATION
REQUEST FOR ADDITIONAL INFORMATION
LICENSE RENEWAL APPLICATION
(TAC Nos. L23455 and L23456)

Virginia Electric and Power Company (Dominion) submitted an application for renewal of the Surry Independent Spent Fuel Storage Installation (ISFSI) license in a letter dated April 29, 2002 (Serial No. 02-116). In a June 13, 2003 letter, the NRC forwarded a Request for Additional Information (RAI) regarding the license renewal application (LRA). Attachments 1 and 2 to this letter contain the responses to the RAI items.

Attachment 3 contains the revised Final Safety Analysis Report (FSAR) Supplement for the Surry ISFSI and supercedes the FSAR Supplement provided in Appendix C of the LRA. The revised supplement reflects the changes to the aging management activities (AMA) resulting from the commitments and information provided in the attached response to the RAI. Additionally, the supplement is renumbered consistent with planned insertion into the Surry ISFSI FSAR as new Section 9.7.

As a separate matter, EPRI issued its final report on their Dry Cask Characterization Project (EPRI Report No. 1002882) in September, 2002. The LRA for the Surry ISFSI contained a commitment to incorporate any applicable additional recommendations from this study. Dominion has reviewed the final report and found no additional recommendations or revised conclusions. Therefore, there is no impact on the submitted LRA as a result of the EPRI study and no changes are necessary to the cask and fuel aging management reviews (LRA Section 3.0), the ISFSI FSAR supplement, or the ISFSI aging management activities (LRA Appendix A).

NMSS01

The NRC's June 13, 2003 letter requested that Dominion respond to the RAI by September 12, 2003. However, due to schedule conflicts, the public meeting between Dominion and NRC staff to discuss RAI clarifications was not held until September 4, 2003. As a result of that meeting, revisions were necessary to the RAI responses. As identified during the September 4, 2003 meeting, Dominion's response to the RAI would be delayed to incorporate the revisions and clarifications that were identified in the meeting.

If you have any questions or concerns regarding this submittal, please contact us.

Very truly yours,

Leslie N. Hartz
Vice President-Nuclear Engineering

Original and 15 copies

Attachments:
1) Responses to Request for Additional Information
2) Mark-up Pages from LRA Appendix E
3) Revised ISFSI FSAR Supplement

Commitments made in this letter: Perform a visual inspection of the oldest CASTOR V/21 dry cask storage container bottom prior to July 31, 2006 (end of the current ISFSI license period).

cc: United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

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SN: 03-385
Docket Nos.: 72-2
Subject: ISFSI Lic. Renewal RAI

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz, who is Vice President - Nuclear Engineering, of Virginia Electric and Power Company. She has affirmed before me that she is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of her knowledge and belief.

Acknowledged before me this 6th day of October, 2003.

My Commission Expires: March 31, 2004.

Maggie McClure
Notary Public

(SEAL)

Attachment 1

Responses to Request for Additional Information

Surry Power Station
Independent Spent Fuel Storage Installation
License Renewal Application

Materials RAI-1:

Justify why the performance of polymeric materials is not a concern for license renewal period of 40 years. Discuss any Time Limited Aging Analysis (TLAA) or monitoring that is used to ensure that the performance of the polymeric materials will meet the safety requirements (i.e. shielding) during the period of license renewal.

A. *The following are examples of cask systems that have components made of polymeric materials:*

- *CASTOR X/33 Moderator Rods contain polyethylene;*
- *Westinghouse MC-10 B outer shielding contains BISCO NS-3 enclosed in stainless steel;*
- *T N-32 top neutron shield contains polypropylene encased in steel and the radial neutron shield contains polyester encased in aluminum; and,*
- *Nuclear Assurances Corporation (NAC) I-28 upper neutron shield and radial neutron shield contains BISCO NS-4 FR.*

B. *Explain the following sentence: "These elastomeric O-rings were not credited in the aging management review of the cask; therefore, the potential for loss of material of the carbon steel components below the closure is managed." (Page 3-18, para 1).*

C. *Justify why an aging management review was not performed for nonmetallic seals, nor an aging management program implemented, e.g., NAC I-28 uses polyethylene seals. (Section 3.2.2, page 3-14, 3-16, and 3-41).*

This information is required because polymeric materials and nonmetallic seals must continue to perform their safety function throughout the license renewal period. The operative degradation mechanisms for polymeric materials suggests higher susceptibility of polymerics to the effects of radiation and time at elevated temperatures as compared to that of metallics. As such, provide an evaluation of the mechanisms of degradation and the cumulative expected exposures for each component vis-a-vis the tolerable exposure derived from laboratory data and literature sources. One concern is that a nonmetallic seal may be in a weakened state and, as such, they may not function as effectively during accident conditions.

This information is required to verify that these materials were considered in the evaluations performed in accordance with Sections III.C, III.D, and III.E of the Preliminary Staff Guidance.

Response to RAI:

(A) Polymeric materials are used in the various cask designs as neutron shielding and for non-metallic (Elastomer) seals. When used for shielding, these materials perform a safety function and are included in the scope of the aging management reviews for the cask components. Elastomer seals are discussed in (C) below. Shielding materials are discussed here.

The complete list of polymeric materials in service for neutron shielding at the Surry ISFSI includes the items listed in this RAI and the polyethylene moderator rods in the CASTOR V/21 cask. Also, the BISCO products in use on the MC-10 and the NAC I-28 casks as well as the polyester radial shield on the TN-32 casks are borated polymers. There were no TLAAs performed to assess the aging of polymeric materials in the Surry ISFSI casks because there was no pre-defined time basis or limitation. The aging management evaluation performed was focused on the ability of the materials to maintain their intended function in spite of expected changes in material properties over time.

The identification of aging effects requiring management was performed during the aging management review portion of the License Renewal Application (LRA) development. Polymeric materials are subject to thermal and radiation induced degradation. Effects of radiation-induced degradation may include embrittlement, cracking or crazing, swelling, discoloration and melting. Polymers can become harder, stiffer and eventually brittle when exposed to radiation. Thermal exposure of polymers can result in decreased tensile strength, cracking, chain scission, or cross-linking. Cross-linking refers to the process where long chain molecules present in polymers are bonded together. Cross-linking makes the polymer brittle, increases the modulus of elasticity, and promotes surface cracking. Chain scission is the breaking of chemical bonds in polymers, which usually results in reduced tensile strength.

The physical form of the shield material is not an issue for the Surry casks since the polymeric materials used for shielding are, in all cases, encased and supported by structurally sound materials that are unaffected by the temperatures or radiation levels assumed in the cask design. Accordingly, the shielding material remains in-place and its configuration as a shielding material is not altered by changes in physical properties. This configuration negates the need for a specific durability discussion resulting from changes in the material properties of the polymeric compounds.

Also, with regard to changes in the physical properties of the polymers, the impact on the impregnated boron in the borated polymer materials was considered. Depletion of the boron in the polymeric matrix is considered negligible and no re-distribution mechanism for the boron is credible. The depletion of boron is considered negligible based on evaluations performed by Westinghouse and Transnuclear for the depletion of ^{10}B in the MC-10 and TN-32 casks, respectively. (Refer to the response to Materials RAI-5.) Although these evaluations were not specifically for polymeric materials, it supports the conclusion that although aging can affect the physical properties of the polymeric materials, the intended function of the boron in the shielding materials is not significantly affected.

Based on only the aging effect of "change in material properties," Dominion did not determine any aging management requirements for the polymeric neutron shielding material. During the July 29, 2003 teleconference to discuss various aspects of the staff's information requests, it was apparent that the potential reduction in hydrogen in polymeric materials was an issue requiring additional evaluation. Radiolytic decomposition and thermal degradation of polymeric compounds can produce off-gassing and a reduction in hydrogen content. The effectiveness of any neutron shielding material is primarily a function of its hydrogen content, which is why hydrogenous materials such as polymers are routinely chosen for neutron moderation/shielding. The off-gassing of hydrogen in the polymeric shielding compounds used in the Surry casks is acknowledged as a potential aging mechanism, but originally was dismissed as negligible. The degree of off-gassing over the license renewal period has not been specifically evaluated. It is, however, expected to be negligible or small, since the location of the neutron shielding is generally in the outer regions of the casks where the temperatures are lower and ionizing radiation levels have been attenuated substantially.

Since it is not possible to completely discount the off-gassing of hydrogen as a potential aging effect nor quantify its effects, the polymeric materials used in the neutron shields of the Surry ISFSI casks require aging management. This will be accomplished through the radiation monitoring programs already in-place for the ISFSI facility boundary. The ISFSI radiation monitoring activities have been added to the Aging Management Activities and are identified in the proposed ISFSI FSAR Supplement.

The ISFSI Technical Specifications require quarterly radiation monitoring at the perimeter fence. Health Physics procedures implement this requirement through continuous monitoring at the ISFSI perimeter fence using Thermal Luminescent Dosimeters (TLD), as well as quarterly radiation surveys at the ISFSI security and perimeter fence locations. The procedure's acceptance criteria for the survey doses (neutron & gamma) provide assurance that the limits of 10CFR Part 20 for doses to the general public are met at the Surry site boundary. Additionally, the radiation monitoring activities ensure the requirements of 10 CFR 72.104(a) are met with regards to offsite individuals. Survey results that do not meet the acceptance criteria would be reported to plant supervision and a Plant Issue would be initiated. Therefore, should the shielding effectiveness of the polymeric materials be reduced such that compliance with 10CFR Part 20 or 10 CFR 72.104(a) is challenged, it would be detected by the quarterly surveys and corrective actions would be initiated.

(B) The closure cover on the Westinghouse MC-10 cask is held in place by closure nuts and associated elastomer seals. Directly below the closure cover is the seal cover, which is fabricated from carbon steel. Westinghouse and Dominion procedures specify that the closure nuts be hand tightened against the elastomer seals. Since a quantitative torque value is not specified for the closure nuts, the elastomer seals were not credited as a barrier in the aging management review. The aging management review conservatively assumes outside moisture can intrude past the elastomer seals to the carbon steel seal cover beneath the closure cover. Therefore, the potential for loss of material beneath the closure cover exists. As previously committed, a visual inspection of the seal cover area will be performed prior to the end of the current ISFSI license period to verify that loss of material is not occurring.

(C) Both elastomer seals and metallic seals are used in the casks at Surry Power Station, however, only metallic seals are credited in the cask safety analyses as leakage barriers between the cask internal environment and the outside atmosphere. Since elastomer seals are not analyzed or credited as a leakage barrier, they do not perform a license renewal intended function and are excluded from the scope of license renewal.

Materials RAI-2:

Justify why "lead slumping" is not a concern for a license renewal period of 40 years in the NAC I-28 gamma shield.

This information is required to determine whether slumping of lead has been taken into account in a manner that ensures the safety functions continue to be provided.

This information is needed to verify that this material was considered in the evaluation performed in accordance with Sections III.B, and III.D of the Preliminary Staff Guidance.

Response to RAI:

Lead slumping associated with a cask drop accident was evaluated in the Topical Safety Analysis Report (TSAR) for the NAC I-28 cask. License renewal, however, considered both the continued validity of the accident analysis evaluation, as well as, the non-accident slumping of lead over the additional 40 year license renewal period.

The cask drop accident evaluation for the NAC I-28 cask concluded that the deformation of the lead gamma shield resulting from the drop was minimal. The physical properties of the lead and the dynamic forces of the drop impact determined the amount of slump in the analysis. The dose impact from the small gap that was estimated to occur (above active fuel) was evaluated and found acceptable. Conservative thermal conditions were used for the lead which bounds the original and renewed license periods. There are no aging effects identified for lead that would cause changes in the physical properties of the material or loss of material. Since the accident scenario is constant and the material conditions of the lead gamma shield would not change over the license renewal period, the amount of slump estimated for a cask drop accident would not change from the TSAR analysis. Therefore, the TSAR accident analysis is bounding.

Non-accident slumping of the gamma shield lead over time has also been considered. In the NAC I-28 cask, the lead is encased by a shell of 1.5" stainless steel on the interior and 2.6" stainless steel on its exterior. Welded seal rings on both ends effectively enclose the lead completely. Since the lead is cast into the NAC I-28 cask body shell, free space is not available to allow the lead to shift or slump. Therefore, without the forces of a cask drop acting on the lead and its supporting stainless steel shell, lead slumping does not occur in the NAC I-28 cask over time.

Materials RAI-3:

Justify the use of EPRI references (6 and 8) in Section 3 of the license renewal application. These documents generalize the maximum temperatures and their duration for the five DCSSs at Surry, based on information (experiences gained) from only the CASTOR V21 cask.

This information is required to verify that the evaluations were performed in accordance with Sections III.A and III.C of the Preliminary Staff Guidance, and is required for completeness of the application.

Response to RAI:

The two EPRI documents referenced in Section 3 of the LRA are the "Dry Cask Characterization Project- Interim Report" (EPRI Tech Report No. 1003010) and "The CASTOR V/21 PWR Spent Fuel Storage Cask: Testing and Analysis, Interim Report" (NP-4887). These documents are referenced in conjunction with the establishment of internal environmental conditions, specifically the maximum expected fuel temperatures, for use in the aging management review process.

The CASTOR V/21 cask evaluated at INEEL (and documented in the EPRI reports identified above) contained 21 fuel assemblies with predicted decay heats ranging from 1.00 to 1.83 kW. The total decay heat loading for the cask was 28.4 kW. Measurement of the peak guide tube temperature provided an estimated peak clad temperature of 352°C (666°F) versus the predicted value of 380°C (716°F). The peak clad temperature did not occur in the high decay heat (i.e., 1.8 kW assemblies). This measured value of clad temperature was used to define the expected peak clad temperature for the AMR evaluations

A comparison of the predicted fuel cladding temperatures for the casks in use at Surry assuming heat loads consistent with that allowed by Technical Specifications show them to be bounded by those obtained from the evaluation of the CASTOR V/21 in the referenced documents.

The safety analysis report for each cask used at Surry describes the thermal analyses which predict the maximum fuel cladding temperature expected under normal conditions assuming the cask is loaded with fuel meeting the appropriate limit for decay heat. Each of these casks was approved for use at Surry conditional upon the storage of fuel meeting the appropriate decay heat limit for the cask. The analyses for the casks resulted in the following predicted maximum fuel cladding temperatures:

CASTOR V/21 - On the basis of the TSAR evaluation and an independent analysis, the NRC Safety Evaluation Report concluded that the fuel cladding will remain below 370°C (698°F) during storage. The thermal analysis was found acceptable provided the maximum heat output of any single assembly did not exceed 1.0 kW and the total heat content stored within the basket did not exceed 21.0 kW.

The approval of the CASTOR V/21 cask for use at Surry imposed the above decay heat restriction (1.0 kW) on the fuel to be stored in this cask and included this operating limit in the ISFSI Technical Specifications.

MC-10 - On the basis of the TSAR evaluation and an independent analysis, the NRC Safety Evaluation Report concluded that the fuel cladding will remain below 336°C (637°F) during storage. The thermal analysis was found acceptable provided the maximum heat output of any single assembly did not exceed .5625 kW and the total heat content stored within the basket did not exceed 13.5 kW.

The approval for use of the MC-10 cask at Surry imposed the above decay heat restriction (.5625 kW) on the fuel to be stored in this cask and included this operating limit in the ISFSI Technical Specifications. Accordingly, the temperatures expected in the MC-10 casks are bounded by the expected maximum temperatures of the CASTOR V/21 cask.

NAC I-28 - The results of the TSAR analysis indicate the maximum cladding temperature is not expected to exceed 253°C (488°F). As indicated in the NRC Safety Evaluation Report, on the basis of confirmatory analysis it was concluded that the fuel cladding will remain below 330°C (626°F) during storage. The thermal analysis was found acceptable provided the maximum heat output of any single assembly did not exceed .558 kW and the total heat content stored within the basket did not exceed 15.6 kW.

The approval for use of the NAC-I28 cask at Surry imposed the above decay heat restriction (.558 kW) on the fuel to be stored in this cask and included this operating limit in the ISFSI Technical Specifications. Accordingly, the temperatures expected in the NAC I-28 casks are bounded by the expected maximum temperatures of the CASTOR V/21 cask.

