

Request for Additional Information
EnergySolutions
Docket No. 72-1007
Certificate of Compliance No. 1007
Model No. VSC-24

By application dated October 12, 2012, as supplemented February 14, 2013, EnergySolutions requested approval of the renewal of the VSC-24 storage system. This request for additional information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission (NRC) staff in connection with its review of the renewal application. NUREG-1927, "Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance," was used by the staff in its review of the application.

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

RAI-1: Justify the basis for the size of the bounding cracks in Section 3.3.3.6, "Palisades MSB-04 Weld Crack Growth Evaluation" of the renewal application and Section 3.4.3.2 "MSB Closure Weld Cracks" in the renewal application along with the applicable Time-Limited Aging Analyses (TLAAs) and associated calculations.

The bases for a bounding 1-inch long by 1/2-inch deep subsurface flaw and hypothetical 1/4-inch deep by 6-inch long flaws are not clear.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(2).

RAI-2: Provide the basis for the acceptance criteria in Table 15 which is no defects on the concrete exterior surface that are greater than 1/2 -inch in diameter (or width) and 1/4-inch deep. Additionally, provide the basis for the 1-year inspection frequency.

Page 3-25 states, "Concrete defects that exceed 1/2-inch in diameter (or width) and 1/4-inch deep are required to be repaired by re-grouting to prevent further degradation of the interior concrete and embedded steel reinforcing. Staff was unable to verify the source of the acceptance criteria.

Table 15 indicated that the inspection frequency for environmental degradation (i.e., cracks, corrosion, etc.) is yearly.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

RAI-3: Provide a TLAA for the polymeric gaskets used for the weather covering and explain how the TLAA will be verified through inspections and justify the frequency of inspections. Alternatively, justify that failure of the polymeric gaskets will not lead to accelerated corrosion of the VSC-24 exteriors.

Polymeric materials, even if not in the presence of a radiation field, will embrittle, creep, and degrade over time. The staff finds that polymeric gasket materials may not function as intended over a 60-year lifespan. The integrity of the weather cover establishes the conditions for the aging management of the system and thus needs a TLA.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(2).

RAI-4: Evaluate the potential for zinc-zircaloy interaction for a cask loaded under the renewed CoC at a higher heat load (up to 24kW). Further, submit a copy of WEP-109-003.12, Revision 2, "Generation of a Heat Load vs. Fuel Temperature Curve."

A copy of WEP-109-003.12, Revision 2 was referenced in enclosure SFD/NRC 13-003, enclosure 1, "Response to Supplemental Information," and should be provided to the staff to make a safety evaluation finding regarding the potential for zinc-zircaloy interaction for systems that could be loaded at heat loads up to 24kW under a renewed CoC.

This information is required to demonstrate compliance with 10 CFR 72.240.

RAI-5: Update the application to address the following.

- a. Include the shield rings labeled as Part Nos. VCC-039 and 040 in Drawing No. VCC-24-002 in Table 6. These rings are in addition to those currently listed in that table.
- b. Include the hydraulic cylinder assembly and the light MSB Transfer Cask (MTC) shield door lead plug in Table 11.
- c. Show where note 2 is used in Table 12.
- d. Include the MTC's rail lower plate and shield door in Table 13.

These items appear in other tables of the application and the drawings in the revisions of the final safety analysis report (FSAR) but are missing from these tables. Also, Table 12 includes a note 2, but this note is not used anywhere in that table.

This information is needed to confirm compliance with 10 CFR 72.240.

RAI-6: Provide the following regarding the RX-277 neutron shield materials.

- a. A copy of the RX-277 Shielding Material Product Data Sheet, Bulletin S-73N for review.
- b. Differences between the neutron shield material in the multi-assembly sealed basket (MSB) lid and the MTC.
- c. Impacts of neutron and gamma radiation in combination.

- d. An analysis for the potential of hydrogen build up associated with off-gassing of the RX-277 and corrosion of steel over a 60-year time period.

