



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION REPORT

DOCKET NOS. 50-327, 50-328, AND 72-34

EXEMPTION REQUEST FOR DEVIATING FROM VARIOUS

10 CFR PART 72 REGULATIONS RESULTING FROM

NON-DESTRUCTIVE EXAMINATION COMPLIANCE

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT

INDEPENDENT SPENT FUEL STORAGE INSTALLATION

1.0 INTRODUCTION

By letter dated August 4, 2022 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML22216A078), as supplemented by letters dated December 19, 2022 (ML22353A066), April 27, 2023 (ML23117A116), and January 3, 2024 (ML24004A039) Tennessee Valley Authority (TVA or the licensee) requested an exemption from the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 72.212(a)(2), 72.212(b)(3), 72.212(b)(5)(i), 72.212(b)(11), 72.214, 72.154(b), and 72.174 for Sequoyah Nuclear Plant (SQN) Independent Spent Fuel Storage Installation (ISFSI).

The licensee loaded spent fuel in the HI-STORM Flood/Wind (FW) dry cask storage (DCS) system Multi-Purpose Canister (MPC) Type 37, Serial Number (No.) 234, for storage in the ISFSI at SQN under Certificate of Compliance (CoC) No. 1032, Amendment No. 3, and its general license (ML22059B061). During a review of manufacturing documents, Holtec International, Inc. (Holtec, or the CoC Holder) [the manufacturer] identified that MPC Type 37 (MPC-37) Serial No. 234 at SQN ISFSI has a longitudinal shell-to-shell weld for which no digital radiography test (RT) is available following a weld repair. The missing radiograph is for approximately 7.5 inches (in.) of weld repair located between approximately 14 and 25 in. from the bottom of the MPC baseplate. When notified of this issue, MPC-37 Serial No. 234 was already put in use and registered by TVA in a letter dated February 24, 2022 (ML22059B061), entitled "Sequoyah Nuclear Plant - Registration of Spent Fuel Storage Cask Pursuant to 10 CFR 72.212(b)(2)." The exemption request, if approved, would permit the licensee to continue to use loaded and sealed Holtec MPC-37 Serial No. 234 in its current condition to store spent fuel for the service life of the canister at SQN.

This safety evaluation report documents the staff's review and evaluation of TVA's exemption request for SQN ISFSI. The staff reviewed TVA's request to determine whether it meets the criteria for an exemption specified in 10 CFR 72.7. The requirements in 10 CFR 72.7 authorizes the Commission to grant exemptions from the requirements of 10 CFR Part 72 if the exemption

Enclosure

is authorized by law and will not endanger life, property, or the common defense and security, and is otherwise in the public interest.

2.0 BACKGROUND

Tennessee Valley Authority is the holder Renewed Facility Operating License Nos. DPR-77 and DPR-79, which authorize operation of the SQN, Units 1 and 2, respectively, in Soddy-Daisy, Tennessee, pursuant to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC) now or hereafter in effect.

Under 10 CFR Part 72, subpart K, "General License for Storage of Spent Fuel at Power Reactor Sites," a general license is issued for the storage of spent fuel in an ISFSI at power reactor sites to persons authorized to possess or operate nuclear power reactors under 10 CFR Part 50. The licensee is authorized to operate a nuclear power reactor under 10 CFR Part 50 and, accordingly, holds a 10 CFR Part 72 general license for storage of spent fuel at the SQN ISFSI. Under 10 CFR 72.212(a)(2), (b)(3), (b)(5)(i), (b)(11) and 72.214, a general licensee may store spent fuel in a cask, so long as it is one of the approved casks listed in 10 CFR 72.214, "List of approved spent fuel storage casks," and the general licensee conforms to the terms, conditions, and specifications of the relevant CoC or amended CoC.

Accordingly, under the terms of the general license, TVA stores spent fuel at its SQN ISFSI using the Holtec International, Inc. (Holtec) HI-STORM FW DCS system. The system is listed in 10 CFR 72.214 as Certificate No. 1032, hereafter referred to as CoC No. 1032. This DCS system is used by TVA at SQN, in accordance with 10 CFR 72.210, "General license issued." SQN uses the HI-STORM FW MPC that holds up to 37 pressurized water reactor fuel assemblies. As part of the DCS storage system, the MPC [of which the weld seam joining the baseplate to the shell is an integral part] ensures the functions of criticality safety, confinement boundary, shielding, structural support, and heat transfer.