CASTOR X/33 - The results of the TSAR analysis indicate that for a heat content of approximately 15 kW the maximum fuel cladding temperature would not exceed 340°C (644°F). As indicated in the NRC Safety Evaluation Report, confirmatory analyses indicated peak fuel rod temperatures less than 342°C (648°F) if the decay heat is limited to 300 watts per assembly or a total decay heat of 9.9 kW. The TSAR indicates a maximum fuel cladding temperature of approximately 245°C (473°F) for this type of heat load.

The approval for use of the CASTOR X/33 cask at Surry imposed the above decay heat restriction (300 W) on the fuel to be stored in this cask and included this operating limit in the ISFSI Technical Specifications. Accordingly, the temperatures expected in the CASTOR X/33 casks are bounded by the expected maximum temperatures of the CASTOR V/21 cask.

TN-32 - The results of the SAR analysis indicate that for a heat content of 32.7 kW or 1.02 kW/assembly the maximum fuel cladding temperature under normal storage conditions could reach 296°C (565°F). As indicated in the NRC SER for the TN-32 cask, confirmatory analysis of the thermal performance of the cask displayed good agreement with the SAR, and there is reasonable assurance the clad temperature will be maintained below allowable limits.

The TN-32 cask used at Surry has been approved for fuel with a decay heat of 1.02 kW/assembly with this decay heat as an operating limit in the ISFSI Technical Specifications. Accordingly, the temperatures expected in the TN-32 casks are bounded by the expected maximum temperatures of the CASTOR V/21 cask.

Materials RAI-4:

Provide an evaluation or data that demonstrates that the properties of zirconium fuel cladding continue to be sufficient to satisfy the safety requirements for the proposed 40-year license renewal period.

This information is required to verify that cladding material properties were adequately considered in the evaluations performed in accordance with Sections III.C, III.D, and III.E of the Preliminary Staff Guidance.

Response to RAI:

Based on the clarification provided on a July 29, 2003 teleconference between Dominion and the staff, the response to this question is related to the content of Interim Staff Guidance (ISG) – 11, Revision 2. As indicated in the Appendix to ISG-11, Revision 2, clad creep is the dominant mechanism for cladding deformation under normal conditions of storage. However numerous laboratory programs and studies (also listed in the Appendix to ISG-11, Revision 2) provide data and analyses that support the following conclusions listed in this Appendix:

(1) deformation caused by creep will proceed slowly over time and will decrease the rod pressure;
(2) the decreasing cladding temperature also decreases the hoop stress, and this too will become exceedingly small;
(3) in the unlikely event that breaching of the cladding due to creep occurs, it will not result in gross rupture.

Based on these studies and conclusions, the NRC has established a maximum cladding temperature limit of 400°C for normal conditions of storage, and for short-term operations including cask drying and backfilling. The Appendix to ISG-11, Revision 2, states that the staff has reasonable assurance that creep will not cause gross rupture of the cladding and that the geometric configuration of the spent fuel will be preserved provided that the maximum cladding temperature does not exceed this limit. Additionally, ISG-11 Revision 2 addresses the issue of hydride reorientation in zirconium-based alloys and its potential for decreasing the ductility and fracture toughness of the spent fuel cladding by limiting thermal cycling of the cladding to temperature differences of less than 65°C.

As indicated in the response to Materials RAI-3, the analyses for the casks used at Surry show the maximum fuel cladding temperature under normal conditions to be well below the 400°C value indicated by the NRC to provide assurance that clad creep will not cause gross rupture of the cladding and that the geometric configuration of the spent fuel will be preserved.

Materials RAI-5:

Justify the continued use of the thermal neutron absorber materials during the license renewal period for the following casks cited in Table 3.2.3: aluminum and borated aluminum in fuel baskets, basket poison, and poison plates of MC-10, TN-32, and NAC I-28. The applicant did not identify the absorber material (if any) used in the CASTOR V/21 and X/33 systems.

In Section B2.2 on Evaluations and Discussion of the Identified TLAAs, the depletion of boron used for criticality control is discussed for the MC-10 (Section B2.2.3) but the depletion is not discussed in Section B2.2 for the other cask systems. Continued efficacy of the absorber materials used in each of the DCSS is required throughout the license renewal period.

This information is required to verify that these materials were adequately considered in the evaluations performed in accordance with Sections III.C, and III.E of the Preliminary Staff Guidance.

Response to RAI:

The neutron absorber materials used in the CASTOR V/21, CASTOR X/33, MC-10, TN-32, and I-28 casks are identified in Tables 3.2-1, 3.2-2, 3.2-3, 3.2-4 and 3.2-5 respectively. The materials used are borated stainless steel (Radionox™) for the CASTOR V/21 and X/33 casks, aluminum clad boron carbide (Boral) for the MC-10 cask, and borated aluminum for the TN-32 and I-28 casks. Based on the aging management review for the types of absorber materials used, and the environment they would experience, it was determined that no aging management program is required to ensure they will continue to perform their required function (i.e., criticality control when cask is filled with water) through the license renewal period. The metallic nature of the stainless steel and aluminum absorber material ensures that it will remain structurally in place. In the case of the MC-10 cask, the aluminum clad Boral absorber material sheets are fixed to the sides of the basket cell enclosures by a stainless steel wrapper welded to the cell enclosure. The Safety Evaluation Report for the Westinghouse MC-10 Topical Report (dated September 30, 1987) documents that an analysis of these welds was performed and the results indicated that they would remain intact when subjected to high (up to 147 g) impact loads. This ensures that the absorber material in the MC-10 cask also remains structurally in place.

The environment surrounding the neutron absorber materials in the Surry casks during storage is an inert cover gas (Helium). Also, based on ASTM Standard C1562-03, the neutron fluence in the fuel basket area of the Surry casks during storage is approximately 10^{14} Neutrons/ cm^2 for a twenty year period. For sixty years, this value could increase to approximately 10^{15} Neutrons/ cm^2. According to 10 CFR 50, Appendix H, neutron fluence values below 10^{17} neutrons/cm^2 are not considered significant with regards to embrittlement concerns for ferritic steels. Aluminum, also in the cask interior, is less susceptible to embrittlement than ferritic steels. Therefore, corrosion or embrittlement of the metallic components in and around the storage cask fuel baskets, including the neutron absorber materials, does not occur and these materials will maintain their durability during the license renewal period. The continued efficacy of the neutron absorber for criticality control in casks during the license renewal period is discussed below.

The Preliminary Staff Guidance, Section III.E, identified the six criteria for a time-limited aging analysis (TLAA). These criteria are restated in Section B2.0 of the license renewal application. All six criteria must be met for a calculation to be identified as a TLAA. One criteria states that the calculation should involve time-limited assumptions defined by the current licensing term such as 20 years. Westinghouse was the only cask vendor that identified a calculation associated with the depletion of ^{10}B in neutron absorber materials as a TLAA. As a result, Westinghouse reanalyzed the depletion of ^{10}B to demonstrate that it was acceptable based on a 60 year (current plus renewal) licensing period. The evaluation results identified the fractional depletion of ^{10}B in neutron absorber materials is approximately 2.1×10^{-6} of the original ^{10}B content. Westinghouse concluded was this fractional depletion of ^{10}B is negligible.

The other cask vendors did not perform a calculation for ^{10}B depletion to demonstrate the acceptability of the poison plate design for the original cask license or renewed license period. Transnuclear did perform a calculation to show that the ^{10}B depletion over a 1000 year period was negligible and need not be considered a factor in the criticality evaluations performed to support the TN-32 Final Safety Analysis Report (FSAR). Dominion has evaluated the depletion of ^{10}B in the CASTOR and NAC casks based on the information provided by Transnuclear in their FSAR.

Chapter 6 of the TN-32 FSAR provides the calculation of the fractional depletion of ^{10}B in the neutron absorber plate in the TN-32 baskets. This calculation conservatively assumed that the total scalar flux in the center of the basket (8.41×10^5 n/cm^2-sec) is thermal. It should be noted that during dry storage the actual neutron flux would be fast and epithermal, not thermal due to the lack of significant moderating media in the basket materials and environment. This calculation further used a thermal neutron cross section of 3837 barns for ^{10}B. The results show that for a 1000 (one-thousand) year duration, the fractional depletion of ^{10}B is only 1×10^{-4}. This degree of ^{10}B depletion is negligible.

Borated stainless steel (Radionox™) is used for neutron absorbing material in the CASTOR X/33 and most of the CASTOR V/21 cask baskets. Three CASTOR V/21 casks in use at Surry have no neutron absorbing material in the basket. The fractional depletion of ^{10}B in the borated stainless steel material used in the CASTOR X/33 and CASTOR V/21 cask baskets is bounded by the evaluation for the TN-32 cask. The neutron emission rate of fuel assemblies in the TN-32 casks is greater than the neutron emission rates evaluated for fuel assemblies stored in either the CASTOR X/33 or CASTOR V/21 casks. Therefore, the depletion of ^{10}B in the neutron absorbing material in the CASTOR X/33 and CASTOR V/21 cask baskets will be negligible. The three CASTOR V/21 casks that have no neutron absorbing material in their baskets have a lower allowable initial enrichment for the fuel to be stored and therefore do not require additional absorber material for criticality control.

Similarly, the ^{10}B depletion for material in the NAC I-28 basket is negligible. The evaluated neutron emission rate provided in the NAC I-28 Topical Safety Analysis Report (TSAR) is only about 22% greater than the neutron emission rate stated in the TN-32 FSAR. As such, the difference in the boron depletion is insignificant and the total depletion of ^{10}B will be negligible.

Evaluations indicate the depletion of ^{10}B in the neutron absorbing material used in the basket of any dry storage cask in use at Surry will be negligible during the license renewal period. Therefore, the assumption of continued efficacy of the thermal neutron absorber materials during the license renewal period is justified. There are consequently no aging management activities associated with any of these neutron absorbing materials.

Materials RAI-6:

Clarify the following statement in footnote 3 to Table 3.2-4 (pages 3-40 and 3-44): "Small gaps may exist where metal-to-metal or metal-to-polymer sub-components interface. These gaps ....not required."

This statement is ambiguous. Clarify whether or not these gaps communicate with the atmosphere and could be subject to weather borne moisture intrusion or other degrading elements.

This information is required to verify that the evaluations were adequately performed in accordance with Section III.C of the Preliminary Staff Guidance and is required for completeness of the application.

Response to RAI:

Due to manufacturing tolerances, small gaps may exist where metal-to-metal or metal-to-polymer cask components interface. These small gaps were conservatively identified during the aging management review process. As a result of cask assembly, these areas become permanently sealed and do not communicate with the outside environment. An example of one such location is the area between the polyethylene moderator rods and the cask body in the CASTOR V/21 and CASTOR X/33 casks.

Materials RAI-7:

Clarify the term "none" in Table 3.2.1 (page 3-25) under the heading of intended function. If there is indeed an elastomeric seal, its function and continued safety should be addressed under the above question regarding polymeric materials.

This information is required to verify that the evaluations were adequately performed in accordance with Section III.C of the Preliminary Staff Guidance. The information is required for completeness of the application.

Response to RAI:

As discussed in LRA Section 3.2.1, subheading "Multiple Sealing System," page 3-8, the elastomer seals on both the primary and secondary lids of the CASTOR V/21 cask are not credited in the cask safety analysis calculations. Their purpose is to provide a barrier to functionally test the credited metallic seals. Accordingly, the elastomer seals do not provide any of the important safety functions of the cask design, (i.e., criticality, shielding, confinement, heat transfer, or structural integrity) as defined in Section III.B of the Preliminary Staff Guidance. Therefore, the elastomer seals are identified in Table 3.2-1 as "not in-scope" and have an intended function of "None." (See also the response to Materials RAI-1C.)

In other cask designs, elastomer seals are used as moisture barriers. Since, in each of these cases, the protected components (e.g., instrumentation junction box) are not in-scope for license renewal, the seals are not credited with a safety function, and are not in-scope.

Materials RAI-8:

Provide additional discussion on when a cask bottom will be inspected prior to the issuance of the renewed license.

Appendix A, page A-2, of the Surry License Renewal Application states: "....visual inspection of the normally inaccessible areas of casks in the event they are lifted in preparation for movement or an environmental cover is removed for maintenance."

In accordance with the NRC's Preliminary Staff Guidance, Section III.D, an inspection of at least one cask bottom (of the population of casks in use at an ISFSI) is to be performed prior to renewal of the license.

Response to RAI:

Required quarterly inspections currently check for signs of corrosion on the exterior of the base of each cask (including rust stains on the concrete around the cask base). Since 1986, there have been no indications of corrosion on the exterior of the cask bottoms. However, Dominion will inspect the exterior of one CASTOR V/21 cask bottom prior to the end of the current ISFSI license period. The results of this inspection will be evaluated to determine acceptability of the findings, any necessary corrective action, or any additional inspection requirements for the remaining cask types. The corrective action process is discussed in Section A2.1 of the ISFSI LRA.

The basis for this approach is that: 1) the CASTOR V/21 cask to be inspected will be representative of all cask types currently utilized at the Surry ISFSI, and 2) the CASTOR V/21 cask to be inspected will be the oldest cask on the pad. The materials on the exterior of the bottom of the CASTOR V/21 casks include stainless steel and epoxy-coated cast iron. These materials are representative of the materials used for all other cask bottom designs. All casks located at the ISFSI are subject to the same environmental (weather) conditions as there are no structures at the Surry ISFSI that could potentially provide any means of shelter from the elements. Additionally, because the inspection will be of a CASTOR V/21 cask, the opportunity to specifically inspect the breech plate bolts for corrosion is addressed. (Refer to Materials RAI-10.)

Regarding future inspections, plant procedures are in place to inspect the exterior bottom of any cask that is lifted off the cask pad for any reason. Therefore, on an opportunity basis, additional exterior cask bottom inspections could occur throughout the license renewal period.

Materials RAI-9:

Provide details and a discussion of those parts of the cask systems (except the bottom, as discussed in the previous question, and the interior portion containing the fuel) that the licensee considers "normally inaccessible" and provide a justification for not performing a special one-time inspection of a representative area.

Page A-3 of License Renewal Application Appendix A states: "Visual inspection of normally inaccessible areas of the casks are on an opportunity only basis and will be evaluated on a case-by-case basis and not trended."

In accordance with the NRC's Preliminary Staff Guidance, Section III.D, a one-time inspection of normally inaccessible areas (not including the interior) of casks should be performed prior to the end of the license period. It is not clear to the staff just how this provision of the staff guidance will be accomplished. (This question is directed at those portions of casks that may have external weather communication but which are not directly visible by normal line of sight or are hidden by some sort of removable (not welded) cover. It is not directed at spaces filled with lead or polymeric shield material).

Response to RAI:

The normally inaccessible areas are defined as the exterior of the cask bottoms, areas underneath a tip-over impact limiter, and the areas on top of the casks (all of which have an environmental cover except the stainless steel NAC I-28). Additionally, there are shield plugs located where the lifting trunnions have been removed from the body of the Westinghouse MC-10 cask. All other external surface areas of the casks exposed to the elements are available for visual inspections which are performed on a quarterly basis for all in-service casks.

Cask Bottoms: Inspections of the exterior of the cask bottoms are addressed in the response to Materials RAI-8.

Impact Limiters: There are impact limiters on the single CASTOR X/33 cask and the two NAC I-28 casks.

The CASTOR X/33 impact limiter external surface is aluminum which has no identified aging effects in the outdoor environment. The CASTOR X/33 cask body is cast iron and has an epoxy coating. The coating is effective in preventing corrosion of the cast iron surfaces, however, no credit is taken for the coating with regards to aging management of the cask exterior. If the coating surface is damaged and the cast iron is exposed to the outdoor environment, loss of material via general corrosion (rust) would be expected. Since such corrosion would occur on the vertical side wall of the cask, evidence of the rust (streaking) would be visible during quarterly inspections well before the corrosion could compromise the integrity of the cask outer wall. Therefore, a special inspection prior to the end of the current ISFSI license period is not warranted.

The exteriors of the NAC I-28 casks and their impact limiters are stainless steel and are not coated. Loss of material is a possible aging effect for stainless steel in an atmosphere/weather environment. Loss of material would be visible on the outer surfaces of the NAC I-28 casks during the quarterly inspection. Since the normally inaccessible area under the impact limiter is of the same materials as the exterior of the cask, the inspections of the accessible areas provide an indication of the conditions at the impact limiter/cask wall interface. Therefore, a special inspection of these areas prior to the end of the current ISFSI license period is not warranted.

