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RSS-SC-SCA-00432

April 1, 2022

**MEETING SUMMARY**

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| **Meeting Date** | January 20, 2022 |
| **Leader/Organization** | N. S. Plate / NR 08G |
| **Attendees** | N. S. Plate / NR 08G, A. S. Hunt / NR 08G, B. White / NRC, J. Borowsky / NRC, S. Fiscus / NNL-RSS, C. B. Haslett / NNL-RSS, J. T. Maciupa / NNL-RSS, A. L. Primas / NNL-RSS, A. C. Koch / NNL-RSS, S. M. Ciez / NNL-RSS, M. N. Sexton / NNL-FRE, J. I. Watjen / NNL-FRE, B. W. Martin / NNL-FRE |

Subject: MTS; Teleconference to Discuss Nuclear Regulatory Commission Questions on the MTS Addendum to the S3G-3 Spent Fuel in the M-140 Safety Analysis Report for Packaging; For Information

Dear Sir:

## PURPOSE

In the Reference (a) letter, Naval Reactors (NR) provided the Nuclear Regulatory Commission (NRC) for review and concurrence the Moored Training Ship (MTS) Addendum to the S3G-3 Spent Fuel in the M-140 Safety Analysis Report for Packaging (SARP). NR, NRC, and Naval Nuclear Laboratory (NNL) met on January 20, 2022, (via Bridgeline) to discuss preliminary NRC questions on the thermal and containment chapters from the MTS Addendum to the S3G-3 Spent Fuel in the M-140 SARP. This meeting summary documents the questions and responses during the discussion that were clarification in nature, and supports generation of the NRC Safety Evaluation Report and potential Requests for Additional Information if deemed necessary by the NRC.

## DISCUSSION

The following is a summary of the NRC questions as well as the responses provided by NR and NNL from the meeting on January 20, 2022.

<u>General discussion of the SARP</u>:

Topic 1: Is the M-140 container designed and fabricated to a specific standard (i.e. Navy Standard)? Normally, there is a callout in the SARP but none was present in the S3G-3 Core Dependent SARP or MTS Addendum.

NNL confirmed that the container is designed and fabricated to a specific set of standards. The M-140 is designed to meet the Type B shipping container criteria of 10CFR71. This is done by the container being designed and fabricated in accordance with MIL, ASME, and ANSI standards. References to these standards are listed throughout the Core Independent M-140 SARP and drawings provided in Appendix 1.3.2. NRC previously reviewed and concurred to the use of these standards during initial certification of the M-140 shipping container. The Core Dependent MTS SARP addendum does not modify the application of these standards for the M-140 shipping container.

Discussions related to the Thermal chapter:

Topic 2: Are the O-Ring temperatures exceeded during NCOT and can the O-Rings function properly at -40°F?

NNL confirmed that the O-Ring temperatures are not exceeded during NCOT and are within the service temperature range. Table 2.6-1 in the S3G-3 Core Dependent M-140 SARP concluded a maximum O-Ring temperature of 155°F (bounded by the analysis at 197°F in the Core Independent M-140 SARP). Section 4.1.3.2 of the Core Independent SARP states that the service temperature of these O-Rings is -65°F to 250°F.

Topic 3: Is the internal pressure calculation for a 1-year period?

Section A.3.4.4 of the MTS Addendum provides the maximum internal pressure analysis for the M-140 with the MTS spent fuel cargo. NNL confirmed that the internal pressure is calculated from a steady-state temperature distribution at the earliest allowable shipment time, which produces the limiting pressure during NCOT.

Topic 4: Can NNL provide explanation/clarification of the NCOT thermal models?

NNL discussed that the NCOT thermal analysis uses the container model from Section 3.4 of the S3G-3 Core Dependent SARP without edits. The detailed fuel cell model is replaced in Section A.3.4 because of the increased margin from using a higher-fidelity model.

Topic 5: Why are fuel properties introduced in the Chapter A.3 section?

NNL discussed that the fuel properties are used in the NCOT detailed fuel submodel, as shown in Figure A.3.4-2.

Topic 6: Is there damage to the closure head during HAC and would this change the analysis of the fire?

NNL discussed that the Core Independent M-140 SARP states that a permanent gap may exist at the closure head seating surface after a top drop accident. This is larger than the initial O-Ring compression. As shown in Figure 1-3 of the Core Independent M-140 SARP, the 14-inch thick closure head is fully recessed into the upper end of the container body. The closure head is not directly exposed to the HAC fire because of the presence of the protective dome. The M-140 Core Independent SARP demonstrates that the protective dome remains in place during all HACs. Accordingly, the small gap is not explicitly modeled in the HAC thermal model since it would not have any significant effect on thermal analysis conclusions.