The staff requests a copy of RX-277 Shielding Material Product Data Sheet, Bulletin S-73N prepared by Reactor Experiments, Inc., Sunnyvale, CA, August, 1991 to assess the conditions necessary to establish integrity of the material. Further, the properties seem to differ between the neutron shield in the MSB lid and the MTC, at least beginning with FSAR Revision 5. Any variations in neutron shield material properties from FSAR revision to FSAR revision should also be described and considered. Additionally, the radiation effects appear to be considered separately and not in combination. Since the material experiences gamma and neutron radiation at the same time, the application should address the effects in combination. Finally, off-gassing RX-277 neutron shielding material in the MSB shield lid can be a potential source of corrosion in carbon steel.

This information is required to demonstrate compliance with 10 CFR 72.236(d) and 240(c).

RAI-7: Provide the TLAA for the bounding Palisades MSB-04 fatigue crack growth analysis.

The calculations supporting the conclusions in Section 3.3.3.6 should be submitted for staff review.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(2).

RAI-8: Justify that the three foot long by 1/8-inch wide gap created by inspecting the lead cask will not create a pathway for trapping water between the bottom base plate of the VCC and the VCC concrete, leading to conditions promoting additional corrosion and concrete degradation. Further, justify why there is no Aging Management Program (AMP) to cover this issue.

The large gap created by inspecting the lead cask may have the potential for creating an environment conducive for corrosion or concrete degradation.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

RAI-9: Provide a corrosion analysis with the predicted corrosion rate for the VCC bolts over the 40-year renewal period. Explain how the predicted corrosion rate is determined and verified through inspections and justify the frequency of inspections.

Section 3.2.2.4 of the renewal application states that some corrosion was observed on the cask lid bolts, but the VCC lid bolts were in acceptable condition.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(2).

RAI-10: Provide an AMP for the concrete reinforcements. The AMP should explain how the corrosion is being accessed, assessed, and verified through inspections and justify the frequency of inspections.

Section 3.2.1.2, "Reinforced Concrete," subsection "Loss of Material," of the renewal application states that the AMP will address degradation of the rebar in Section 3.4 of the renewal application. Table 9 in Section 3.4 of the renewal application states that corrosion of the rebar is part of the AMP, but it is not clear how the aging effects are being accessed or evaluated, since inspection of the rebar is not being considered.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

RAI-11: Revise the renewal application to address the following issues that may arise due to the potential for additional licensees to use the cask under the renewed CoC.

- a. Use of the cask by a licensee under different environmental conditions (i.e., marine or other environments). It is not clear that the evaluations in the current application address this scenario and address the spectrum of potential aging mechanisms that can occur at different sites.
- b. Use of galvanized steel grate (vs. ceramic tiles) as allowed by the technical drawings in the revisions of the FSAR and the implications for corrosion of the MSB base.
- c. Use of the cask by a licensee at the design basis heat load.

While the current licensees using the cask are not located in a marine environment and use ceramic tiles to support the MSB in the VCC, this may not be true of future licensees that use the cask under the renewed CoC. Additionally, a current licensee may, in the future, load a cask and use galvanized steel grates instead of ceramic tiles. Current or future licensees may also load a new cask at the design basis heat load, which could impact evaluations dependent upon the cask heat load (e.g., evaluations of cladding temperatures and fuel rod internal pressures vs. values of 400°C and 90MPa, respectively, and the effects on cladding/fuel rod integrity). Thus, the analyses in the renewal application should be expanded to address these three scenarios or condition the CoC (and amendments) to prevent these three scenarios.

This information is needed to confirm compliance with 10 CFR 72.240.

RAI-12: Provide the reference(s) for the carbon steel corrosion allowance of 0.003-inch/year that is assumed for the TLAA in Section 3.3.3.3 of the application. Further, explain how the corrosion rate is verified over the 40-year renewal period.

The source for the expected 0.003-inch/year corrosion loss is not described.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(2).

- RAI-13: Reconcile statements in Section 3.4.2.4 and 3.4.4, the “Safety analyses of the MSB structural lid and closure weld are based on nominal dimensions and do not include a corrosion allowance” with that of Section 3.3.3.3, where the corrosion allowance of 0.003-inch/year is assumed in the TLAA.

The two statements appear to contradict each other, requiring clarification.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(2).