Environmental Covers: Areas underneath the environmental covers of the CASTOR V/21, CASTOR X/33, TN-32, and MC-10 casks are assumed to be subject to an atmosphere/weather environment regardless of the cask type or design of the environmental cover. As previously stated, the NAC casks have no environmental covers.

The CASTOR V/21 and X/33 cask environmental covers do not have penetrations subject to leakage, however, moisture and possibly condensation can be present in this area. The warm outer surfaces of the casks effectively minimizes condensation. Also, the CASTOR V/21 and X/33 designs do not have a perimeter moisture barrier on the environmental covers. Therefore, the area is "vented." Water pooling due to precipitation does not occur inside of these environmental covers.

The CASTOR V/21 and X/33 casks have stainless steel in the area under the environmental covers. Over the operational history of these casks, the environmental covers have been removed numerous times. No indication of corrosion has been detected. However, as part of the visual inspection of the exterior of a CASTOR V/21 cask bottom prior to the end of the current ISFSI license period, the environmental cover will be removed and the normally inaccessible top area will be inspected. (Refer to Materials RAI-8.)

The TN-32 cask environmental cover design had a leakage problem as discussed in the LRA Section 3.1.5.2. These covers have been backfitted to preclude leakage. Future covers incorporate the backfit modification. Additionally, the TN-32 casks contain desiccant material between the environmental cover and the cask lid to preclude any moisture buildup in the enclosed area. The TN-32 casks have an elastomer moisture barrier seal incorporated into the environmental cover design, however, this seal is not credited for aging management.

Since the modifications were made to the TN-32 environmental covers, there have been two occasions when covers have been removed and the area underneath the covers examined. In both cases, the areas were dry and no evidence of active corrosion was found. Therefore, based on recent observations and the conditions found, a special inspection of the area underneath theTN-32 environmental covers prior to the end of the current ISFSI license period is not warranted.

The MC-10 cask has bolt penetrations through the top of the environmental cover (closure lid) with elastomer O-ring seals to prevent water intrusion. The elastomer seals are not credited for aging management since they are not tightened to any specified torque value. Accordingly, the possibility of precipitation entering the closure lid cannot be excluded and the closure lid interior area warrants inspection. The seal lid under the cover is comprised of un-coated carbon steel. As presented in the LRA, Appendix A, the upper seal lid area of the MC-10 cask will be inspected prior to the end of the current ISFSI license period. Future inspections or corrective actions would be determined based on the results of this inspection.

Also on the MC-10 cask, there are shield plugs located where the lifting trunnions have been removed from the body of the Westinghouse MC-10 cask. These are for shielding purposes, but also function as environmental covers for the trunnion location recesses. There are no gaskets located on these plugs. Therefore, the possibility of precipitation entering the trunnion recessed areas cannot be excluded and the area behind the shield plugs warrants inspection. As part of the inspection of the MC-10 closure cover, the shield plugs will also be removed for inspection.

Regarding future inspections of all cask types, the areas under environmental covers will be inspected for aging effects whenever they are accessible as a result of maintenance activities as documented in the LRA, Appendix A.

Materials RAI-10:

Provide a discussion and details of the plan and schedule for inspecting the bottom of the CASTOR V/21 cask.

Page A-4 of the Surry License Renewal Application Appendix states that the EPRI Dry Cask Characterization Project documented corrosion of bolts holding the rear breech plate on the CASTOR V/21 cask, and that such conditions could exist at Surry. It is not clear to the NRC staff if there is a plan for an inspection for this potential degradation mechanism, prior to the issuance of the renewed license.

This information is needed to ensure adequate evaluations were performed in accordance with Section III.D of the Preliminary Staff Guidance and is required for completeness of the application.

Response to RAI:

Refer to the response for Materials RAI-8 regarding cask bottom inspection plans.

Materials RAI-11:

Ensure that all age-related degradation mechanisms experienced by the five different storage cask designs at the ISFSI have been identified.

The applicant indicated that one of the DCSSs currently in use at the Surry ISFSI has been identified by EPRI to have age-related degradation. The EPRI Dry Cask Storage Characterization Project documented the occurrence of corrosion on one of the bolts holding the rear breech plate on the CASTOR V/21 cask. It is not clear whether the applicant experienced other age-related degradation associated with other DCSSs that are currently in use at the Surry ISFSI. The staff agrees it is important to review documents such as drawings and SARs of each cask design currently in use at the Surry ISFSI to determine the cask components that require aging management review (AMR). Further discussion of the engineering evaluations/judgements and operating experience with respect to age-related degradation of each cask currently in use at the Surry ISFSI would clarify that no component important to AMR is overlooked.

This information is required to ensure adequate evaluations were performed in accordance with Section III.C of the Preliminary Staff Guidance.

Response to RAI:

The Preliminary Staff Guidance document provides a list (pages 4, 5, & 6) of aging mechanisms for consideration with regards to ISFSI license renewal. The staff list of aging mechanisms was not used directly to develop the mechanisms considered in the evaluation process described above. Instead, the Dominion Material Aging Effects Report (MAER) was independently developed and then compared to the staff list to ensure completeness. Each of the listed staff aging mechanisms (appropriate to casks or fuel) was considered in the Dominion evaluation process. In addition, annealing and hydride reorientation were also considered for the fuel cladding.

A summary of the aging mechanism comparison between the Dominion generated list and the Preliminary Staff Guidance listing is provided at the end of this response.

The compilation of potential aging mechanisms prepared by Dominion was based largely on experience from the Surry Power Station License Renewal (10CFR Part 54) process, the EPRI Dry Cask Characterization Study, and Surry ISFSI operating experience. The large majority of aging mechanisms were extracted from various industry documents (e.g., EPRI, NRC). The EPRI Dry Cask Characterization Project - Interim Project Report, October 2001 (EPRI Report TR-1003010) and its final report dated September 2002 (EPRI Report TR-1002882) were the primary documents for fuel assembly related aging mechanism evaluations.

Based on these documents, a list of potential aging mechanisms was compiled for the various material/environment combinations identified for the Surry cask types.

Various mechanisms are only applicable at certain conditions such as high temperature or moisture, for example. Each identified mechanism was characterized by a set of applicable conditions that must be met for the mechanism to occur. Given this evaluation process, each cask and fuel component was evaluated to determine if the listed aging mechanisms were credible considering the material, environment, and conditions of storage. The evaluation is independent of the cask type at this level of detail.

As a result of this process, the loss of material was identified for various material/environment combinations associated with each cask type. The loss of material can be identified by visual inspection assuming the area is accessible for inspection. The occurrence of minor corrosion that is not yet visible to inspections, does not challenge the integrity or function of the subject component. Operating experience supports the results of this evaluation for the aging effects requiring management. Section 3.1.5 of the LRA provides a discussion of operating experience. Site specific degradation was observed only on the TN-32 and CASTOR V/21 casks. With the exception of maintenance on minor surface coating defects, no instance of age-related degradation was identified for the other cask types on site. However, the other cask types represent only 4 total casks, 1 CASTOR X/33, 1 MC-10, and 2 NAC I-28s. Also, as previously stated, the cask type does not matter when the evaluations are done at the material/environment/conditions level. The age-related degradation identified by the operating experience would have been identified in the evaluation process regardless of whether or not they had been observed.

There are two exceptions to the above paragraph regarding visual inspections: 1) the cask lid metallic seals which are managed by pressure monitoring, and 2) polymeric shielding materials which are managed by radiation monitoring. Both of these exceptions involve only the aging effect of loss of material. (See the responses to Materials RAI-1 and Aging Management Activities RAI-1 for more details.)

No age related degradation was identified for any cask interior components subject to an inert helium environment or for any fuel assembly components. Therefore, no aging management is required for these components over the license renewal period.

Materials RAI-11: Aging Mechanism Comparison (Preliminary Staff Guidance vs. Dominion MAER)	
SSCs in Outside Environment Concrete Structures	
Freeze Thaw	Included in MAER
Leaching of Calcium Hydroxide	Included in MAER
Aggressive Chemical Attack	Included in MAER
Reaction with Aggregates	Included in MAER
Elevated Temperature	Included in MAER
Irradiation of Concrete	Included in MAER
Creep	Included in MAER
Shrinkage	Included in MAER
Corrosion	Included in MAER
Abrasion and Cavitation	Not Applicable (No flowing water)
Restrain, Shrinkage. Creep and Aggressive Environment	Included in MAER
Concrete Interaction with Aluminum	Not Applicable
Cathodic Protection Current	No cathodic protection in-scope
Structural Steel and Stainless Steel	
Corrosion, Local or Atmospheric	Included in MAER
Elevated Temperature	Included in MAER
Irradiation	Included in MAER
Stress Corrosion Cracking	Included in MAER
Reinforced Steel (Rebar)	
Corrosion of Embedded Steel	Included in MAER
Elevated Temperature	Included in MAER
Irradiation	Included in MAER
Miscellaneous	
Settlement	Included in MAER
Strain Aging (of Carbon Steel)	Included in MAER
Loss of Prestress	Included in MAER
Corrosion of Steel Piles	None In-Scope
Corrosion of Tendons	None In-Scope
Cask Internals	
Corrosion, Boric Acid Corrosion	Included in MAER
Creep	Included in MAER
Erosion/Corrosion	Not Applicable (No moving media)
Stress Corrosion Cracking (includes intragranular, transgranular, and irradiation assisted)	Included in MAER
Neutron Irradiation Embrittlement	Included in MAER
Stress Relaxation	Included in MAER
Thermal Embrittlement	Included in MAER
Wear	Not Applicable (No moving parts)
Additional Items Not In Staff Guidance	
Annealing in Fuel Cladding	Included in MAER
Hydride Re-orientation in Cladding	Included in MAER
Lead Slumping	Included in MAER
Radiolytic Decomposition in Polymers	Included in MAER

Materials RAI-12:

Clarify the criteria used for determining when corrective actions should be implemented for components identified in the AMR.

Page A-3 of Appendix A indicates that engineering evaluations will be performed to determine whether observed deterioration of material condition is significant enough to compromise the ability of the dry storage cask to perform its intended function. Corrective actions may be taken as a result. Since certain material degradation effects may not always be apparent to visual observations, it is not clear how observed deterioration of material condition can be used quantitatively in the engineering evaluation. It appears that surface corrosion is the primary deterioration mechanism monitored. The adequacy of determining the extent of material degradation by such visual observation should be justified by addressing other potential mechanisms.

This information is required to ensure adequate evaluations were performed in accordance with Section III.C of the Preliminary Staff Guidance.

Response to RAI:

As per LRA Section A, page A-3, "The acceptance criteria for all visual inspection is the absence of anomalous indications that are signs of degradation." Any coated surface defects are considered as anomalous indications. However, minor coating defects due to scratches or nicks are repaired by work orders as maintenance items. Coated surface defects are repaired because subsequent corrosion is considered to have the potential to "compromise the ability of the dry storage cask to perform its intended function."

A coating surface defect that is apparently due to improper coating, or a defect that is larger than "normal" or otherwise is "unusual" may be indications of a "deviating" condition. The inspector determines the difference between a routine "maintenance" item and a deviating condition based on the extent and type of degradation involved. Any deviating condition would initiate a "Plant Issue" which in turn, initiates the corrective action system.

Corrosion observed during inspections of normally inaccessible areas would typically be considered a deviating condition. As such a Plant Issue would be generated and an engineering evaluation would be required. The deviating condition would be evaluated thoroughly to determine the cause and any required corrective actions. This evaluation would also consider the applicability of the deviation to other cask designs with similar material/environment conditions. Corrective actions would be identified to preclude future occurrences. An example of this level of evaluation is given in LRA Section 3.1.5.2 dealing with the environmental cover leakage for the TN-32 casks.

The quarterly visual inspections, the MC-10 and CASTOR V/21 environmental cover inspections, the CASTOR V/21 cask bottom inspection, and inspections of normally inaccessible areas (on an opportunity basis) will utilize the same threshold for a deviating condition. Cask pressure monitoring alarms or radiation surveys in excess of ISFSI Technical Specification limits are considered deviating conditions and would initiate the corrective action system.

As stated in the response to Materials RAI-11, the aging management activities applied to the Surry ISFSI facility are adequate to detect the aging effects of credible aging mechanisms. Loss of material is the only aging effect deemed credible for the material/environment combinations and storage conditions at the Surry ISFSI. Therefore, visual inspections, cask pressure monitoring, and radiation monitoring are adequate to manage these aging effects and to initiate corrective actions as required.

Materials RAI-13:

Clarify how the Maximum Cumulative Usage Factor (CUF) for fatigue was calculated for CASTOR V/21 casks and CASTOR X/33 casks.

Section B2.2 of Appendix B indicates that the CUF for fatigue for the CASTOR V/21 casks was calculated to be 0.111 for 30 years and 0.128 for CASTOR X/33 casks for the same 30 year period. It is not clear why the CUFs are different, since both casks are in the same location and exposed to the same temperature range.

This information is required to ensure adequate evaluations were performed in accordance with Section III.C of the Preliminary Staff Guidance.

Response to RAI:

The CASTOR V/21 and CASTOR X/33 casks are exposed to the same temperature ranges and cycles, however, there are major differences between the designs of the two casks. The V/21 is designed to accommodate fuel that is loaded five years after discharge from the reactor, and utilizes fins on the outer surface to dissipate the heat load. The X/33 cask accommodates more fuel assemblies, but with a much longer cooling time. Also, the two casks have differing dimensions, with the X/33 larger in diameter and, therefore, more rigid. Thus there are differing stress levels in the casks, including the thermal stresses. For the same reasons, the stress concentration factors for the X/33 and for the cask V/21 are also different. Detailed discussions of the evaluations are provided in the following documents.

Calculation of the maximum cumulative usage factor (CUF) for fatigue for the CASTOR V/21 is documented in Section 4.2 of Topical Safety Analysis Report (TSAR) for the CASTOR V/21 Cask Independent Spent Fuel Storage Installation (Dry Storage) Revision 2A (non-proprietary volume). The TSAR for the CASTOR V/21 casks was reviewed and approved by the NRC as identified in the letter dated April 03, 1987 from Mr. Leland C. Rouse of NRC to Mr. Victor J. Barnhart of General Nuclear Systems, Inc.

Calculation of the maximum cumulative usage factor (CUF) for fatigue for the CASTOR X/33 is documented in Section 4.2 of Topical Safety Analysis Report (TSAR) for the CASTOR X/33 Spent Fuel Storage Cask, Revision 4A (non-proprietary volume). The TSAR for the CASTOR X/33 casks was reviewed and approved by the NRC as identified in the letter dated April 22, 1994 from Mr. Frederick C. Sturz of NRC to Mr. Patrick L. Paquin of General Nuclear Systems, Inc.

Scoping Methodology (SM) RAI-1:

Clarify how the site-characteristics addressed in Chapter 2 of the FSAR will change (or have changed) in the next 40 years. Specify how the scoping evaluation in the license renewal application considered external factors (such as site characteristics) that are outside the direct control of Dominion Power.

It appears that some information in the SAR is based on 1980-era data and does not directly address changes to the site-characteristics over the next 40 years. For example, population distribution and site meteorology information (which may change) could affect radiological safety conclusions. It is not clear if the current licensing basis considered the realized and predicted changes in site-specific characteristics over long periods of time such as 60 years.

This information is required to verify that the SSCs important to safety will continue to meet the current licensing basis in accordance with Section II of the Preliminary Staff Guidance and the requirements of 10 CFR 72.104, 72.106, and 72.122(b&c) for an additional 40 years.

Response to RAI:

Per the Preliminary Staff Guidance, Section III.B, the determination of whether or not a cask component is in scope is based on the function(s) which that component performs. Site characteristics could potentially be a factor in the design or selection of various cask components. Therefore, changes in these characteristics could also potentially impact the ability of components to perform their safety functions. As part of the license renewal process for the Surry Power Station, an Environmental Report (ER) per the requirements of 10CFR51.53(c) was required. This comprehensive environmental review considered current and projected changes in site characteristics (e.g., population and meteorology), where applicable. The ER prepared for the Surry plant license renewal effort under 10CFR Part 54 used available current data and was incorporated by reference into Appendix E of the ISFSI LRA. No new or significant information regarding site characteristics beyond those considered in the Surry original license ER were identified in the Surry license renewal ER. Accordingly, it is concluded that none of the site characteristics addressed in Chapter 2 of the ISFSI FSAR would change significantly enough to affect the ISFSI scoping determination.