Topic 7: How is the new thermal model validated?

The HAC model compares favorably to the previously reported HAC results shown in Figure A.3.5-7.

The NCOT fuel submodel compares favorably to the previous results as well, though it is not explicitly shown. Internal quality assurance has been completed on this model to show that the fuel cell temperatures agree well with hand calculations, but this was not discussed in this unclassified call.

The NCOT and HAC container models compare well with prototypic M-140 test data, but this was not discussed in this unclassified call.

Topic 8: What is the error in the fin heat transfer methodology in the S3G-3 Core Dependent M-140 SARP?

NNL discussed that the Appendix 3.6.1 equation for fin effectiveness should be the ratio of finned heat transfer to the bare cylinder (without-fins) heat transfer. The equation on Page 3.6.1-3 has pi * L * ($D_0$ + 2l) in the denominator when it should be pi * L * ($D_0$) representing the surface area of the bare cylinder. This results in a 10% conservatism in the convection heat transfer, which was corrected for the Section A.3.5 HAC model. Due to the 10% conservatism, no changes to the S3G-3 Core Dependent SARP were made.

Topic 9: How are the convection and radiation terms applied to the fin heat transfer?

NNL discussed that the FEA package allows us to apply a separate convection and radiation heat transfer boundary condition to the surface, as described in Section 3.4.1.1.2 of the S3G-3 Core Dependent SARP for NCOT and Section A.3.5.2.6 of the MTS Addendum for HAC. The fin effectiveness is used for convection, and the increased emissivity is used for radiation for the fins.

Topic 10: How is the gap spacing between the spacer plates and the vessel changed during the HAC transient in your model?

NNL clarified that during the thermal transient, no changes were made to the geometry but there were changes to the gap conductance, h = k / L, as thermal expansion dictated a change in the gap, L. These results were based on many iterations to fine-tune when to change the gap.

Topic 11: Was the container analyzed in another orientation as a sensitivity study?

NNL confirmed that the toppled, horizontal orientation was evaluated as a sensitivity study and showed acceptable results.

Topic 12: Why not use the S3G-3 Core Dependent SARP for the safety basis and say that the MTS conclusions are bounded.

NNL confirmed that the MTS thermal results are bounded by the S3G-3 evaluation. However, documentation of this specific MTS analysis is required to verify that the MTS results are bounded.

Discussions related to the Containment chapter:

Topic 13: Radiolysis was set to the 5% limit. Why were there no calculations to show the container met 5% in a 1-year period?

NNL confirmed there is a discussion of radiolysis is presented in Section 2.4.4 of the Core Independent M-140 SARP. Containers are sampled during initial venting. No measurable hydrogen has been detected with measuring equipment that has a detectability limit of 0.2%.

Topic 14: Are all of the penetrations in the containment boundary doubled seal O-Rings?

NNL confirmed that all the penetrations in the M-140 containment boundary are doubled sealed with O-Rings. The Subsections of 4.1.3.2 and 4.1.3.3 of the Core Independent M-140 SARP list all of the M-140 containment boundary penetrations and states that all of these penetrations are doubled sealed with O-Rings.

Topic 15: Are the M-140 container welds multi-pass welds?

NNL confirmed that the M-140 container welds are multi-pass welds. The container welds are 14-inch thick full-penetration narrow groove multi-pass welds (shown in Figure 4-4 of the Core Independent M-140 SARP). Although the Core Independent M-140 SARP does not explicitly state the welds are multi-pass, Section 8.1.1 describes the inspection of these welds which states, "the root pass and final cover pass weld", implying that the container welds are multiple passes. For additional perspective, the M-140 containment boundary welds are multiple pass welds that were nondestructively examined, including 100 percent radiography, which provides adequate assurance that no through weld leakage path exists.

**CONCLUSION**

The discussion above summarizes the meeting held on January 20, 2022 between NR, NRC, and NNL on the MTS Addendum to the S3G-3 Spent Fuel in the M-140 SARP. NR (Plate) agrees that this accurately summarizes the topics discussed with the NRC and are clarification in nature. If deemed required, NRC will provide NR a requests for additional information to formally disposition technical questions on the SARP provided for NRC review and concurrence in the Reference (a) letter.

JOHN MACIUPA
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John T. Maciupa, Engineer
Shipping Container Analysis
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Reference:

(a) G#C21-04011, dated August 26, 2021, M-140 Spent Fuel Shipping Container – Safety Analysis Report for Packaging S3G-3 Spent Nuclear Fuel; Request for Nuclear Regulatory Commission Review and Concurrence (U)