3.0 REGULATORY REQUIREMENTS

The subject request is for an exemption from the following 10 CFR requirements, among others:

- Paragraph 72.212(a)(2) limits a general license to storage of spent fuel in casks approved under the provisions of 10 CFR Part 72.
- Paragraph 72.212(b)(3) requires the general licensee to ensure that each cask it uses conforms to the terms, conditions, and specifications of a CoC or an amended CoC listed in 10 CFR 72.214.
- Paragraph 72.212(b)(5)(i) requires the general licensee to perform written evaluations which establish that the relevant cask, once loaded with spent fuel or once the changes authorized by an amended CoC have been applied, will conform to the terms, conditions, and specifications of a CoC or an amended CoC listed in 10 CFR 72.214.
- Paragraph 72.212(b)(11) requires, among other things, that the general licensee comply with the terms, conditions, and specifications of the CoC or the amended CoC, as appropriate.

- Section 72.214 lists CoC No. 1032 as an approved cask for storage of spent fuel under the condition specified in the CoC.
- Paragraph 72.154(b) of 10 CFR requires the licensee to have available documentary evidence that material and equipment conform to the procurement specifications prior to installation or use of the material and equipment and to retain or have available this documentary evidence for the life of the ISFSI or spent fuel cask.
- Paragraph 72.174, in part, requires that Records pertaining to the design, fabrication, erection, testing, maintenance, and use of structures, systems, and components important to safety must be maintained by or under the control of the licensee or certificate holder until the NRC terminates the license or CoC.

In its exemption request, the licensee stated that MPC-37 Serial No. 234 does not fully comply with the following CoC requirements:

- Section 6 of the CoC which states, "Features or characteristics for the site or systems must be in accordance with Appendix B to this certificate."
- Appendix B, Section 3.3 of the CoC, which states that the American Society of Mechanical Engineers (ASME) Code, 2007 Edition is the governing code for the HI-STORM FW MPCs, with certain approved alternatives.

4.0 PROPOSED EXEMPTION

The licensee requested an exemption from the requirements of 10 CFR 72.212(a)(2), 72.212(b)(3), 72.212(b)(5)(i), 72.212(b)(11), 72.214, 72.154(b), and 72.174 by letter dated August 4, 2022, as supplemented by letters dated December 19, 2022, and April 27, 2023. On January 3, 2024 (ML24004A040), SQN supplemented its request in response to the NRC's request for additional information (RAI) dated November 8, 2023 (ML23307A081).

The proposed exemption request is for MPC-37, Serial No. 234, which does not fully comply with CoC No. 1032 requirements. Condition 6 of CoC No. 1032 states, "Features or characteristics for the site or systems must be in accordance with Appendix B to this certificate." Appendix B, Section 3.3 of the CoC requires, with certain approved alternatives that are not relevant in this case, the HI-STORM FW MPC-37 Serial No. 234 to meet the ASME Boiler and Pressure Vessel (B&PV) Code, 2007 Edition. The ASME B&PV Code requires that 100 percent of the weld seam joining shell-to-shell of the MPC, including the MPC longitudinal shell-to-shell weld, be inspected by digital radiography test (RT) in accordance with section III, subsection NB of the ASME B&PV Code.

During a review of manufacturing documents, the manufacturer (i.e., Holtec) identified that MPC Serial No. 234 at SQN ISFSI has a longitudinal shell-to-shell weld for which no digitally radiographic examination (i.e., RT) is available following a weld repair. The missing radiograph is for approximately 7.5 in. of weld repair located between 14 and 25 in. from the bottom of the MPC baseplate. When Holtec notified TVA of this issue, TVA had already placed MPC-37 Serial No. 234 in use and registered it in a letter dated February 24, 2022 (ML22059B061), entitled "Sequoyah Nuclear Plant - Registration of Spent Fuel Storage Cask Pursuant to 10 CFR 72.212(b)(2)."