The National Environmental Protection Act (NEPA) requires consideration of what is reasonably known or projected at the time of decision making for a particular licensing action (e.g., license renewal), and to the level of detail that is commensurate with the significance of evaluated impact. In general, changes of potential environmental significance that may occur in the site characteristics, such as population distributions or regulatory requirements governing environmental issues, are identified and considered through the responsible organizations at Dominion. These include the environmental compliance, emergency preparedness, and radiological protection organizations. The continued safety of the public and the protection of the environment over the duration of an ISFSI license renewal period are addressed in the programs and on-going monitoring provided by these organizations.

The site characteristic of population distribution is particularly important from a radiological safety perspective. Population projections for locations in proximity to the Surry Power Station have proven to be overly conservative (i.e., too high). (Refer to the response to the Environmental Review RAI-4.) However, the radiological safety for the general population around the station or the ISFSI is not maintained by information based on projections. Land Use Census requirements for the Surry Power Station determine the location of the nearest resident on an annual basis. ISFSI boundary and Surry plant site radiation monitoring is continuous and in compliance with the requirements of 10 CFR Part 20 and 10 CFR Part 72. Following receipt of updated U.S. Census data (every 10 years), the Dominion Emergency Preparedness organization evaluates shifts in population centers and provides a re-assessment of the evacuation time for each of its nuclear sites including the Surry plant and ISFSI. These activities are part of the current licensing basis requirements for the licensee to remain cognizant of the changing population distributions. As part of the current licensing basis, these activities would carry over into the license renewal periods for both the Surry plant and ISFSI.

SM RAI-2:

Discuss Dominion Power's plan to maintain the spent fuel pool for the proposed license life up to 2046.

The spent fuel pool could be necessary to perform cask maintenance activities, satisfy action requirements in technical specifications, and unload spent fuel. The current licensing basis in the FSAR indicates the spent fuel pool and handling equipment is licensed and regulated under the Part 50 power license. However, the exemption request states that renewed power licenses would expire by 2033. It is not clear what elements of the spent fuel pools structures, systems, and components, as required under Part 50, must be maintained to provide reasonable assurance that these cask activities can be safely performed during storage operations between 2033 and 2046.

This information is required to determine whether the scoping evaluation considered predicted changes in the current licensing basis for retrievability in accordance with Section II of the Preliminary Staff Guidance and the requirements of 72.122(l).

Response to RAI:

Currently, the ISFSI Final Safety Analysis Report states that the spent fuel pool at the Surry Power Station will remain functional until the ISFSI is decommissioned. The ISFSI Technical Specifications require removal of the fuel from the storage casks if certain surveillance requirements are not met. At this time, the only available option for removal of fuel from the casks at Surry is the use of the spent fuel pool and associated cask handling systems. Since the ISFSI Technical Specifications require the ability to remove fuel from the cask, the spent fuel pool and cask handling systems must remain functional unless other facilities are licensed and constructed. Expiration of the Part 50 power license does not obviate the need to meet the ISFSI license requirements.

Furthermore, pursuant to 10CFR50.54, License Conditions, Item (bb), Dominion is required to "...submit written notification to the Commission for its review and preliminary approval of the program by which the licensee intends to manage and provide funding for the management of all irradiated fuel at the reactor following permanent cessation of operation of the reactor until title to the irradiated fuel and possession of the fuel is transferred to the Secretary of Energy for its ultimate disposal in a repository." Since there are currently no plans to construct other fuel transfer facilities at Surry to accommodate the ISFSI after the expiration of the Surry operating license, the current structures, systems, and components that are used to store spent fuel and load storage casks would be required to remain in operation. Current maintenance and testing programs in place will ensure the continued safe performance of spent fuel storage and cask activities for the proposed license life.

Should alternative facilities become necessary, licensing actions would be initiated at the appropriate time to gain the necessary approvals for alternative methods or facilities to perform cask maintenance activities, satisfy action requirements in Technical Specifications, and unload or transfer spent fuel for final disposition. Any such alternatives, either implemented or planned, would be included in the spent fuel management program scope submitted in accordance with 10CFR50.54(bb).

SM RAI-3:

Clarify whether the casks loaded with spent fuel will only be used to store its original contents, or whether they may be reused to store different fuel during the renewed license period. Provide a table of fuel parameters in the currently loaded casks, including the burnup, cooling time, decay heat, fuel type, and fuel condition prior to loading.

It must be established that the DCSS is capable of handling the thermal and radiation loading of the potential fuel that is allowed by NRC license during the additional 40-year storage period. For example, the application should address whether a cask could be unloaded (and its fuel shipped to a permanent repository) and then reused to store hotter fuel from the spent fuel pool.

This information is required to determine significant differences in internal conditions between otherwise identical casks, in accordance with Section III.D.8 of the Preliminary Staff Guidance and the requirements of 72.122(a) and (b).

Response to RAI:

While there are no plans to unload currently loaded casks and then reload them with different fuel assemblies, the current ISFSI license does not preclude this possibility. The license renewal evaluation process performed by Dominion has established that the spent fuel casks being used at Surry will perform their required function over the license renewal period assuming the casks are loaded with fuel which meets the requirements of the current Technical Specifications. Based on the implementation of aging management activities identified through the aging management reviews for the cask components, it is concluded that the durability of the cask design and materials is not compromised by aging effects. No credit has been taken for additional fuel decay or reduction in heat load in the development of this stated conclusion. As the functionality of the casks is not expected to degrade over the license renewal period, the unloading and reloading of the casks should not be precluded if it is deemed prudent to do so and fuel meeting the Technical Specification requirements for the cask is available. It should be noted that fuel currently being discharged from the Surry reactors would not meet the storage requirements for the older casks and would, therefore, make their re-use for storing different fuel than originally stored unlikely.

Should a cask be reused to store different fuel than originally stored, the cask would under go visual inspections during the unloading/loading sequence to ensure no degradation of the cask and lid sealing surfaces had occurred that would preclude the cask from maintaining its storage functionality. Visual inspection of the assemblies removed and verification of removal force would provide indication of any basket damage. New O-ring seals are used with any cask closure. Prior to placement at the ISFSI the casks must meet Technical Specification limits on surface dose rates. For reloaded casks this measurement of the surface dose rate (assuming it met the Technical Specifications limit) would provide assurance that the shielding ability of the cask still meets its design function and would continue to do so over the license renewal period.

Section III.D.8 of the Preliminary Staff Guidance requests that detailed information on the individual fuel assemblies stored in the various casks at a storage facility be provided as part of the license renewal application. Any analyses performed for the individual cask types (criticality, heat loads, etc.) must assume parameters that meet or bound the parameters identified in the facility Technical Specifications. Therefore, the Technical Specifications provide the bounding parameters for fuel inventory currently in storage at Surry. The fuel currently in dry cask storage at Surry met the Technical Specification requirements for burnup, cooling time, decay heat, fuel type, and fuel condition at the time of loading into the respective casks. The following tables summarize these Technical Specification requirements for the casks used at Surry.

CASTOR V/21	**(Source: Surry ISFSI Technical Specifications Table 2-1)**
Fuel Storage Capacity	≤ 21 Intact unconsolidated Fuel Assemblies
Fuel Type	15 x 15 Zircaloy clad PWR Fuel Assemblies
Initial Enrichment, (U235 w/o) Stainless Steel Basket Borated Stainless Steel Basket	 ≤ 2.2 ≤ 3.7
Average Burnup (MWD/MTU)	≤ 40,000
Decay Heat (kW/Assembly)	≤ 1.0
Cooling Time, Years after irradiation (≤ 35,000 MWD/MTU) Years after irradiation (> 35,000 MWD/MTU)	 ≥ 5 ≥ 6

MC-10	**(Source: Surry ISFSI Technical Specifications Table 2-2)**
Fuel Storage Capacity	≤ 24 Intact unconsolidated Fuel Assemblies
Fuel Type	15 x 15 Zircaloy clad PWR Fuel Assemblies
Initial Enrichment, (U235 w/o)	≤ 3.7
Average Burnup (MWD/MTU)	≤ 35,000
Decay Heat (kW/Assembly)	≤ .5625
Cooling Time, Years after irradiation	 ≥ 10

NAC- I28	(Source: Surry ISFSI Technical Specifications Table 2-3)
Fuel Storage Capacity	≤ 28 Intact unconsolidated Fuel Assemblies
Fuel Type	15 x 15 Zircaloy clad PWR Fuel Assemblies
Initial Enrichment, (U235 w/o)	≤ 1.9
Average Burnup (MWD/MTU)	≤ 35,000
Decay Heat (kW/Assembly)	≤ .558
Cooling Time, Years after irradiation	≥ 10

CASTOR X/33	(Source: Surry ISFSI Technical Specifications Table 2-4)
Fuel Storage Capacity	33 Intact unconsolidated Fuel Assemblies
Fuel Type	15 x 15 Zircaloy clad PWR Fuel Assemblies
Initial Enrichment, (U235 w/o)	≤ 3.5
Average Burnup (MWD/MTU)	≤ 35,000
Decay Heat (kW/Assembly)	≤ .30
Cooling Time, Years after irradiation	≥ 10

TN-32	(Source: Surry ISFSI Technical Specifications Table 2-5)
Fuel Storage Capacity	≤ 32 Intact unconsolidated Fuel Assemblies
Fuel Type	Westinghouse 15 x 15 Standard Westinghouse 15 x 15 Surry Improved Fuel
Initial Enrichment, (U235 w/o)	≤ 4.05
Average Burnup (MWD/MTU)	≤ 45,000
Decay Heat (kW/Assembly)	≤ 1.02
Cooling Time, Years after irradiation	SM RAI-3 Figure 1 (for Fuel Assembly) SM RAI-3 Figure 2 (for Burnable Poison Rod Assembly, BPRA) SM RAI-3 Figure 3 (for Thimble Plug Device, TPD)

SM RAI-3 Figure 1
(Source: Surry ISFSI Technical Specifications Figure 2-5.1)

MINIMUM ACCEPTABLE COOLING TIME IN YEARS AS A FUNCTION OF BURNUP AND INITIAL ENRICHMENT

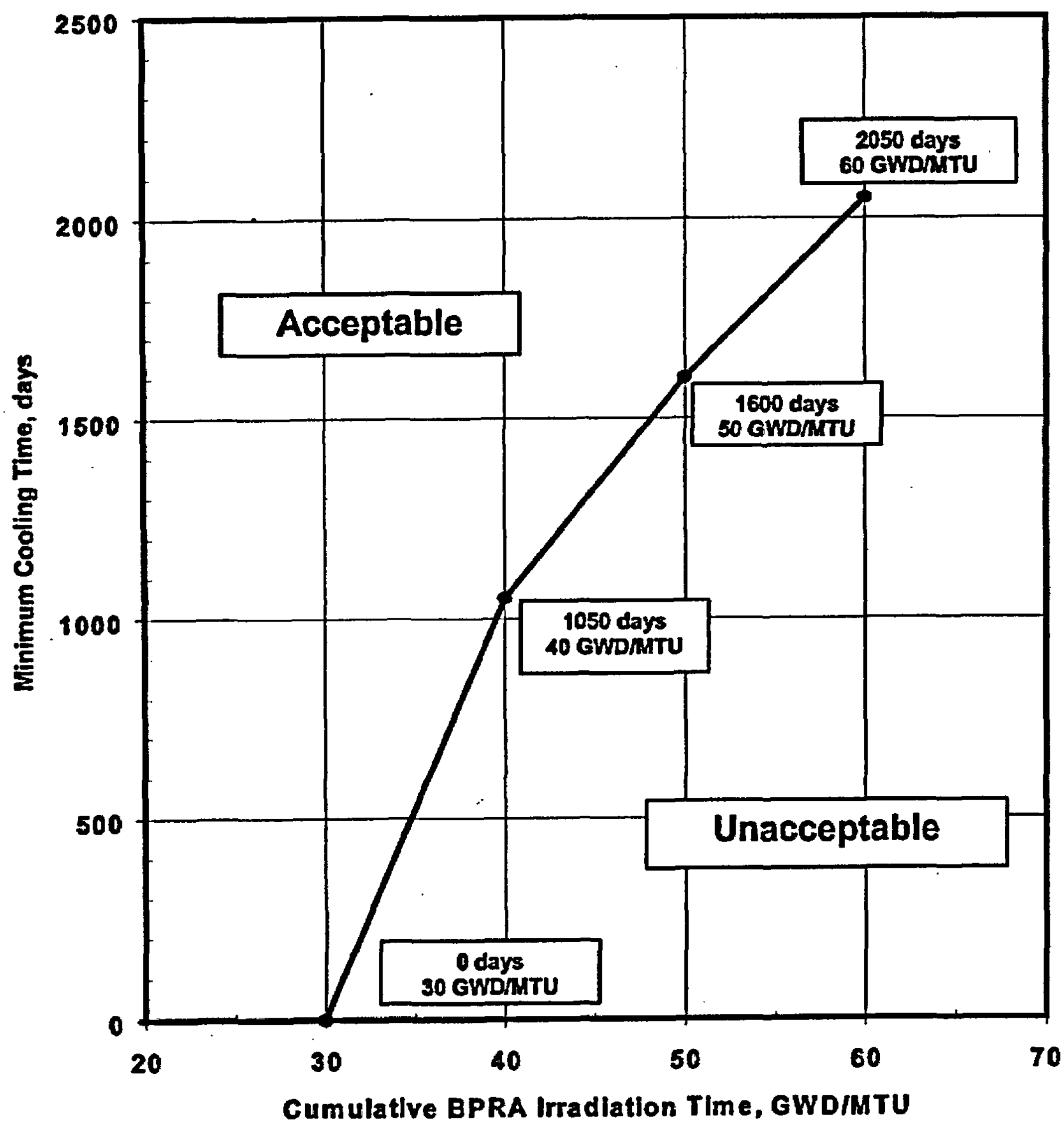
Initial Enrichment (wt % U-235) (1)	Burnup (GWD/MTU) (2)																
	15	20	30	32	33	34	35	36	37	38	39	40	41	42	43	44	45
1.2	7	7															
1.3	7	7															
1.4	7	7															
1.5	7	7	7	8	8	8	8	9									
1.6	7	7	7	7	8	8	8	9	9	9	9						
1.7	7	7	7	7	8	8	8	8	9	9	9	10					
1.8	7	7	7	7	7	8	8	8	9	9	9	10					
1.9	7	7	7	7	7	7	8	8	8	9	9	9	10	10			
2.0	7	7	7	7	7	7	8	8	8	8	9	9	9	10	10		
2.1	7	7	7	7	7	7	7	8	8	8	9	9	9	10	10		
2.2	7	7	7	7	7	7	7	7	8	8	8	9	9	9	10	10	
2.3	7	7	7	7	7	7	7	7	8	8	8	9	9	9	10	10	
2.4	7	7	7	7	7	7	7	7	8	8	8	8	9	9	9	10	10
2.5	7	7	7	7	7	7	7	7	7	8	8	8	8	9	9	9	10
2.6	7	7	7	7	7	7	7	7	7	7	8	8	8	8	9	9	10
2.7	7	7	7	7	7	7	7	7	7	7	8	8	8	8	9	9	9
2.8	7	7	7	7	7	7	7	7	7	7	8	8	8	8	9	9	9
2.9	7	7	7	7	7	7	7	7	7	7	7	8	8	8	8	9	9
3.0	7	7	7	7	7	7	7	7	7	7	7	7	8	8	8	9	9
3.1	7	7	7	7	7	7	7	7	7	7	7	7	8	8	8	9	9
3.2	7	7	7	7	7	7	7	7	7	7	7	7	7	8	8	8	8
3.3	7	7	7	7	7	7	7	7	7	7	7	7	7	7	8	8	8
3.4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	8	8	8
3.5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
3.6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
3.7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
3.8	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
3.9	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
4.05	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

■ - not evaluated

(1) Round actual value down to next lower tenth.
(2) Round actual value up to next higher GWD/MTU.