- RAI-14: Revise the operating experience section, as appropriate, of the AMPs to incorporate NRC Information Notice 2013-07, “Premature Degradation of Spent Fuel Storage Cask Structures and Components from Environmental Moisture,” [April 16, 2013] and NRC Information Notice 2011-20, “Concrete Degradation by Alkali-Silica Reaction,” [November 10, 2011].

These two information notices address recent operating history for dry cask storage systems.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

- RAI-15: Revise the renewal application to provide quantitative metrics or measures that define “good condition”.

Page 3-18 of the renewal application states, “Upon removal of the VCC cask lid, the VCC lid gasket was found to be in “good condition with no evidence of leakage during the initial storage period”. The coating on the MSB structural lid and closure weld was also found to be in good condition, with a few small areas that had “bubbled” but were still intact.” Note that this could be an indication of under paint corrosion.

This information is required to demonstrate compliance with 10 CFR 72.11.

- RAI-16: Revise the renewal application to include inspecting the MTC and provide and justify the inspection intervals.

The current language in Section 3.4.2.5 of the license renewal application permits the MTC to remain in a sheltered environment for over 40 years without inspection. Degradation of lubricants, hydraulic fluids, etc. and corrosion of uncoated carbon steel surfaces would be expected over 40 year renewal period.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

RAI-17: Reconcile statements in Table 18 of the renewal application, "Examination of MTC Assembly" and Section 3.4.2.5, "Examination of the MTC Assembly."

Section 3.4.2.5 states that "If it is determined that corrosion on the underlying steel has resulted in loss of material (as opposed to just discoloration), then the MTC assembly shall be evaluated for continued use and the corroded surfaces shall be repaired."

Table 18, "Preventative Actions," states "Identification and repair of corrosion on the exposed surfaces of the MTC assembly...protects pool chemistry during fuel loading/unloading operations..."

Table 18, "Acceptance Criteria," states no coating degradation that exposes the underlying carbon steel surface and no corrosion of the underlying carbon steel surfaces that results in significant loss of material and prevents the MTC assembly from performing its intended structural and shielding functions.

It is unclear to the staff if uncoated steel that shows signs of discoloration, e.g., rust blooms, is acceptable. Uncoated steel in the spent fuel pool may cloud the pool during loading/unloading operations, which may contradict the statement in Table 18, "Preventative Actions."

This information is required to demonstrate compliance with 10 CFR 72.236(h).

RAI-18: Justify reliance on a corrosion allowance for the MSB bottom plate and shell in the current renewal application to support not needing an AMP for these components. Also, explain how the corrosion allowance will be verified.

Section 2.2.1.2 describes a corrosion allowance for the MSB bottom plate and shell and uses that in a TLAA for the MSB shell and bottom plate. It also uses this allowance to justify not needing an AMP for these MSB components. At least in terms of the shielding analyses in the FSAR, no allowance for corrosion is available since the shielding analyses use the nominal dimensions in the technical drawings, or in some cases appear to use dimensions that exceed those in the technical drawings for these MSB components. Thus, it would seem that an AMP may be needed for these MSB components.

This information is needed to confirm compliance with 10 CFR 72.236(d) and 72.240.

RAI-19: Provide evidence or justification demonstrating the lack of general, crevice, pitting, or other corrosion mechanisms between the VCC shield lid and MSB.

Section 3.2.2.4 notes that the VCC shield ring was, "lifted a small amount" but does not provide any details about the inspection for potential corrosion.

This information is required to demonstrate compliance with 10 CFR 72.11.

- RAI-20: Clarify if the VCC lid bolts for each VCC storage system will be replaced or justify the bolts are acceptable for extended service.

The acceptability of bolts for extended service should be checked and the potential failure problems unique to bolts must be analyzed.

This information is required to demonstrate compliance with 10 CFR 72.240(c).

- RAI-21: Clarify the use of ACI 201.1 R-08 in the renewal application.

In response to Observation 2 of the NRC's Request of Supplemental Information, the applicant stated that, "in Section 3.4.2.2, the exposed surfaces on the sides and top of the VCC assembly are visually examined in accordance with ACI 201.1R-08..." The staff cannot find a reference to ACI 201.1R-08 in Section 3.4.2.2 or Table 15 of the renewal application, although it is listed in Section 3.4.2.2 Examination of the VCC Assembly Exterior Concrete".