Section III, subsection NB, of the ASME Code requires that 100 percent of the weld seam joining the baseplate to the shell of the canister be examined by a RT. Further, ASME Code section III, subsection NB requires, in part, that “examination of a weld repair shall be repeated as required for the original weld.” Thus, in effect, the NRC staff is considering an exemption from the requirement to repeat volumetric examination by RT as required for the original weld on an approximately 7.5-in. portion of the repaired weld.

The exemption request, if granted, would permit the licensee to continue using MPC Serial No. 234, to store spent fuel for the service life of the canister, in its current condition, without volumetric examination data from radiographic testing for an approximately 7.5-in. section of the repaired weld seam joining the baseplate to the canister shell.

5.0 SAFETY EVALUATION AND EXEMPTION ANALYSIS

Pursuant to 10 CFR 72.7, “Specific exemptions,” the Commission may, upon application by any interested person or upon its own initiative, grant such exemptions from the requirements of the regulations of 10 CFR Part 72 as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest.

AUTHORIZED BY LAW

Section 72.7 of 10 CFR allows the NRC to grant exemptions from the requirements of 10 CFR Part 72. The NRC staff has determined that issuance of this exemption is consistent with the Atomic Energy Act of 1954, as amended, and not otherwise inconsistent with NRC’s regulations or other applicable laws. Therefore, the requested exemption is authorized by law.

WILL NOT ENDANGER LIFE OR PROPERTY OR THE COMMON DEFENSE AND SECURITY

The staff reviewed TVA’s exemption request for SQN and concludes, as discussed below, that the proposed exemption from certain requirements of 10 CFR Part 72 will not cause the HI-STORM FW storage cask to encounter conditions beyond those for which it has already been evaluated and demonstrated to meet the applicable safety requirements in 10 CFR Part 72.

The staff followed the guidance in NUREG-1536, Revision 1, “Standard Review Plan for Spent Fuel Dry Cask Storage Systems at a General License Facility,” published in July 2010, to complete its safety evaluation. The NRC staff’s evaluation includes confinement, materials, and structural safety areas, which are the relevant technical disciplines affected by this exemption.

5.1 Confinement Evaluation

As described in the licensee’s exemption request, ASME B&PV Code [specifically section III, NB-5000] requires that weld repairs be inspected with respect to the same criteria as the initial welds. In the case of MPC-37 Serial No. 234, the licensee stated that the longitudinal shell-to-shell welds were inspected via digital RT, in accordance with section III, subsection NB; however, this RT inspection was not performed for an approximately 7.5-in. section of repaired weld on MPC-37 Serial No. 234. The licensee further stated that, “the weld repair was performed in accordance with all [Holtec] quality procedures. The condition for which this exemption is requested is only related to the post repair volumetric examination.”

Findings of Confinement Review

The licensee stated, in the “Confinement” section of its submittal, that MPC-37 Serial No. 234 successfully passed a helium leakage test during factory acceptance testing and following the completion of the weld repair. The licensee contends that, meeting the criteria for the helium leakage test carried out in conformance with the existing Final Safety Analysis Report (FSAR) for the HI-STORM FW storage system, and the applicable Technical Specifications (TS), in accordance with the requirements in American National Standards Institute (ANSI) N14.5-1997, “Radioactive Materials - Leakage Tests On Packages For Shipment,” demonstrates that the MPC-37 Serial No. 234 meets the leaktight criteria of ANSI N14.5-1997. The licensee’s evaluation of MPC-37 Serial No. 234 in its current condition concluded that the proposed loading configuration does not impact the criticality control, shielding, or thermal design functions of the loaded MPC.

Based on the above, and the results of the leaktight test performed by the licensee, the NRC staff found that the subject MPC met the leaktight criteria of ANSI N14.5-1997 when tested for leakage following the completion of the weld repair. The NRC staff concluded that the results of the leaktight testing adequately demonstrate that this MPC continues to meet the regulatory requirements for confinement as outlined in 10 CFR Part 72, and therefore the weld repair completed on MPC-37 Serial No. 234 has had no effect on the confinement performance of the MPC in question.