SM RAI-3 Figure 2
(Source: Surry ISFSI Technical Specifications Figure 2-5.2)

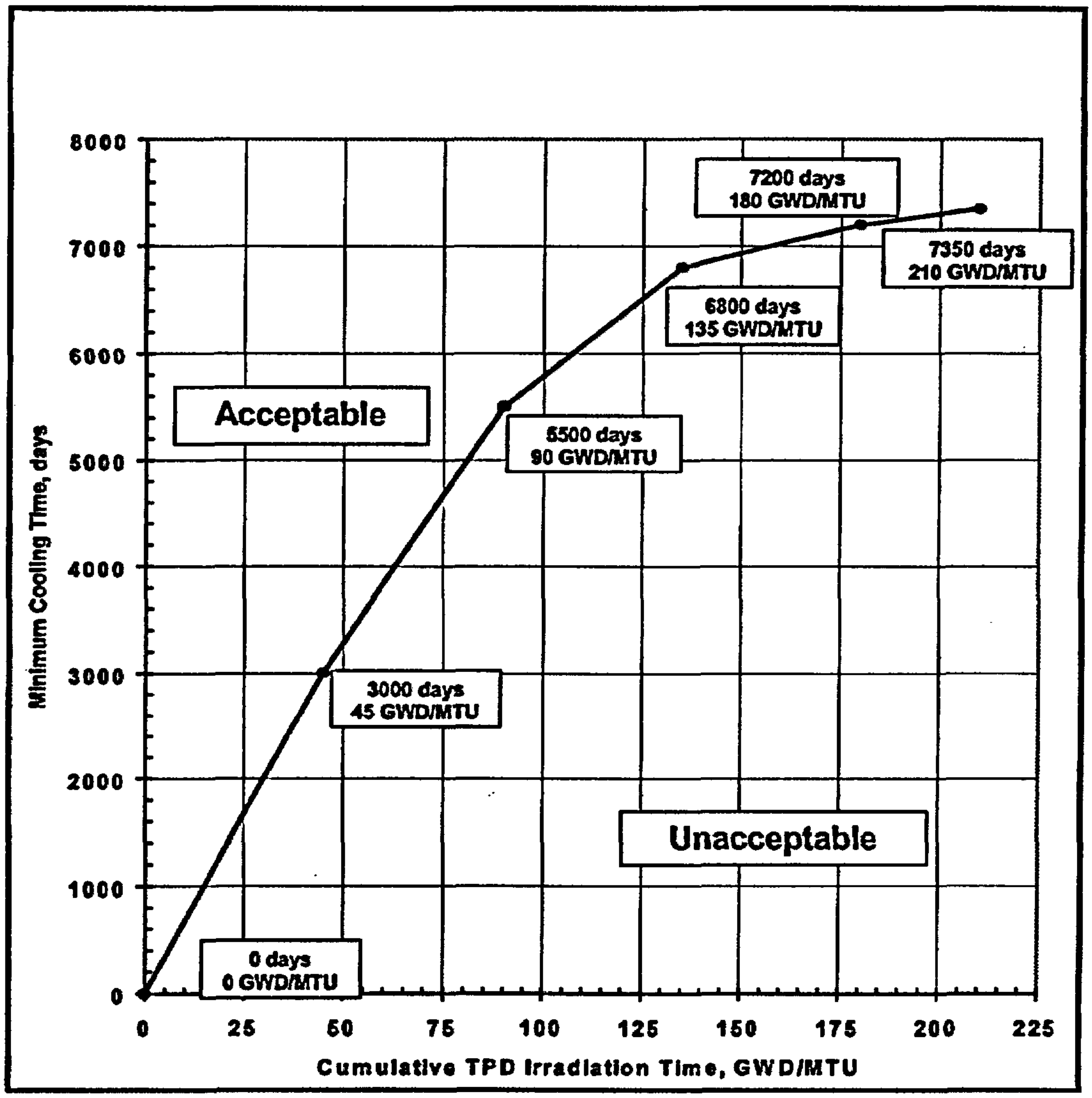
COOLING TIME AFTER SHUTDOWN FOR BPRAs
IN TN-32 DRY STORAGE CASKS



(The cumulative irradiation is taken to be the sum of the individual fuel assembly burnup values in which the BPRA was resident during in-core operation.)

SM RAI-3 Figure 3
(Source: Surry ISFSI Technical Specifications Figure 2-5.3)

COOLING TIME AFTER SHUTDOWN FOR TPDs
IN TN-32 DRY STORAGE CASKS



(The cumulative irradiation is taken to be the sum of the individual fuel assembly burnup values in which the TPD was resident during in-core operation.)

Aging Management Reviews (AMR) RAI-1:

Clarify whether the aging management evaluation of the TN-32 poison plates considered the analysis in Appendix A.5 of the Surry SAR, which addresses the criticality evaluation for a period of only 20 years.

This information is required to determine whether the aging management evaluation considered the current licensing basis for criticality safety in accordance with Section III.D.8 of the Preliminary Staff Guidance and the requirements of 72.124.

Response to RAI:

Appendix A.5 of the ISFSI FSAR addresses the depletion of boron in the TN-32 poison plates and concludes the depletion has a negligible impact on the criticality analysis. The ISFSI FSAR states the "...evaluation of the criticality design and performance have demonstrated that the cask will provide for the safe storage of spent fuel for a minimum of 20 years with an adequate margin of safety." The boron depletion calculation addressed a significantly longer period of time.

Chapter 6 of the TN-32 Final Safety Analysis Report (FSAR) shows the fractional depletion calculation of ^{10}B in the neutron absorber plate in the TN-32 baskets. This calculation conservatively assumed that the total scalar flux in the center of the basket (8.41×10^5 n/cm^2-sec) is thermal. With the lack of significant moderating media in the basket materials, the actual neutron flux will be fast and epithermal, not thermal. This calculation further used a thermal neutron cross section of 3837 barns for ^{10}B. The results show that for a 1000 (one thousand) year duration, the fractional depletion of ^{10}B is only 1×10^{-4}. This is negligible depletion. The aging management evaluation of the TN-32 neutron absorber plate considered the degree of boron depletion of poison plates. It consequently was determined that there are no aging management activities associated with the criticality evaluation for TN-32 casks.

AMR RAI-2:

Justify why the fuel pellet is not within the scope of license renewal as stated in Table 3.3-1.

The physical properties of the pellet are factors that impact the criticality analysis and are considered in the criticality safety design of the casks.

This information is required to determine whether the aging management evaluation considered potential degradation mechanisms important to criticality safety in accordance with Section III.D.8 of the Preliminary Staff Guidance and the requirements of 72.124.

Response to RAI:

Preliminary Staff Guidance (PSG) Section III.B provides guidance for determining what ISFSI SSCs are within the scope of license renewal. Specifically, the PSG indicates that the SSCs to be evaluated within the scope of license renewal are those that are:

1. Important to safety, as they are relied upon to: (a) maintain the conditions required to store spent fuel safely, (b) prevent damage to the spent fuel during handling and storage, or (c) provide reasonable assurance that spent fuel can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public, as identified in the CLB. These SSCs ensure that important safety functions are met for: (1) criticality, (2) shielding, (3) confinement, (4) heat transfer, and (5) structural integrity.

or,

2. Classified as not important to safety, but, according to the CLB, whose failure could prevent an important to safety function from being fulfilled or whose failure as a support SSC could prevent an important to safety function from being fulfilled.

Further the PSG indicates that, "the function performed by a SSC that causes it to be within scope of license renewal is its intended function."

The fuel pellets were determined to not be within scope of license renewal as they are not relied upon to perform any of the important safety functions listed above, nor could their failure prevent an important to safety function from being fulfilled with respect to the dry cask storage systems used at the Surry ISFSI.

In accordance with 10CFR72.124(a) and 10CFR72.236(c) the dry storage systems in use at Surry were designed to maintain the stored fuel in a subcritical condition. Analyses show these dry storage systems to be subcritical by a substantial margin under credible conditions (i.e., $k_{eff} \leq .95$).

The current licensing basis (CLB) for the dry cask storage systems evaluates conservative criticality safety scenarios assuming the cask is loaded with unirradiated fuel. Fuel pellet characteristics for this evaluation are those which are applicable to the fuel assembly type to be stored which has been determined to be the most limiting from a criticality safety standpoint. The types of fuel assemblies and their allowable initial enrichment are incorporated into the Technical Specifications governing the use of the cask. The fuel type (i.e., fuel rod array and dimensions) along with the cask fuel basket provide the storage geometry for the system assumed in the CLB criticality safety analysis.

10CFR72.124(b) indicates that for criticality control, when practicable, the design of an ISFSI or MRS must be based on favorable geometry, permanently fixed neutron absorbing materials (poisons), or both.

As these criteria were met for the design of the dry storage systems in use at Surry, then for extended dry storage, maintaining the initial storage geometry and, in some designs, maintaining sufficient neutron poison efficacy would be sufficient for maintaining the required subcritical margin.

In order to maintain the favorable geometry analyzed for the dry storage system current licensing basis, the structural aspects of the fuel assembly (skeleton and fuel rod) and basket must remain intact. As evaluated and described in the license application for renewal of the Surry ISFSI license and the response to Materials RAI-4 (zirconium fuel cladding), the geometry and structural aspects of the fuel assembly and basket will remain intact under dry storage conditions (i.e. inert atmosphere) during the license renewal period.

Neutron poisons are used to offset the reactivity increase when water is added during cask loading or unloading. Neutron emission from irradiated fuel that can be placed in dry storage typically has a fast neutron energy spectrum and does not result in significant multiplication of neutrons in UO_2 fuel. Therefore, criticality is not possible under dry storage conditions even without additional neutron absorbing materials. A neutron moderator such as water is required in order to produce the thermal neutron spectrum necessary to induce fission and neutron multiplication. During normal operation, loaded dry storage casks would typically only be filled with water during the loading phase to provide shielding of the fuel. Other instances where the cask inner lid requires removal (such as unloading or maintenance) would also require the cask to be returned to the pool and flooded. The CLB criticality safety evaluation discussed above assumes the cask is flooded with water and determines whether thermal neutron absorber material is required to maintain the appropriate subcritical margin. If further criticality control is warranted, the water used to flood the cask may be required to contain dissolved soluble boron. In this situation, the necessary concentration of boron is stated as a requirement in the Technical Specifications. Further discussion of the thermal neutron absorber materials used and justification of their continued efficacy during the license renewal period is addressed in the response to Materials RAI-5.

As described above the criticality safety of the dry storage system is maintained by the ability of the fuel and basket to maintain their structural geometry and the neutron absorber to maintain its efficacy over the license renewal period.

The fuel pellet's physical properties are not expected to change significantly post-reactor operation through the license renewal period. As indicated in ASTM Standard C 1562-03, Standard Guide for Evaluation of Materials Used in Extended Service of Interim Spent Nuclear Fuel Dry Storage Systems, any post-operation degradation of the fuel pellet would primarily occur as a result of oxidation which requires direct exposure to air. Under normal dry storage conditions, exposure of the fuel pellets to air would not exist, even in the presence of minor cladding defects resulting from reactor operation. The fuel is stored in an inert atmosphere, and either the seal system or cask cavity atmosphere is continuously monitored to ensure air in-leakage does not occur. Studies cited in the ASTM Standard indicate that the extent of UO_2 oxidation is a time, temperature, and burnup dependant phenomenon. Further, the ASTM Standard indicates that under the conditions of extended dry storage, insufficient oxidation will exist to create or propagate cladding defects. Accordingly, there is no basis to assume the fuel pellets will have a detrimental effect on the fuel cladding and thereby adversely affect the structural geometry of the fuel or the criticality safety analysis for the license renewal period. Therefore, the fuel pellets need not be considered in the scope of license renewal.

Aging Management Activities (AMA) RAI-1:

Discuss how cask seals are inspected under the inspection activities as stated in Table 3.2-4 for aging management. Clarify if the corrective actions and resolution of the TN-32 seal lid failures have addressed an additional 40-year service life for protection against normal conditions, anticipated occurrences, credible accidents, and natural phenomena events within the current licensing basis. Specify whether the cask seals could be in an undetected degraded state that meets normal operating conditions, but not in the required state of integrity to withstand credible accidents.

This information is required to determine whether the aging management maintenance and surveillance program considered the current licensing basis in accordance with Sections III.D.7 and D.8 of the Preliminary Staff Guidance and the requirements of 10 CFR 72.104, 72.106, and 72.122(b&c) for an additional 40 years.

Response to RAI:

This RAI consists of three parts and is addressed below accordingly.

1) As stated in LRA Appendix A, Section A2.1, subheading "Parameters Monitored or Inspected," continuous pressure monitoring of the cask cover gas is the method to "... verify the integrity of the seals in the dry storage cask closure covers."

2) As part of the corrective action to the TN-32 lid seal failures, a root cause evaluation was performed. This evaluation identified a design problem with the over-pressure monitoring system environmental cover penetration (Conax connector) that allowed water intrusion into the main cask lid area and, subsequently, the outboard metallic (aluminum) seals. The implemented corrective action replaced the original penetration with a water-tight seal and relocated the penetration to the side of the cover. The corrective action did not alter the design basis of the cask, but simply restored the originally intended design conditions. The aging management review for the TN-32 cask conservatively assumed that the area external to the main cask lid was potentially subject to atmosphere/weather conditions and, therefore, considered all appropriate aging effects for the materials involved. (Note: An elastomer seal is used as a moisture barrier. No credit was taken for this seal.) As a result, this area requires aging management. The ISFSI AMA provides this management by the continuous pressure monitoring of the TN-32 cask and the requirement to provide a visual inspection of the cask lid external areas any time the environmental cover is removed.

The experience of the TN-32 lid seal failures is an example of the effectiveness of the aging management and corrective action system in effect at the Surry ISFSI. The aging management activities are on-going and ensure that the redundant lid seal systems for all casks are intact and functional. By maintaining the integrity of the lid seal systems now and in the future, the conditions assumed for the current licensing basis are maintained into the license renewal period. The resolution of the TN-32 environmental cover leakage problem does not remove or alter the requirement for aging management of the main lid area.

3) The potential for an undetected degraded state of the metallic seals in any cask design cannot be dismissed but is accounted for by the redundant seal system design per the requirements of 10CFR72.236(e). There are no identified aging effects for the inboard metallic lid seals subject to the inert helium environment. Any seal failure would most likely affect the outboard metallic lid seals that are potentially subject to atmosphere/weather environment. Since the seals are continuously monitored for integrity, leakage of either metallic seal would be detected. Seals associated with the removal of a cask lid to replace a failed seal would be replaced as part of the corrective action.

Environmental Review (ER) RAI-1:

Provide information (dates, quantities, locations, material release) for all reportable spills, releases, and accidental discharges to the environment since the previous Environmental Report (ER), if applicable. Provide a summary of the measured radiological dose impacts in Section 4.0 of Appendix E, during the entire current license period for ISFSI operations, as reported under 10 CFR 72.44(d)(3).

This information may identify unexpected environmental trends during the current license period, and provides insights on expected environmental trends over an additional 40 years.

10 CFR 51.61 states that... "The environmental report shall contain the information specified in 51.45 and shall address the siting evaluation factors contained in Subpart E of Part 72 of this chapter." Furthermore, 10 CFR 72.70 (a) states that each specific licensee for an ISFSI "...shall update periodically...the final safety analysis report (FSAR) to assure that the information included in the report contains the latest information developed."

Response to RAI:

This RAI appears to be concerned with future environmental trends. Accordingly, the last seven years' Annual Radiological Environmental Reports, required by 10CFR72.44(d)(3), were reviewed. These reports are submitted annually to NRC Region II with copies to the Director, NMSS, in compliance with Surry ISFSI Technical Specification, Appendix C, Section 1.4.1. In each case, the report states that there have been no liquid or gaseous effluents nor solid waste released from the Surry ISFSI. Surry Radiological Protection has re-affirmed that no radiological effluent releases of any kind have originated from the ISFSI since its licensing in 1986. In addition, Dominion's Electric Environmental Services department has confirmed that there have been no non-radiological releases, such as fuel oil, at the Surry ISFSI facility.