This information is required to demonstrate compliance with 10 CFR 72.11.

- RAI-22: Clarify which surfaces of the VCC Assembly are coated with Dimetcote 6, or equivalent, as described in Section 2.2.1.3 of the renewal application.

The subject section notes that "exposed" steel is also coated with Dimetcote 6 or equivalent. The term "exposed" also refers to an external environment in contact with the outside atmosphere as described in Section 3.1.2, "Environments" of the renewal application. The understanding of the staff is that surfaces that are in contact with the atmosphere but are in a sheltered environment are coated with Dimetcote 6 or equivalent.

This information is required to demonstrate compliance with 10 CFR 72.236(d).

- RAI-23: Identify in Section 2.2.1.3 of the renewal application the intended purpose and nuclear service level for the Dimetcote 6 inorganic zinc paint coating. Verify that the equivalent coating(s) to be used will be of the same nuclear service level. Identify also the industry standard(s) that will be used to reapply the coating to components on the VCC. Provide data to support the expected service life of the Dimetcote 6 coating.

The renewal application states that the metal surfaces of VSC-24 VCC's steel components are coated with industry standard coating, Dimetcote 6, or the equivalent for preventing corrosion of the metal components. Typically, these types

of coatings are used to protect the steel from excessive corrosion and facilitate decontamination of the surfaces.

This information is required to demonstrate compliance with 10 CFR 72.236(d).

RAI-24: Update Section 3.2.2.2 of the renewal application to justify how local coating failure and corrosion were determined on the MSB from the 5-year inspection. Explain the basis for the 5-year inspection interval. Also, quantify what does “very little coating degradation” mean and explain what does “significantly less than design basis” mean.

Page 3-15 discusses the condition of the MSB shell during the 5 year inspection interval. The results of the 5-year inspections showed that only local coating failure and corrosion had occurred on the MSB shell, and the amount of corrosion is significantly less than the design basis. However, it is unclear what was performed for the determination.

This information is required to demonstrate compliance with 10 CFR 72.240.

RAI-25: Describe how the necessary torque values of the bolts will be verified.

Staff was unable to verify this information in the renewal application for the VSC-24.

This information is required to demonstrate compliance with 10 CFR 72.236(e).

RAI-26: Revise Table 17 of the AMP (Examination of VSC Top End Steel Components) to indicate the standard for bolt procurement.

Bolts that are improperly heat-treated may crack in service under normal conditions (if tempered too little) or under off-normal (accident) conditions (if tempered too much).

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

RAI-27: Include item #2 of the “parameters monitored” (aggressive chemical attack...) in the monitoring and trending column of Table 15 (Examination of VCC assembly exterior concrete).

The monitoring and trending AMP element discusses what will be done for cracking, but chemical attack is not discussed.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

RAI-28: Explain in Table 15 how the interval between inspections may be changed as a result of inspection findings from environmental degradation (blisters, spalling, ASR, etc.) of concrete.

Table 15 states that detection of aging is done only at a frequency of one year.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

RAI-29: Explain in Table 15 what additional actions will be taken to confirm the extent and driving force that will cause ASR-induced degradation or leaching of CaOH of the VCC. These actions should also consider the potential degradation of the MTC from leaching of the concrete.

Section 3.4.2.2 of the renewal application indicates that if performance monitoring indicates the potential presence of ASR-induced degradation or leaching of CaOH, then additional actions shall be taken to confirm the presence of the degradation mechanism.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

RAI-30: Justify that the proposed condition to allow use under Amendment 4 or later of VSC-24 SSCs constructed under the initial CoC and Amendments 1, 2 and 3 avoids the problems associated with the initial CoC and Amendments 1, 2 and 3. Also, confirm that differences in hardware or operations requirements between amendments will allow SSCs constructed under Amendment 4 or later to be used with the previous amendments.