5.2 Materials Evaluation

The staff’s materials review focused on the analysis of one MPC longitudinal weld. During the fabrication process, Holtec performed a typical weld repair of the MPC 234 shell-to-shell weld after the initial digital RT examination showed a section of the weld that had a 3.7-in.-long defect [i.e., lack of fusion (LOF)]. This defect was in a section identified as RT 0-1 located between 4 and 14 in. from the baseplate. The weld was excavated to remove the defect and a successful liquid penetrant test (PT) examination of the entire excavated area was performed. The dimensions of the excavated area were approximately 6 5/8 in. in length by 5/8 in. in width and 9/32 in. in depth. The licensee stated that detailed profile dimensions of the repaired area are not available but referred to Holtec procedures that require a 3-to-1 taper for weld repair excavations. The weld repair was performed using ASME Section IX qualified gas tungsten arc weld (GTAW) procedure and successfully passed a final PT exam.

After the PT exam was completed, the repaired section was re-inspected using the same digital RT process which identified another defect [LOF]. This defect was defined as approximately 0.327 in. in length. This indication was also located in the section identified as RT 0-1 and was excavated to remove the defect. The final excavation was approximately 16 1/2 in. in length by 5/8 in. in width and 1/4 in. in depth. This excavation overlapped with the adjacent section identified as RT 1-2 located approximately 8.5 to 25 in. from bottom of the baseplate. This new excavation cavity received a PT examination followed by a GTAW weld repair. A final PT examination was performed prior to RT. Following completion of the final weld repair, MPC 234 successfully passed a helium leakage test during factory acceptance testing, and a hydrostatic test was performed at SQN during loading operations.

After MPC 234 was put in service, Holtec identified that a section of this second weld repair does not have supporting RT documentation. As discussed in its supplemental letter dated April 27, 2023, Holtec identified that the length of the weld not examined via RT is 10.608 in., which is located approximately between 16.493 in. to 27.101 in. from the bottom of the MPC baseplate

on the longitudinal Weld No. 21. These approximations are based on measurements taken from the RT images for RT 0-1 and RT 1-2.

The licensee also provided additional clarification with respect to the process and NDE results for the shell-to-shell weld repair for MPC 234. The licensee stated that the repairs along the MPC shell-to-shell weld were successfully completed per written procedures. The licensee stated that after the weld repair was completed, the repaired area was examined by PT and no relevant indications were identified. In addition, the licensee stated that following the PT of the entire weld repair, the post repair RT examination of RT 0-1 portion of the weld repair area did not show any relevant indications and did not require rework.

The requested exemption would allow the licensee to continue using MPC 234 as it resides inside a HI-STORM FW overpack located on an ISFSI pad. The licensee's assertion of reasonable assurance of safety for the MPC 234 is based on the following:

- The weld repair was performed in accordance with all Holtec quality procedures.
- The RT inspection was not performed for an approximately 10.608-in. section of repaired weld on MPC 234, out of an approximately 653 inches of total MPC welds. This is approximately 1.62 percent of the MPC 234 welds and more than 98 percent of the MPC welds have been examined by RT.
- MPC 234 continues to meet all its design basis requirements and safety functions based on an updated analysis.

The licensee asserts that there is a reasonable assurance of safety for the requested exemption for MPC 234 based on a structural evaluation for the MPC that shows that the MPC 234 maintains structural and confinement functions with no change to the criticality, shielding, or thermal functions. The licensee's structural evaluation is based on an assumed weld strength reduction factor to account for the missed RT inspection of the 10.608-in. portion of the MPC 234 shell-to-shell weld.

The licensee reviewed the ASME B&PV Code to develop an assumed weld strength reduction factor, including a comparison of the extent of RT examination of the MPC 234 to the nondestructive examination requirements for pressure vessel welds in ASME B&PV Code, section VIII, Division 1, which contains the rules for the construction of pressure vessels as well as ASME section III, subsection ND, which is applicable to Class 3 Components. The licensee stated that ASME section VIII, Division 1, and ASME section III, subsection ND, both specify a strength reduction factor of 0.85 for Category A butt welds subject to spot radiography. Requirements for spot radiography as specified in UW-52 of section VIII, Division 1 and ND-5430 require a minimum of a 6-in. spot to be examined for every 50-foot increment of the weld. The licensee stated that the level of inspection performed on the welds of MPC 234 far exceeds these minimum ASME B&PV Code requirements for spot radiography. The licensee also stated that for SA 240 Type 304 stainless steel, the design stress values applicable to ASME B&PV Code section VIII, Division 1, and section III, subsection ND, are generally equal to the design stress intensity values applicable to section III, subsection NB, except for minor variances at 300 to 400 degrees Fahrenheit.