As per Section 4.0 of LRA Appendix E, the dose to the public consists only of gamma and neutron doses from the sides of the casks. Because no effluent releases have occurred since licensing in 1986, Dominion considers it reasonable to assume the trend will continue and that there will be no releases of any kind from the Surry ISFSI and that no significant dose contributions will result from the operation of the ISFSI facility during the license renewal period. The dose discussions in the LRA, Section 4.3.1 remain applicable.

ER RAI-2:

Revise the environmental report to only address the requested licensing actions in the application.

The ER provides assessments for modifications of the design with a fourth storage pad. However, this design modification is not part of the ISFSI design which is requested in the license renewal.

This information is required to determine compliance with 10 CFR 51.45.

Response to RAI:

The inclusion of assessments of a fourth pad at the Surry ISFSI was intended to be conservative and bounding in addressing potential future requirements. The fourth pad was never intended to be part of the license renewal request. The LRA clearly identified that the fourth pad would require a separate licensing action to either the current or a renewed ISFSI license. Dominion currently has no plans to build a fourth ISFSI pad at Surry. Accordingly, discussion regarding a fourth pad is no longer appropriate and should not be considered in the review of the Surry ISFSI license renewal request.

Based on the license renewal process recently utilized by the Surry Power Station to renew its operating license, it is typical to supplement or supercede information that was provided in the LRA, but not to revise or update the application itself or its attachments. In other words, the LRA, subsequent RAIs and responses, and any other formally docketed supplemental information, constitutes the whole of the information basis on which the application request is reviewed. The staff Safety Evaluation Report (SER) prepared to accompany an approved licensing action would document these information submittals as the basis for its findings. However, when appropriate to ensure clarity and/or for completeness, portions of the application information may be revised and provided as part of an RAI response (for example, a revised table). In this case, the RAI information supercedes the information in the application. Because of the multiple references throughout Appendix E of the LRA, pages showing deletions of the text regarding the fourth ISFSI pad are provided in Attachment 2 to this RAI response. These pages supercede their corresponding pages in Appendix E, but are not intended to be "change-out" pages.

ER RAI-3:

Delete the line in Appendix E, Table 1-2 regarding the Benefit-Cost Analysis.

There is no benefit-cost analysis in Section 4.5 of the Environmental Report. In accordance with 10 CFR 51.45(c), one is not required.

Response to RAI:

Refer to the discussion in the response to Environmental Review RAI-2 regarding revisions to the LRA or its appendices.

The staff is correct on this matter. The environmental report does not include a cost-benefit analysis, nor is one required. The table has been corrected and for completeness is included in the pages provided in Attachment 2.

ER RAI-4:

Modify Appendix E, Section 4.0, Dose to the Public, to provide the most current population data.

The annual collective dose to the public is based on 1980s population data assuming a 20 percent growth in the number of residents.

Title 10 CFR 51.61 states that... "The environmental report shall contain the information specified in 51.45 and shall address the siting evaluation factors contained in subpart E of part 72 of this chapter." Furthermore, 10 CFR 72.70 (a) states that each specific licensee for an ISFSI "...shall update periodically...the final safety analysis report (FSAR) to assure that the information included in the report contains the latest information developed."

Response to RAI:

The collective dose to the public was calculated by assuming that 48 residents were located within 2 miles of the ISFSI in 1980, and that all 48 of these residents received as much dose as the maximally exposed off-site resident located at 1.5 miles. In addition, this dose was adjusted for a 20 percent increase in population at the end of the license period, based on the population increases within the two mile radius that were projected in the FSAR.

The environmental review performed for the Surry plant license renewal effort under 10CFR Part 54 was incorporated by reference into Appendix E of the ISFSI LRA. At the time of submittal, the 2000 census data was not available for use. Therefore, the ISFSI supplement to the Environmental Report (LRA, Appendix E) used the ISFSI FSAR data as its base. The inputs are updated in the following paragraph.

Actual population counts used to revise the emergency preparedness evacuation plans were conducted following the 1990 and 2000 censuses. These counts indicate that the population near the ISFSI initially dropped sharply, then stabilized at 20 persons residing within 2 miles of the ISFSI. If these more recent trends are assumed to continue through one license renewal period, the annual collective dose to future residents within 2 miles of the ISFSI would be 1.12×10^{-6} person-rem, approximately 3 times lower than the number projected in the original Environmental Report. As indicated in Appendix E, Section 4.3.1 of the LRA, the likelihood of significant population increases within 2 miles is very small due to large areas of water and current land-use restrictions. Therefore, the original calculation of collective dose in the LRA was very small and is also very conservative. Since the assessment is bounding, no revisions are necessary to the application data.

ER RAI-5:

Verify the location of the nearest permanent resident is valid as presented in Appendix E, Figure 4-1, Dose Rate for 84 Base-case Casks versus Distance.

Figure 4-1 in Appendix E and Figure 7.3-6 in the SAR are identical. Figure 7.3-6 is based on 1980 population data and the nearest resident is 1.5 miles from the site.

10 CFR 51.61 states that... "The environmental report shall contain the information specified in 51.45 and shall address the siting evaluation factors contained in subpart E of part 72 of this chapter." Furthermore, 10 CFR 72.70 (a) states that each specific licensee for an ISFSI "...shall update periodically...the final safety analysis report (FSAR) to assure that the information included in the report contains the latest information developed."

Response to RAI:

The Offsite Dose Calculation Manual for Surry requires that a "Land Use Census" be performed annually and reported in the Annual Radiological Environmental Report which is provided to the NRC per Surry Technical Specification 6.6.B.2. The Land Use Census includes the location of the nearest permanent resident. The Annual Radiological Environmental Reports from 1996 through 2002 were reviewed. In each of those years, the nearest resident was approximately 1.7 miles south of Unit 1 and approximately 1.5 miles south southwest of the ISFSI. Therefore, the information in the LRA regarding the distance to the nearest resident (1.5 miles) is accurate.

ER RAI-6:

Provide an analysis for residual impacts or unavoidable adverse impacts which remain after mitigation measures have been applied in Section 6.2, Appendix E.

This information is required to determine compliance with 10 CFR 51.45.

Response to RAI:

Per LRA Appendix E, Section 6.2, any impacts from license renewal are small and mitigation is not required. Per LRA Appendix E, Section 6.3, there are no unavoidable adverse impacts associated with the renewal of the ISFSI license. Monitoring of the cask and site provides an on-going means to assess any such impacts if they were to occur.

As noted in the response to Environmental Review RAI-1, there have been no accidental releases or spills (either radiological or non-radiological) at the ISFSI since it was licensed in 1986. Procedures require monitoring of the cask and site and establish protocols to follow in the unlikely event of the detection of a release or a spill.

The Surry Power Station has a health physics procedure for ISFSI radiation monitoring. This procedure addresses: 1) radiation surveys at cask loading, 2) area radiation surveys during and after cask placement at the ISFSI, and 3) quarterly monitoring of the ISFSI facility boundary. If survey results are unsatisfactory, the HP Shift Supervisor, System Engineer, and HP Supervisor are notified and a Plant Issue is initiated. Therefore, unexpected monitoring results are handled by the corrective action system.

Additionally, on a daily basis, plant operations personnel check the status of the ISFSI cask pressure monitoring alarm panel (located at the ISFSI facility). This ensures that the system used to monitor the integrity of the cask seals is maintained and functional, and would also identify any alarming condition indicative of potential seal leakage.

Appendix L of the Oil Discharge Contingency Plan describes the 285-gallon aboveground diesel fuel oil storage tank located at the Surry Power Station ISFSI. It also describes spill notification and response procedures. Dominion has an Oil Spill Prevention, Control and Countermeasures (SPCC) Plan which covers spills at the Surry Power Station, including the ISFSI. Therefore, if there was a non-radiological industrial spill at the ISFSI, the SPCC plan would be followed to ensure protection of the environment, workers, and the public.

The on-going monitoring programs and the specified responses to findings ensure that any residual impact or unavoidable adverse impact would be identified and mitigated.

ER RAI-7:

Provide a description of the environmental impacts expected from the alternative actions which were considered in Chapter 7.0 Alternatives of Appendix E and complete Table 8-1 of Appendix E where applicable.

The regulations in 10 CFR Part 51 require the environmental impact from both the proposed action and the alternatives to be described. This information is required to determine compliance with 10 CFR 51.45(c).

Response to RAI:

The National Environmental Protection Act (NEPA) requires consideration of what is reasonably known or projected at the time of decision making for a particular licensing action (e.g., license renewal), and to the level of detail that is commensurate with the significance of evaluated impact. It is Dominion's understanding that it is not required to perform analyses of alternatives that it has determined are not reasonable. This understanding is based on NRC wording in Regulatory Guide 4.2 and 10 CFR 51, and on Council on Environmental Quality (CEQ) regulatory requirements.

NRC has recommended that Dominion use Regulatory Guide 4.2 in preparing the environmental report for Surry ISFSI license renewal. Regulatory Guide 4.2 makes clear that an applicant is not expected to present or analyze all possible alternatives, directing applicants to discuss the range of practicable alternatives (per Chapter 9 introduction, "practicable" means that the alternative meets the projected power need [Section 9.1]), a reasonable number of realistic siting options (Section 9.2.1), and realistic alternatives in terms of both economic and environmental costs (Section 9.3).

NRC regulations also qualify the extent to which alternatives analysis is pertinent. Regulation 10 CFR 45 directs environmental reports to include appropriate alternatives and, should NRC decide to prepare an environmental impact statement, NRC regulation 10 CFR 51 Subpart A, Appendix A, Section 5 calls for discussion of all reasonable alternatives.

NRC regulation 10 CFR 51.10(a) indicates NRC's policy to take into account CEQ regulations. CEQ regulation 40 CFR 1502.14 requires exploration and evaluation of all reasonable alternatives, and for alternatives which were eliminated from detailed study, a brief discussion of the reasons for their having been eliminated.

Dominion has included in Chapter 7 of the Surry ISFSI license renewal environmental report identification of alternatives and Dominion's basis for determining that some of the alternatives are not reasonable. For alternatives that Dominion determined may be reasonable, Chapter 7 briefly discusses potential environmental impacts and Table 8-1 provides a summary characterization of these impacts. Dominion has revised Table 8-1 to include, for those alternatives that Dominion determined were not reasonable, a summary of Dominion's basis for its determination. For completeness, the revised LRA Appendix E Table 8-1 is included in the pages provided in Attachment 2.

The Surry ISFSI license renewal environmental report evaluated the potential impact of continued operations and the reasonableness of alternatives over a proposed 40-year license renewal period. The environmental evaluation was based on a combination of information from the original environmental report, information currently available from Dominion and industry experience (including the NRC staff's history with ISFSIs), and the current status of environmental regulations. To account for future changes affecting environmental issues, Dominion has, over the course of the Surry plant and ISFSI licenses, committed the necessary resources to implement environmental monitoring programs administered by the environmental compliance and radiological protection organizations. The monitoring programs comply with regulatory requirements and address both non-radiological and radiological issues. Examples include spill prevention, terrestrial and aquatic monitoring, and land use census programs. As changes occur to regulations, population, or any relevant site characteristic addressed in the environmental report, Dominion determines the impact of the change and implements actions necessary to ensure continued environmental protection and regulatory compliance. Dominion's on-going involvement with state and federal government regulatory agencies ensures responsiveness to change. Accordingly, the on-going commitment for environmental monitoring ensures that changes potentially impacting the environment surrounding the Surry ISFSI are appropriately considered and compliance to environmental regulations is maintained.

Attachment 2

Mark-up Pages from License Renewal Application
Appendix E: Supplement to Applicant's Environmental Report

Surry Power Station
Independent Spent Fuel Storage Installation
License Renewal Application

1.3 Environmental Report Scope and Methodology

NRC regulation 10 CFR 72.42 provides for ISFSI license renewal and regulation 72.34 requires an application to include an environmental report that meets the requirements of 10 CFR 51 Subpart A. In Subpart A, 10 CFR 51.60 requires that the environmental report be a separate document entitled "Supplement to Applicant's Environmental Report" and specifies environmental report contents. The regulation focuses on presenting any significant environmental change from the previously submitted environmental report. Dominion has prepared Table 1-2 to verify conformance with the regulatory requirements. For each requirement of 10 CFR 51.60, including 10 CFR 51.45 as adopted by reference, Table 1-2 indicates which environmental report section provides responsive information.

Table 1-2
Sections of this Environmental Report that Respond to License Renewal Environmental Regulatory Requirements at 10 CFR 51

Regulatory Requirement	Responsive Environmental Report Sections(s)	
10 CFR 51.60(a)		Entire Document
10 CFR 51.45(a) description of proposed action	3.0	Proposed Action
10 CFR 51.45(a) statement of purposes	1.1	Purpose and Need for Action
10 CFR 51.45(a) affected environment	2.0	Site and Environmental Interfaces
10 CFR 51.45(b)(1)	4.0	Environmental Consequences and Mitigating Actions
10 CFR 51.45(b)(2)	4.0	Environmental Consequences and Mitigating Actions
	6.3	Unavoidable Adverse Impacts
10 CFR 51.45(b)(3)	7.0	Alternatives
	8.0	Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.45(b)(4)	6.5	Short-Term Use Versus Long-Term Productivity of the Environment
10 CFR 51.45(b)(5)	6.4	Irreversible and Irretrievable Resource Commitments
10 CFR 51.45(c) alternatives for reducing or avoiding effects	4.0	Environmental Consequences and Mitigating Actions
	6.2	Mitigation
~~10 CFR 51.45(b) benefit/cost analysis~~	~~4.5~~	~~Benefit - Cost Analysis~~ RAI ER-3
10 CFR 51.45(d)	9.0	Status of Compliance
10 CFR 51.53(c)(3)(iv)	5.0	Assessment of New and Significant Information

CFR = Code of Federal Regulations

The operation of the Surry Power Station for an additional 20 years beyond the original license term may require that the ISFSI license be amended to allow the construction and utilization of one more pad with a capacity of up to 28 casks. The fourth storage pad would be constructed on previously disturbed land adjacent to the existing pads at the time it was needed. Two acres of woodland could be affected by the possible need to move the perimeter fence 75 feet into the woodlands in the event a fourth pad is constructed. The 1985 Environmental Report and Environmental Assessment evaluated the expansion for Pad 3.

Additional Features

Compacted areas around the storage pads allow positioning of the handling equipment. These compacted areas are connected via an access road to the ISFSI entrance. The area between the compacted areas and the ISFSI fence is seeded with grass and mowed as needed. The areas surrounding additional slabs would be compacted to properly support the haul vehicle and transporter needed for handling the casks.

A low-level waste storage building is located within the ISFSI perimeter, near the entrance and between Pads 1 and 2. Standard metal shipping containers also are stored in the area between the pads, and north of the low-level waste storage building. These containers and the low-level waste storage building are not part of ISFSI operations and are not part of the license renewal application.

Auxiliary Systems

The only utility provided to the Surry ISFSI is electric power for lighting, general utility, and instrumentation purposes. The source of electricity is a 34.5/0.48 kV transformer that provides power to the low-level storage facility. The 34.5 kV line is normally fed from an offsite power source but can be manually transferred to the station switchyard. The low-level storage facility transformer provides power to ISFSI loads through a separate feeder and disconnect and distribution panel located near the ISFSI local annunciator. This distribution panel also provides feed to the storage pads. Service power for lighting and welding receptacles is 480V, 60 Hz, single or three phase.

Annunciator lamps are located on the local ISFSI annunciator. If triggered by cask monitoring devices, they light up and remain lit until reset. In addition, a flashing light visible to personnel at the power station is activated.

Ventilation and offgas systems are not required for the Surry ISFSI and none are provided.

Because there are no airborne contaminants associated with the ISFSI, neither compressed air nor breathing air supply systems are required or provided. Air sampling systems are not required at the Surry ISFSI.

Steam is not required at the Surry ISFSI, and none is provided.

As indicated in Section 3.1, operation of the Surry Power Station for an additional 20 years beyond the original license term would result in the generation of additional spent fuel assemblies. This may require that the ISFSI provide additional dry storage capacity ~~(up to a total of four storage pads)~~, and would require a license amendment to increase the amount of spent fuel that may be stored at the facility. The exact number of additional storage casks is difficult to predict due to uncertainties in the anticipated spent fuel off-site shipping schedule. However, it is possible to bound the analysis based on an assembly discharge rate of 60 assemblies per 18-month cycle for each reactor unit. This represents an average discharge rate of about 80 assemblies per year, and an average emplacement rate of less than three TN-32 casks per year.