The applicant proposed a certificate condition to condition the initial CoC and Amendments 1 through 3 to require new SSCs be constructed per Amendment 4 or later. The condition also allows for SSCs already constructed under the initial CoC and Amendments 1 through 3 to be used as long as they are loaded per Amendment 4 or later. Recognizing that the later amendments were developed to address various issues encountered under the earlier amendments (i.e., pre-Amendment 4), it is not clear that a condition that allows use of SSCs constructed under the previous amendments precludes continuance of the issues associated with those amendments (e.g., hydrogen-induced cracking, hydrogen generation, welding electrode selection, clouding of the spent fuel pool). Also, it is not clear that SSCs constructed to later amendments will meet the requirements of earlier amendments, including for hardware or operations, and thus be useable under those earlier amendments in accordance with the proposed condition.

This information is needed to confirm compliance with 10 CFR 72.240.

RAI-31: Revise the renewal application to provide consistent descriptions of the AMPs and to ensure the AMPs include appropriate corrective actions, inspection intervals, and operating experience.

Sections 3.4.2 and 3.4.4 describe the proposed AMPs. These AMPs are summarized in Tables 14 through 19. Table 13 also summarizes which AMPs are applied to which SSC components. However, the information provided is not consistent. Thus, the scope of components covered by each AMP and the actions that should be taken is not clear. For example, it seems that Table 13 should include AMP Section 3.4.2.4 for the MSB structural lid and shell covers. Also, based on the AMP descriptions, the MSB shell is included in the AMPs and should also be listed in Table 13. In some cases the AMP scope in the summary table is not as extensive as in the AMP section; in other cases it is the opposite. In some cases, the summary table is internally inconsistent, leaving out SSC components in one element that are included in other elements of the AMP. Some AMP tables also seem to be missing some appropriate corrective actions. For example, an indication of a problem with the MSB neutron shield in Table 17 would seem to necessitate a check of the neutron shields for other MSBs. Also, in Table 16, the actions would seem to need more than just an evaluation of the condition's extent and continued usability. The table should describe the actions to take in the case where continued use is not possible.

This information is needed to confirm compliance with 10 CFR 72.240.

RAI-32: Revise Section 3.2.1.4 to evaluate the potential for creep or slumping of the lead in the MTC during extended storage due to gaps from tolerances.

During extended storage, the lead should not creep or slump to any extent that critically impairs the safety function.

This information is required to demonstrate compliance with 10 CFR 72.236(d) and 72.240(c).

RAI-33: Clarify how dose rate measurements have been and will be used, provided the effectiveness of that approach can be justified, to identify degradation that could impact safety functions and for:

- a. The performance monitoring described in Section 3.2.2.3 and
- b. The examination of the VSC top end components described in Section 3.4.2.4 of the application.

The applicant describes the dose rate surveys that have been performed by the licensees that currently operate the VSC casks. The applicant also includes neutron dose rate measurements as part of a proposed AMP for the VSC top end components. The purpose in both cases has been, or is, to identify degradation of VSC components that have a shielding function. It is not clear that the current

criterion of an increase in dose rates is adequate to identify degradation that “could possibly impact” safety functions or to verify the shielding effectiveness. Though recognized by the applicant, it is not clear if and how the criterion accounts for decay of the source term with time. Thus, degradation may be occurring but not to the extent that causes dose rates to increase, at least until the degradation has significantly progressed. Therefore, verification of shielding effectiveness may be performed by comparison of measured dose rates versus expected dose rates for the source in the contents. It is not clear that the proposed Aging Management Plan provides this kind of verification.

This information is needed to confirm compliance with 10 CFR 72.240.

RAI-34 Justify why a lead cask inspection was not done at Arkansas Nuclear One (ANO) and Point Beach.

Section 3.2.2.4 of the application provides some basis for the decision to perform the lead cask inspection at Palisades. However, considering the past issues with the VSC-24 (i.e., hydrogen induced cracking) the application should provide a justification for the decision to not have a lead cask inspection at all three sites. It should be noted that environmental degradation that leads to corrosion is very different at the three sites.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).

RAI-35 Revise Section 3 of the application to indicate if AMPs and TLAs will be changed as a result of inspections and operating experience.

Section 3 of the renewal application does not indicate that that AMPs and TLAs will be updated as a result of inspection findings or current knowledge from operating experience from the industry.

This information is required to demonstrate compliance with 10 CFR 72.240(c)(3).