The licensee also provided a comparison of the weld strength reduction factor used to demonstrate the weld integrity for MPC 234 to the requirements of ASME section III, subsection NG, applicable to core support structures, using the weld strength reduction factors in table NG

3352-1. This table specifies a joint efficiency (analogous to a weld strength reduction factor) of 0.75 for a full penetration weld subjected to PT of both the root pass and the final pass. The licensee stated that the strength reduction factor in table NG 3352-1 would be overly conservative because more than 98 percent of the shell-to-shell weld for MPC 234 was volumetrically examined using digital RT examination.

The licensee also referenced the weld strength reduction factor of 0.8 from the NRC Interim Staff Guidance 15 (ISG-5) [which was incorporated into NUREG- 2215, Standard Review Plan for Spent Fuel Dry Storage Systems and Facilities - Final Report, published in April 2020, section 8.5.3.2.1] for welded austenitic stainless steel spent fuel storage canisters that are examined using progressive, multiple layer PT examinations in lieu of a volumetric examination NDE method that is required by ASME section III, subsection NB.

Based on the above reviews, the licensee assumed a weld strength factor of 0.8. The licensee provided a structural analysis that showed MPC 234 would meet the requirements for the structural analysis as required by ASME B&PV Code, section III, subsection NB, using this weld strength reduction factor.

Evaluation Findings of Materials Review

The NRC staff reviewed the information provided by the licensee including: (1) the licensee's comparisons of the weld strength reduction factors based on the NDE examination requirements contained in ASME B&PV Code section VIII, subsection ND of section III, and subsection NG of section III; (2) the specific requirements in those ASME B&PV Code sections; (3) the guidance in, and applicability of ISG 15; and (4) the information provided by the licensee regarding the weld repair procedures and post-weld repair NDE results.

The NRC staff determined that, although the weld strength reduction factors specified in the ASME B&PV Code sections cited by the licensee are not specifically applicable to the Holtec HI-STORM FW MPC 234, which was approved using the design and construction requirements in ASME B&PV Code, section III, subsection NB, the values of the weld strength reduction factors specified in these ASME B&PV Code are conservative with respect to the possible weld strength reduction for MPC 234 because: (1) approximately 1/4 in. of the 1/2 in. weld was removed in the 10.608 in. long 3-to-1 tapered section of the repair excavation that was not examined by RT after second repair; (2) the 10.608-in. weld that remained after excavation at this 3-to-1 tapered section was volumetrically examined by RT prior to excavation; (3) 100 percent of the repair weld section was successfully examined by PT both after excavation and repair; (4) approximately 75 percent of the approximate 10.608 in. repair weld section was examined using RT since it was a partial excavation of only 1/4 in. depth with 3-to-1 taper; and (5) in total, more than 98 percent of the shell-to-shell weld was examined using RT and 100 percent was examined using PT.

The NRC staff reviewed the guidance in ISG-15 which states that, if progressive surface examinations such as multiple layer PT or magnetic particle testing (MT) is used for a spent fuel storage canister closure lid weld in lieu of a volumetric examination, a strength reduction factor of 0.8 is to be imposed on the weld design to account for imperfections or flaws that may have been missed by the progressive surface examinations. The NRC staff found that, although the guidance for the use of the weld strength reduction factor in ISG 15 was not intended to be applied for a shell-to-shell weld of the MPC, the value of the weld strength reduction factor from ISG-15 would be conservative for the MPC 234 shell-to-shell weld, for the same reasons

provided for the review comparisons of the weld strength reduction factors from the ASME B&PV Code sections, as cited by the licensee.