~~If the U.S. Department of Energy (DOE) started to take delivery of the assemblies directly from the spent fuel pool in 2010, a fourth storage pad would be unnecessary. In 2010 approximately 71 casks would be stored at the ISFSI. If DOE delayed taking delivery of Surry fuel, a fourth storage pool would be needed. One scenario assumes that DOE would start to take delivery of spent fuel in 2026. In 2026, approximately 104 casks would be stored at the ISFSI, with 20 casks on the fourth storage pad would be necessary.~~ The current FSAR base case assumes that all 84 locations on three pads are full. This environmental report uses for its analyses the FSAR base case of 84 casks on three pads~~, and 104 casks on four pads,~~ with all future casks being TN-32 casks. T~~he range of 84 to 104 casks was based on assumptions about spent fuel shipping schedules that may not be implemented. However, Dominion feels this range of casks stored on the ISFSI conservatively bounds the analysis of human health impacts.~~

If high enrichment and high burn-up fuel is available in the future (e.g., 5 weight percent Uranium-235 and 60,000 megawatt days per metric ton uranium), such fuel would exceed the current operational limits allowed in the Technical Specifications for any of the storage casks currently in use at the ISFSI. The advantage of using higher burn-up fuel is that it would reduce the discharge rate from the reactor. ~~and could delay or avoid the need for a fourth storage pad.~~ However, for purposes of this analysis, it is assumed that all the fuel stored at the ISFSI is consistent with the reference TN-32 cask fuel specified in the FSAR.

3.3 Construction

The FSAR base-case scenario is limited to the construction of a third storage pad in addition to the two currently built and in use. Because the third pad will be identical to the first two, the amount of time, personnel and material to construct this pad are assumed to be the same. ~~A fourth pad may need to be constructed in the future. This construction is assumed to require the same time, personnel, and materials as to construct Pad 3.~~ The number of construction workers is discussed in Section 3.5 Employment.

RAI ER-2

3.5 Employment

The workers involved in routine ISFSI operations are drawn from the general population of employees at the Surry Power Station. The amount of time dedicated to ISFSI operations can be estimated from calculations of the radiation dose to workers presented in Chapter 7 of the FSAR.

One or two employees are required to conduct the maintenance and inspection operations at the ISFSI. Table 7.4-2 of the FSAR estimates the time required for these tasks to be about 10 man-hours per year, assuming 84 casks on three pads. These operations would be required for as long as the ISFSI contains storage casks. ~~The additional amount of time required to maintain 104 casks on four pads would be another 2 to 3 hours~~. RAI ER-2

As many as three employees are required to load, transport and emplace each cask. Table 7.4-1 of the FSAR estimates the time required in radiation areas for these tasks to be 174 man-hours per year, assuming that an average of three TN-32 casks are loaded each year. Work in non-radiation areas, including receipt and inspection of empty casks, is estimated to require an additional 44 hours for a total of approximately 220 man-hours per year. Moving a cask back to the spent fuel pool in preparation for unloading the assemblies for shipment is expected to take less time. However, the frequency at which casks are removed from the ISFSI pad may be greater than the frequency of emplacement. Transporting the casks between the Surry Power Station fuel building and the ISFSI is expected to stop or be curtailed when DOE is accepting spent fuel that is stored in the spent fuel pool. It is anticipated that the cask removal frequency will peak at the end of the reactor license period, at which time more employees would be available for this task.

Based on the above considerations, it is unlikely that ISFSI operations will require more than one full-time-equivalent employee. ~~The addition of up to 104 total casks will not increase this estimate.~~ This is a very small fraction of the Surry Power Station work force, which is slightly less than 1,000 workers, including utility and contractor personnel. ISFSI operations will continue to be performed by Surry Power Station employees who have additional responsibilities at the Power Station. Employment at Surry Power Station will not be affected by continued ISFSI operations. RAI ER-2

The construction of a third ~~and possibly a fourth~~ storage pad will require approximately 20 temporary workers ~~each time~~. The time required to build ~~each~~ a pad is estimated to be 7,090 man-hours or approximately 6 weeks. RAI ER-2

Decommissioning the ISFSI may require that the concrete slabs be removed and the site restored to pre-ISFSI conditions. Since no decontamination of the ISFSI structures is expected, such restoration would be limited in large part to the removal and disposal of the concrete slabs in a construction debris landfill, followed by back filling, grading, and landscaping. Although detailed decommissioning plans have not been developed it is

4.2 Impacts from Refurbishment and Construction

No refurbishment of the ISFSI is planned during the 40-year license renewal period. Therefore, there would be no impacts from refurbishment.

As discussed in Section 3.1 the Surry Independent Spent Fuel Storage Installation (ISFSI) ~~will~~ may require ~~one and possibly two~~ additional storage pads during the license renewal term. The pads would be built on previously disturbed ground adjacent to the existing pads. Best management practices during construction would prevent erosion and sedimentation of surface water. Stormwater runoff is diverted to a percolation basin. The ISFSI is approximately 35 feet above the mean sea level at Hampton Roads, VA. The pads are approximately 3 feet thick. As described in Section 2.2, Geology, Soils, and Groundwater, the Surry Power Station site is 25 to 35 feet above sea level and groundwater is approximately 1 to 2 feet above sea level. Construction of ~~one or possibly two~~ additional pads at the ISFSI would not adversely affect the geology, soils, groundwater or surface water of the area.

~~The perimeter fence could need to be moved about 75 feet into the surrounding woodland. If this occurred an additional two acres would be incorporated into the facility.~~ The woods surrounding the facility are mixed pine/hardwood forest that has been timbered in the past. No threatened or endangered species occur in the immediate vicinity of the ISFSI. Land immediately west of the facility slopes toward a northerly drainage into the wetlands of the Hog Island Wildlife Management Area. Surveys for cultural resources have not identified any sites in the potentially affected area, and indicated that there would be no potential for cultural or archaeological resources at the ISFSI.

All Dominion land-disturbing activities are done according to the requirements of permits issued by Surry County. In addition, Dominion has procedures in place for sediment and erosion control best management practices, and for identifying and preserving previously unknown cultural artifacts. All land-disturbing activities at the ISFSI would be conducted using these procedures. For these reasons, any impacts from construction would be small and would not warrant mitigation.

method of spent fuel storage minimizes direct radiation exposures and eliminates the potential for contamination incidents.

The general order of cask placement in the ISFSI was developed based on ALARA considerations. The second storage pad was not used until the first storage pad was filled and, likewise, Pad 3 would not be used until Pad 2 is filled. Casks are placed on a pad in rows of two starting at the northern end and finishing at the southern end. Therefore, personnel placing the first casks on the second pad were closer to the spent fuel emplaced on the first pad at the start of ISFSI operations and farther from the spent fuel discharged more recently from the fuel pool, thus minimizing the amount of radiation exposure from previously filled pads. In addition, the third pad would be built nearest Pad 1, some distance from the most recently discharged spent fuel on Pad 2. ~~The location of the fourth pad, if required, will be evaluated considering construction and worker dose~~. RAI ER-2

Sources of Radiation

Neutron and gamma radiation emanating from the shielded casks is the primary source of radiation exposure. Descriptions of the fuel that the casks are designed to store are provided in the Sealed Surface Storage Cask (SSSC) topical reports and in Appendix A of the FSAR. The exterior surfaces of the casks are decontaminated prior to transfer to the ISFSI. The fuel is not removed from the casks nor are the casks opened while at the ISFSI.

The original environmental report analysis assumed a CASTOR V/21 reference storage cask loaded with 21 fuel assemblies with an initial enrichment of 3.5 weight percent U-235, a burn-up of 45,000 megawatt days per metric ton uranium, and a cooling time of 5 years. A bounding factor of 3 was applied to that analysis to account for future cask designs. The current reference cask used in the FSAR for purposes of analysis is a TN-32 cask loaded with 32 fuel assemblies with an initial enrichment of 3.5 weight percent U-235, a burn-up of 45,000 megawatt days per metric ton uranium, and a cooling time of 7 years. This enrichment, rather than the approved limit of 4.05 percent, yields a more conservative radionuclide inventory. The average (neutron plus gamma) dose rate limits for the reference TN-32 cask are 224 mrem/hr and 76 mrem/hr for the side and top surfaces, respectively. The dose rate decreases as a function of time due to radioactive decay. However, to simplify the analysis, the dose-rate calculations in the FSAR conservatively assumes that 84 TN-32 reference casks are emplaced simultaneously. The calculated dose rate from 84 casks decreases rapidly as a function of distance, as shown in Figure 4-1.

Occupational Dose

Surry Power Station personnel involved in ISFSI and LLWSF operations will incur the highest occupational doses from the ISFSI because of their proximity to the casks. Due to the distance between the ISFSI, the power station, and the site boundary, much smaller dose are incurred by other plant workers and members of the public.

The occupational exposures to ISFSI personnel from ISFSI operations are calculated in Section 7.4.1 of the FSAR. The collective dose to workers involved in the loading, transport, and emplacement of a single cask was estimated to be 2.65 person-rem (Table 4-1), assuming a reference TN-32 cask and 84 casks in the ISFSI. ~~The contribution from 20 additional casks (on Pad 4, if it were required) would not significantly increase this estimate, because most of the dose is contributed by the cask being emplaced.~~ RAI ER-2

The annual collective dose for surveillance and maintenance activities was estimated to be 1.4 person-rem (Table 4-1). To estimate the dose rates for operability tests and calibration, the worker was assumed to be located at the control panel at the perimeter fence entrance. Visual surveillance assumed a walk-down of each of the three pads at a distance no closer than 2 meters to the casks. During surface defect repairs, the worker was assumed to be positioned next to a cask. The five surrounding casks (all within 16 feet of the worker) would be the predominant dose contributors during repair work. Base-case TN-32 surface dose rates were utilized and it was assumed that three storage pads were filled with 84 casks. ~~If a fourth pad were to be required to accommodate an additional 20 casks, this estimate would increase very little, because most of the dose is from the nearest casks.~~ RAI ER-2

Table 4-1
Annual Doses from ISFSI Operations

Task	Person-Rem
LLWSF[a]	1.3
Surry Power Station[a]	1.3
ISFSI Operations -	
Cask Preparation and Placement[b]	7.9
Maintenance and Surveillance[a]	1.4
Total	**11.9**

Source: Ref. 4.3-1.
a. Assumes completed ISFSI (84 design-basis casks).
b. Assumes 3 TN-32 casks per year.

The annual dose to LLWSF workers from the ISFSI was estimated to be 1.3 person-rem, assuming that all three pads were full (Table 4-1). Credit was taken for air attenuation of neutrons and gammas; however, no credit was taken for the shielding effect of one cask behind another or the shielding provided by the LLWSF building to the personnel. Because the LLWSF is located between the first and second pads, any contributions from the casks on the third ~~and fourth~~ pad~~s~~ would be smaller than contributions from casks on the first two pads.

To evaluate the additional annual dose to station personnel from ISFSI operations, the FSAR conservatively assumes 84 TN-32 casks in the ISFSI. All workers at the Surry Power Station are assumed to be in offices, nonshielded buildings, or in the plant yard. This population includes a normal work force of utility and contractor personnel as well as the increased staffing required during outages. As a bounding estimate, the total number of workers assumed in the FSAR was 600 spending a total of 1,248,000 man-hours per year in the Surry yard area and in offices. The shortest distance between the Surry Units 1 and 2 perimeter fence and the nearest cask is approximately 2,100 feet. The dose rate from the ISFSI to a yard location 2,100 feet away is 0.001 mrem/hr. The exposure for station workers due to the ISFSI is conservatively estimated to be 1.3 person-rem per year (Table 4-1).

The annual occupational dose for ISFSI operations is given in Table 4-1. The estimated total occupational dose of 11.9 person-rem per year is based on the transfer of three reference casks per year and an ISFSI with 84 reference casks. ~~A facility with 104 casks would result in a slightly higher annual occupational dose, but still less than the 21.2 person-rem estimate in the original environmental report.~~

In the future, Surry Power Station may be authorized to store fuel that exceeds the enrichment and burn-up limits specified in the current ISFSI license. In-reactor residence time would increase, and the required minimum spent fuel pool storage times could exceed 7 years. However, it is unlikely that such fuel would be available for storage at the ISFSI before 2005. Therefore, casks containing such fuel could be stored on the third ~~and possibly fourth~~ pad~~s~~, if necessary. It is likely that casks designed to store the higher burn-up assemblies would require that such assemblies be stored in the middle of a cask, with lower burn-up assemblies placed in the outer locations, to minimize the dose rates at the cask surface. Due to surface dose rate limitations and the potential for regionalized storage within the cask, it is unlikely that casks containing higher burn-up fuel would result in higher occupational doses than estimated in the original environmental report. The environmental impacts, if any, of storing spent fuel with higher enrichment and burn-up limits would be evaluated more precisely if and when Dominion applies for authority to store such spent fuel in the ISFSI. RAI ER-2

Dose to the Public

The only doses to members of the public during normal operations will result from the gamma and neutron radiation that is emitted from the cask surfaces. The dose rate decreases rapidly as a function of distance from the ISFSI, as indicated in Figure 4-1. The calculated dose rate at the nearest site boundary, located approximately 1,500 feet northwest of the ISFSI, is 50 mrem/year from 84 reference TN-32 casks. This estimate is lower than the original dose rate estimate of 136 mrem/year, which was based on a factor of 3 times the dose from 84 CASTOR V/21 reference casks.

~~If 20 additional TN-32 casks were required for storage on a fourth pad, the calculated dose rate at the site boundary based on the reference cask design would increase by approximately 25 percent. While a fourth storage pad may be slightly closer to the site boundary, it would not noticeably affect the dose rates calculated for a location 1,500 feet away. In any event, the estimated dose rate for 104 TN-32 casks would be lower than 100 mrem/year and would meet the requirements of 10 CFR 20.301. Depending on the cask design, storing higher burn-up fuel on a fourth pad could increase the calculated dose rates. However, it is unlikely that the small number of casks containing high burn-up assemblies would result in an overall dose rate at the nearest boundary in excess of 100 mrem/yr (which is the annual dose rate limit prescribed by regulation).~~ RAI ER-2

The ISFSI licensing basis for the annual dose to the nearest permanent resident, located 1.5 miles from the ISFSI, was based on 84 CASTOR V/21 reference casks. The annual dose calculated for that case was 6.0×10^{-5} millirem, several orders of magnitude below the 10 CFR 72.104 limit of 25 millirem per year from all doses associated with Surry Power Station operations. The revised calculations based on 84 TN-32 reference casks result in a dose of 5.6×10^{-5} millirem per year, which is less than the original licensing basis. ~~Twenty~~ RAI ER-2 additional TN-32 reference casks would result in a dose to the nearest resident of 6.9×10^{-5} millirem per year, or 15 percent higher than the original licensing basis. As indicated earlier, the use of higher burn-up fuel may result in slightly higher dose rates from individual casks. However, the dose to the nearest resident from Station and ISFSI operations would still be well below the 25 millirem per year regulatory limit.

The collective dose to the public from normal operations was conservatively estimated by assuming that all residents within a 2-mile radius of the plant were at the same distance from the ISFSI as the nearest permanent resident. The annual collective dose from 84 TN-32 reference casks to 48 residents (in 1980) within a two-mile radius of the ISFSI is calculated to be 2.7×10^{-6} person-rem. Assuming a 20 percent growth in the number of residents within 2 miles and a maximum of 104 TN-32 reference casks would result in a collective dose of 4.0×10^{-6} person-rem. In either case, the collective dose from ISFSI operations would be several orders of magnitude lower than the collective dose from natural background radiation. This is additionally conservative because much of the area within 2 miles of the ISFSI is station property, part of the Hog Island Wildlife Management Area, or surface water, and thus, not available for new housing.

<u>Dose from Construction Activities</u>

The collective exposure to construction workers is expected to be higher for the construction of the third pad relative to the collective exposure from the construction of the second pad due to the additional casks now stored on the second pad and the proximity of the third pad to Pad 1.

The exposure analysis in the original environmental report estimated that construction of a third pad would result in a collective dose of 78 person-rem to 20 workers. This estimate was based on an average dose rate of 11 millirem per hour and a construction time of 7,090 man-hours. A radiological survey conducted on July 2, 2001, with the second pad approximately 50 percent full, reported a dose rate of 0.33 millirem per hour along the east side of the security fence surrounding Pad 1. This is the closest point at which Pad 3 construction workers would be exposed. The dose rate measured at the east perimeter fence of the ISFSI was 0.12 millirem per hour, which would be the dose rate to workers involved in extending that side of the perimeter fence. Based on these measurements, the collective dose from Pad 3 construction is likely to be 20-30 times lower than the original estimate.

A fourth pad, if needed would likely be constructed adjacent to the west side of Pad 2's security fence and could require the extension of the west side perimeter fence. However, the most suitable location for a possible fourth pad has not yet been evaluated. The dose rates measured at these locations were 1.2 millirem per hour, and 0.25 millirem per hour, respectively, on July 2, 2001. These are likely to increase once Pad 2 is full. Because Pad 3 would be located at a significant distance from the new Pad 4, any contributions from the

~~newly placed casks on Pad 3 are expected to be smaller than the current contribution from Pads 1 and 2. Some reduction in the contribution from all three pads would occur due to radioactive decay by the time Pad 4 was built. It is estimated that the average dose rate to Pad 4 construction workers would be well below 11 millirem per hour. Therefore, the constructions of Pads 3 and 4 are bounded by the existing analysis.~~ RAS ER-2

4.3.2 Other Impacts

The continued operation of the Surry Power Station ISFSI during the 40-year license renewal term would have no impacts on the following resources:

- Geology or soils
- Hydrology
- Air quality
- Aquatic resources
- Socioeconomics
- Social Services or Public Utilities
- Land Use
- Aesthetics

There are no liquid discharges from the ISFSI, so no geologic or water resources or aquatic resources would be affected. As described in Section 4.2, Impacts from Refurbishment and Construction, all stormwater runoff is diverted to a percolation basin. There are no air emissions from the ISFSI so air resources would not be affected.

As described in Section 3.5, Employment, all operations, maintenance and surveillance activities at the ISFSI would be performed by Surry Power Station employees as part of their job. No additional employees would be required to operate the ISFSI. Construction of ~~up to two~~ an additional pad~~s~~ would require approximately 20 construction workers for 6 weeks ~~twice~~ during the 40-year license renewal term. Twenty additional employees is an order of magnitude less than the number of additional employees during Surry Power Station outages. As stated in the Surry Power Station Environmental Report (Ref. 4.3-3), 700 additional employees during annual outages do not adversely affect social services and public facilities such as public water supplies or transportation. Analyses done for the Surry Power Station indicate that the addition of 60 new permanent employees also would not strain the available social services and public facilities. Therefore, based on these bounding analyses done for the Surry Power Station in connection with renewal of the reactors operating licenses, Dominion concludes that the continued operation of the Surry ISFSI would not affect regional socioeconomics, social services, or public facilities. RAS ER-2

Table 8-1
Comparison of Surry ISFSI License Renewal with the Alternatives

	Alternatives												
Impacts	License Renewal	No Action	Ship to permanent repository	Ship to North Anna	Increase SPS pool capacity	Construct new pool at SPS	Ship to reprocessor	Ship to interim storage facility	Improve fuel usage	Operate SPS at reduced power	Ship to another utility's storage	Construct an ISFSI away from SPS	Other technologies
		No environmental advantage. Requires removal of fuel from the ISFSI and construction of replacement power facility	Not a reasonable alternative because repository will not be available until after expiration of current license	Not a reasonable alternative because there is insufficient storage space in North Anna spent fuel pool or ISFSI	Not a reasonable alternative because past modification has maximized the capacity of the existing pool		Not a reasonable alternative because there are no domestic reprocessors	Not a reasonable alternative because there is no federal interim storage facility	Not a reasonable alternative because improved fuel usage has not eliminated need for storage	Not a reasonable alternative because alternative does not address fuel already in storage	Not a reasonable alternative because excess capacity is not available at other plants		
Geology/ Soils	None					Small						Small	None
Hydrology	None					Small						Small	None
Air Quality	None					Small						Small	None
Aquatic Resources	None					None						None	None
Socioeconomics	None					Small						Small	None
Land Use	None					Small						Small	None
Threatened or Endangered Species	None					None						None	None
Historic/ Cultural Resources	Small					Small						Small	Small

Attachment 3

Revised Final Safety Analysis Report Supplement

Surry Power Station
Independent Spent Fuel Storage Installation
License Renewal Application

PROPOSED NEW SURRY ISFSI FSAR SECTION 9.7

9.7 Aging Management

An assessment of the Surry ISFSI inspection and monitoring activities identified new and existing activities necessary to provide reasonable assurance that ISFSI cask subcomponents within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis (CLB) for the renewal period. This section describes these aging management activities.

This section also discusses the evaluation results for each of the cask-specific time-limited aging analyses (TLAAs) performed for license renewal. The evaluations have demonstrated that the analyses remain valid for the renewal period; the analyses have been projected to the end of the renewal period; or that the effects of aging on the intended function(s) will be adequately managed for the renewal period.

9.7.1 Dry Storage Cask Inspection and Monitoring Activities

The Surry ISFSI is a facility to place and store spent fuel in licensed containers (dry storage casks) until such time that the fuel may be shipped off-site for final disposition. The dry storage casks at the Surry ISFSI are designed for outdoor storage. Accordingly, the exterior materials and coatings are capable of withstanding the anticipated effects of "weathering" under normal conditions.

The purpose of the Dry Storage Cask Inspection and Monitoring Activities is to:

1. Determine that no significant deterioration of the exterior of the in-service dry storage casks has occurred,
2. Determine that no significant degradation of the in-service dry storage cask seals has occurred, and
3. Determine that no significant degradation of the in-service dry storage cask polymer neutron shield materials has occurred

The scope of the Dry Storage Cask Inspection and Monitoring Activities involves 1) the continuous pressure monitoring of the inservice dry storage casks, 2) the radiation monitoring and surveillance activities, 3) the quarterly visual inspection of all types of licensed dry storage casks that are inservice at the Surry ISFSI, 4) a visual inspection of a CASTOR V/21 cask bottom which is to be performed prior to the end of the original ISFSI license period, 5) a visual inspection of the MC-10 dry storage cask seal cover and shield plug areas which is to be performed prior to the end of the original ISFSI license period, and 6) the visual inspection of the normally inaccessible areas of casks in the event a casks is lifted in preparation for movement or an environmental cover or impact limiter is removed for maintenance.

Visual inspections identify degradation of the physical condition of the exterior surfaces of all of the dry storage casks. These inspections check for loss of material of the dry storage casks. Pressure monitoring of the dry storage casks provides a means to detect seal degradation. Seal degradation could occur as a result of loss of material (corrosion) of metallic O-ring seals. Loss of material may result from moisture in the seal area for seals that have exposure to an atmosphere/weather environment. Radiation monitoring at the ISFSI facility boundary provides a means to detect shielding material degradation due to loss of material.

A visual inspection of the seal cover and shield plug areas of the MC-10 dry storage cask performed prior to the end of the original ISFSI license period will identify degradation of the material resulting from water intrusion. A visual inspection of the bottom of a Castor V/21 dry storage cask performed prior to the end of the original ISFSI license period will identify degradation of the bottom materials, representing all cask types, resulting from entrapment of water under the casks. Visual inspections, pressure monitoring, and radiation monitoring provide reasonable assurance that any degradation of the dry storage casks is identified.

The acceptance criterion for all visual inspections is the absence of anomalous indications that are signs of degradation. The inspector determines if an anomalous condition is a maintenance issue or a deviating condition. For deviating conditions, engineering evaluations determine whether observed deterioration of material condition is significant enough to compromise the ability of the dry storage cask to perform its intended function. Occurrence of degradation that is adverse to quality will be entered into the Corrective Action System. The acceptance criterion for pressure monitoring is the absence of an alarmed condition. Alarm panel response procedures identify the various criteria for the different types of dry storage casks in use at the Surry ISFSI, and specify any required corrective actions and responses.The acceptance criterion for radiation monitoring is specified in the facility health physics procedures and is consistent with the allowable limitations set forth in the ISFSI Technical Specifications.

9.7.2 Time-Limited Aging Analysis

As part of an application for a renewed ISFSI operating license, ISFSI-specific time-limited aging analyses (TLAAs) must be identified. The TLAA identification process required a review of the design basis documents to provide a reasonable assurance that TLAAs will be identified.

Once a TLAA is identified, an evaluation is performed to disposition each ISFSI-specific TLAA using one of three different approaches described below:

(i) The analyses will remain valid for the license renewal period.

(ii) The analyses have been projected to the end of the license renewal period.

(iii) The effects of aging on the intended function(s) will be adequately managed for the license renewal period.

The following TLAAs have been identified by reviewing the necessary design basis documents and are projected to be valid for the license renewal period, in accordance with approach (ii) defined above.

General Nuclear Services CASTOR V/21 Casks

- Fatigue Analysis for Cask Wall.

General Nuclear Services CASTOR X/33 Cask

- Fatigue Analysis for Cask Wall.
- Fatigue Analysis for Secondary Lid Bolts.

Westinghouse MC-10 Cask

- Neutron Irradiation Influence on the Nil Ductility Transition (NDT) Temperature of the Cask Body.
- Thermal Fatigue Analyses.
- Affect on Criticality due to Depletion of the Boron-10 in the Boral Plates due to Spontaneous Fission.

A summary of potential aging effects addressed by the listed TLAAs and their disposition basis is presented in the following sections. No TLAAs were identified for the Nuclear Assurance Corporation I-28 casks, the Transnuclear TN-32 casks, or spent fuel assemblies.

9.7.2.1 General Nuclear Services CASTOR V/21 Casks

The only TLAA identified for the CASTOR V/21 casks is a cask wall fatigue analysis due to daily temperature cycles. The original fatigue analysis was performed for the cask wall for a 30-year period consisting of 900 cycles of a temperature range of 0°F to 70°F, 150 cycles of a temperature range of 0°F to 70°F with rain and/or snow, and 9900 cycles of a temperature range of 50°F to 90°F.

The maximum Cumulative Usage Factor (CUF) for fatigue was calculated to be 0.111 for 30 years. The total period for the renewed license will be the original 20 year license period plus the renewal period of 40 years. Therefore, extrapolating linearly, the CUF for 60 years can be conservatively estimated to be 0.222. This value of 0.222 is less than the allowable value of 1.0. Therefore, the cask wall CUF has been projected to be valid for the license renewal period.

9.7.2.2 General Nuclear Services CASTOR X/33 Cask

The TLAAs identified for the CASTOR X/33 casks are fatigue analyses for 1) the cask wall due to daily temperature cycles and 2) pressure loading and transport loads for the secondary lid bolts.

Cask Walls

The original cask wall fatigue analysis was performed for 900 cycles of a temperature range of 0°F to 70°F, 150 cycles of a temperature range of 0°F to 70°F with rain and/or snow, and 9900 cycles of a temperature range of 50°F to 90°F for a 30-year period.

The maximum CUF for fatigue was calculated to be 0.128 for 30 years. The total period for the renewed license will be the original 20 year license period plus the renewal period of 40 years. Therefore, extrapolating linearly, the CUF for 60 years can be conservatively estimated to be 0.256. This value of 0.256 is less than the allowable value of 1.0. Therefore, the cask wall CUF has been projected to be valid for the license renewal period.

Secondary Lid Bolts

The original fatigue analysis for the secondary lid bolts was performed for 100 cycles of a pressure range of 0 psi to 90 psi, and 10^6 cycles ±3g acceleration for the transport load. The maximum CUF for fatigue was calculated to be 0.14 for 30 years. The total period for the renewed license will be the original 20 year license period plus the renewal period of 40 years. Therefore, extrapolating linearly, CUF for sixty (60) years can be conservatively estimated to be 0.28 by extrapolating linearly. This value of 0.28 is less than the allowable value of 1.0. Therefore, the CUF has been projected to be valid for the license renewal period.

9.7.2.3 Westinghouse MC-10 Cask

Thermal Fatigue

The CUF for thermal fatigue analyses for several components were identified as TLAAs. The original thermal fatigue calculations were performed for a 40 year license period. With the exception of the primary cover cap screws, the original values were extrapolated linearly to provide a conservative projection of the CUFs for 60 years. The following table list the components evaluated along with the original and projected/re-calculated CUF values:

Cumulative Usage Factors (CUF) For Thermal Fatigue

Components	CUF for 40 years	CUF for 60 years
Cask Body (Vessel)	0.0146	0.0219
Cask Bottom (Lower Head)	0.0146	0.0219
Shield Cover	0.0146	0.0219
Primary Cover	0.0146	0.0219
Seal Cover	0.0146	0.0219
Shield Cover Studs	0.0146	0.0219
Closure Cover Studs (Seal Cover Studs)	0.0146	0.0219
Primary Cover: Cap ScrewsThreads and shank-to-head shoulder region	0.82	Recalculated to be 0.43 for cap screw threads and 0.022 for shank-to-head shoulder region.

The CUF for thermal fatigue of the primary cover cap screws due to temperature variation was initially calculated to be 0.82 for 40 years. This was the only CUF that would exceed the allowable value of 1.0 if linearly projected for 60 years. A single evaluation for cap screw threads and shank-to-head shoulder region for 40 years was, originally, performed conservatively by using the smaller diameter of the cap screw shank, and applying reduction factor for the threaded end to it. In the evaluation of the Primary Cover Cap Screw for sixty years, separate CUFs for cap screw threads and the shank-to-head shoulder region were calculated. The calculations have been based on daily fluctuations with total cycles of 21,900 for 60 years. The CUF values are determined to be 0.43 for cap screw threads and 0.022 for shank-to-head shoulder region, which are within allowable value of 1.0.

Therefore, the thermal fatigue of the above components have been re-analyzed or projected to be valid for the license renewal period.

Shift of Nil Ductility Transition (NDT) Temperature

A TLAA was identified for the influence of neutron irradiation over sixty years on the nil ductility transition (NDT) temperature of the MC-10 cask body.

The MC-10 SAR states, "A 40 year neutron fluence ... at the vessel wall is not expected to shift the NDT temperature." Since this statement implies that there is a TLAA related to NDT temperature, a calculation has been performed to show that the expected shift in the NDT temperature due to 60-year neutron fluence would be acceptable. Based on testing, no shift is expected in NDT temperature below the irradiation value of 10^{17} Neutrons /cm^2. Since the neutron fluence for sixty years is calculated to be 2.2 x 10^{14} Neutrons/cm^2, it is concluded that there will be no shift in NDT temperature.

Therefore, the neutron irradiation influence on the NDT temperature of the cask body has been projected to be valid for the license renewal period.

Depletion of the Boron-10

When the cask cavity is dry or has borated water in it, the MC-10 meets the criticality criterion of $k_{eff} < 0.95$ without other neutron poisons present (i.e., the Boral™ that is a part of the cask design). These are the likely future scenarios for the cask, (i.e., continued dry storage followed by placement in the fuel pool for fuel transfer to a transportation cask). With pure water in the cask, the MC-10 still meets the criticality criterion of $k_{eff} < 0.95$ with the Boral poison in the cask. However, analysis has shown that the criterion may not be met if the Boral is not present. Some of the Boron-10 (neutron poison material) could be consumed over time by the $B^{10}(n,\alpha)Li^7$ reaction, resulting from spontaneous fission within the spent fuel. Depletion is expected to only reduce the Boron-10 content by a small fraction of the original amount. A calculation was performed to demonstrate that there is sufficient neutron poison material remaining over the additional 40 year license renewal period with the pure water present in the cask cavity and that the TSAR conclusions do not change for the total license period of 60 years. The calculation indicated that the Boron-10 depletion was negligible for the total license period.

Therefore, the affect on criticality due to depletion of the Boron-10 in the Boral plates due to spontaneous fission has been re-analyzed and projected to be valid for the license renewal period.

9.7.2.4 Nuclear Assurance Corporation I-28 Casks

No TLAAs have been identified for this cask.

9.7.2.5 Transnuclear TN-32 Casks

No TLAAs have been identified for this cask.