The NRC staff assessed the weld strength reduction factor used for MPC 234 considering the MPC materials and the design of the shell-to-shell weld using conservative assumptions. The NRC staff postulated that the portion of the repaired area of the weld that was not subjected to the post weld repair RT examination includes a buried weld flaw since the weld prep and final were both examined only by PT. In addition, the NRC staff assumed a worst-case flaw size when considered information provided by the licensee on the results of the initial RT of the shell-to-shell weld, the profile of the weld excavation, the weld repair process, as well as the NDE conducted after excavation and again after the weld repair was completed. Hence, the NRC's staff's review focused on the limited section of the weld at the 3-to-1 tapered location, which was repaired and then not examined by RT, using a conservative estimation of the size of a possible buried weld flaw.

The NRC staff made a conservative assumption of a worst-case flaw size because: (1) the weld repair procedure with the multiple pass manual GTAW was developed to facilitate a weld repair, provide more control over weld deposition, and minimize the introduction of weld flaws; (2) the 10.608-in. long weld had a depth of 1/4 in. (partial excavation for defect removal) with sound weld metal as backing, based on the initial RT results prior to excavation, and the PT results prior to the weld repair; (3) the post repair weld examinations using PT and RT did not show any relevant indications that would require another excavation and repair; (4) any weld repair flaw present in the non-examined RT weld repair section would be limited to the dimensions of the weld repair in the partial excavation area of the overall weld; (5) based on the post repair PT results, any flaw introduced during repair welding would be embedded in the weld with low stress concentration of little to no significance to structural performance or the confinement function of the MPC; and (6) the analysis was based on the minimum weld size of the MPC shell-to-shell weld.

Using the worst-case flaw size, the NRC staff independently used the ASME B&PV Code to determine that, for the entire shell-to-shell weld, the weld strength reduction factor which would be applied to the structural analysis of such a joint, would be at least 0.825 based on: (1) the combination of RT and PT examination for the shell-to-shell weld; (2) the MPC shell is sufficiently thick to prevent significant stress concentrations for relatively small buried weld flaws; (3) the MPC shell-to-shell welds are all high toughness materials that are not susceptible to brittle fracture; and (4) MPC 234 successfully passed a helium leakage test during factory acceptance testing and a hydrostatic pressure test during the loading operations.

The NRC staff's independent analysis determined that a stress reduction factor of 0.825 was appropriate using conservative assumptions. Therefore, the staff finds that the strength reduction factor of 0.8 used by the licensee is conservative and sufficient to account for the possible presence of non-surface breaking flaws in the portion of the repair weld that was not subjected to post repair volumetric examination.

Based on the above, the NRC staff finds that there is adequate material performance of the components important to safety for MPC 234. Therefore, the staff determined that the exemption request for MPC 234, from a materials perspective, is acceptable.

5.3 Structural Evaluation

The staff's structural review focused on the re-analysis of the MPC longitudinal weld, as detailed in Enclosure 3 of the August 4, 2022, exemption request, "Response to Request for Technical Information, RRTI-3087-007, Revision 2," and RRTI-3087-0007, Revision 4, as provided in TVA's supplemental letter dated January 3, 2024, to verify that the safety function of the MPC is maintained after considering a weld strength reduction factor to the allowable stress values used as design criteria. After the MPC was put in service, Holtec identified that a section of this second weld repair did not have supporting documentation of a post-repair RT. As discussed above, the licensee applied a weld strength reduction factor in its analysis to account for imperfections or flaws the presence of which, for an approximately 11 in. longitudinal weld portion of the MPC-37 Serial No. 234, could not be ruled out in the absence of a post repair RT. The longitudinal weld is located approximately between the 10 in. and 30 in. elevation from the bottom of the MPC baseplate.

Re-Analysis of the MPC Shell Weld

The HI-STORM FW FSAR, HOLTEC Report No. HI-2114830, table 10.1.4, "HI-STORM FW MPC NDE Requirements," establishes the weld acceptance criteria used to demonstrate that the weld will perform its safety function under all loading conditions is as defined in ASME B&PV Code, section III, subsection NB. In accordance with appendix B, section 3.3, "Codes and Standards," of CoC No. 1032, the HI-STORM FW MPC-37 must meet the 2007 Edition of the ASME B&PV Code. The ASME B&PV Code section III, subsection NB, states, in part, that "examination of a weld repair shall be repeated as required for the original weld." For original welds, it is required that 100 percent of the shell-to-shell weld seam joining the shell of the canister be examined by RT. Since the unexamined portion of the repair weld is not in conformance with the ASME B&PV Code requirements described in the CoC, the licensee applied a weld strength reduction factor in its design analysis to compensate for the missing RT examination of the repair. The licensee's structural evaluation seeks to demonstrate that the use of the affected MPC-37 Serial No. 234 will not adversely impact its structural integrity with the applied weld strength reduction factor.

As discussed in the NRC staff's materials evaluation of the exemption request, the NRC staff determined that the strength reduction factor of 0.8 imposed on the weld design (i.e., an overall 20 percent reduction in the allowable stress) is adequate to account for potential imperfections or flaws that may have been missed from an incomplete RT examination after repairs to MPC 37 Serial No. 234 were completed. In accordance with tables 2.2.1 and 4.4.5 in the HI-STORM FW FSAR, the licensee established the following governing load cases for the safety evaluation of the MPC: [Case 1] the design condition with a 120 pounds per square in. gauge (psig) normal internal pressure only to bound short term normal operations, [Case 2] an accident condition with a 200 psig accident internal pressure, [Case 3] a short-term MPC lifting operation (during stack-up) with a 120 psig operating internal pressure plus weight of the contents, [Case 4] an off normal condition that considers a 120 psig off normal internal pressure plus bounding off normal temperature contours, and [Case 5] a design basis short term operation with a 120 psig internal pressure plus bounding short term operation temperature contours. Enclosure 3 of the exemption request, RRTI-3087-007, "Safety Evaluation of Missing RT on MPC Longitudinal Shell to Shell Weld," [non-public] reevaluated these load cases using the weld strength reduction factor. The reduction factor is used to effectively reduce the allowable stress intensities that were considered in the original structural analysis of the MPC and to determine new safety factors for each of the load cases at the affected region of the MPC shell. The new

safety factors are used to demonstrate that the safety function of the MPC is maintained after considering the non-conforming condition.

Figures 1.1 through 1.5 provides the resultant stresses for each of the load cases described above at the section of the shell in question. During its review, the NRC staff noted that the section of the shell in question is a region where resultant stresses are highly transitional, as illustrated in Figure 1.5 of calculation no. HI-2094418, revision 20, "Structural Calculation Package for HI-STORM FW System." The resultant stresses in this section of the shell can vary significantly with minor change in position along the longitudinal direction (i.e., variations are in orders of magnitude). After considering the structural evaluation originally provided in the exemption request, the NRC staff determined that additional information was necessary because: (1) sufficient information was not available to clearly correlate and validate the maximum stress results provided for the exemption request, and (2) the analysis did not consider accident conditions to help demonstrate that the MPC-37 Serial No. 234 remains capable of maintaining its safety function after a postulated accident, which resulted in two RAI questions (i.e., RAI-1 and RAI-2), as documented in NRC's RAI letter dated November 8, 2023. The licensee responded to the NRC staff's RAI by letter dated January 3, 2024.

In its January 3, 2024, response to the NRC's staff's RAI, regarding RAI-1's request for additional information regarding data correlation, TVA provided a correlation of stresses in the affected location in Revision 4 of calculation no. RRTI-3087-0007. Enclosure 4 of the RAI response also provided the coordinates of all the nodes included in the stress plots presented in RRTI-3087-0007 for the affected region. Therefore, the licensee concluded that the additional information it provided demonstrates that the nodes analyzed for the exemption request start from approximately 9 in. and end at approximately 31 in. from the bottom of the MPC.

During its evaluation of the licensee's response to RAI-1, the NRC staff noted that Enclosure 4 shows that the plotted region considered in the analysis is in the range between 8.94 in. and 31.25 in., which bounds the affected longitudinal weld section located between approximately 10 in. and 30 in. from the bottom of the MPC. The NRC staff finds the licensee's response acceptable because the analyzed stress intensities correspond to the affected weld region.

In its response to RAI-2, regarding analysis considering accident conditions, dated January 3, 2024, the licensee stated that the resultant stresses from the existing non mechanistic tipover analysis (Holtec Report HI-2094353) were used to calculate the new safety factors using the same weld strength reduction factor established for the non-conforming testing condition. The licensee concluded that all calculated safety factors remained greater than 1.0. The licensee revised calculation no. RRTI-3087-0007 (Revision 4) to include this analysis.

During its evaluation of the licensee's response to RAI-2, the NRC staff noted that the licensee revised its safety evaluation for the missing RT on MPC longitudinal shell-to-shell weld to include a re-analysis of the non-mechanistic tipover with the proposed weld strength reduction factor. The NRC staff finds the licensee's response acceptable because the analysis results demonstrates that the calculated safety factors remain greater than 1.0 after considering the reduction factor.

Based on the above, the NRC staff considers that the licensee's analysis adequately demonstrated that the MPC shell maintains a safety factor above 1.0 for all loading conditions, and that sufficient design margin remains to accommodate the resultant stress from each loading condition, even with the reduced stress allowable used to account for potential imperfections or flaws in the repaired weld.

Evaluation Findings of Structural Review

The NRC staff reviewed the licensee's analysis detailed in Enclosure 3 of the August 4, 2022, exemption request, "Response to Request for Technical Information, RRTI-3087-007, Revision 2," and RRTI-3087-0007, Revision 4, as provided in TVA's supplemental letter dated January 3, 2024, for the MPC shell-to-shell weld. Based on the review, the NRC staff finds that a safety factor greater than 1.0 is maintained (i.e., calculated stresses remain below the allowable stress intensities with the reduction factor) for all normal, off-normal, and accident conditions after the stress allowable for each load case is reduced by 20 percent, to account for imperfections or flaws that may be missed due to the non-conforming weld inspection.

Based on the above, the NRC staff finds that the licensee demonstrated that the shell-to-shell weld for MPC 37 Serial No. 234, loaded under CoC No. 1032, Amendment No. 3, is capable of maintaining structural integrity and performing intended safety function under normal, off-normal, and accident conditions. Therefore, the NRC staff concludes that the structural properties of MPC 37 Serial No. 234, as addressed in the exemption request, remain in compliance with 10 CFR Part 72, and therefore, from a structural perspective, this exemption, is acceptable.

5.4 RECORD KEEPING PROVISIONS EVALUATION

As noted above, the licensee requested an exemption from the requirements in 10 CFR 72.154(b) and 72.174 to have available documentary evidence that material and equipment conform to the procurement specifications prior to installation or use of the material and equipment and to retain or have available this documentary evidence for the life of the ISFSI or spent fuel cask. The records covered by the requested exemption are those detailing the results for the RT discussed above that was not performed. Therefore, no such records exist rendering compliance with the records keeping requirements an impossibility. Because the staff has determined that the licensee has adequately demonstrated the safety of the MPC without the required inspection of the weld, then the staff has also determined that there is no safety impact in exempting the licensee from the associated record keeping requirements.

5.5 CONCLUSION OF SAFETY REVIEW

As described above, based on staff's evaluation of information provided by the licensee, the NRC staff determined that, as to the confinement evaluation, the proposed loading configuration does not impact the criticality control, shielding, or thermal design functions of the loaded MPC. Moreover, the staff determined that, as to the materials evaluation, the analysis indicated adequate material performance of the components important to safety for MPC 234. The NRC staff also determined that the licensee demonstrated that the specific weld in question can maintain structural integrity and perform the intended safety function under normal, off-normal, and accident conditions. Because the licensee has demonstrated the MPC in question continues to meet the standards of reasonable assurance of adequate protection of public health and safety, the NRC staff has determined that granting the exemption to 10 CFR sections 72.212(a)(2); 72.212(b)(3); 72.212(b)(5)(i); 72.212(b)(11) and 72.214, regarding a lack of a RT examination of a weld on MPC 234, does not endanger life or property or the common defense and security.

If not performing the RT does not endanger life or property or the common defense and security, it follows that not retaining records of those test results would also not endanger life or

property or the common defense and security. Therefore, the NRC staff also finds that the requested exemption from 10 CFR 72.154(b) and 72.174, if granted, would not endanger life or property or the common defense and security.

OTHERWISE IN THE PUBLIC INTEREST

In considering whether granting the requested exemption is in the public interest, the NRC staff considered the alternative of not granting the requested exemption. If the requested exemption were not granted, in order to comply with the CoC, MPC-37 Serial No. 234 would need to be opened and unloaded, the contents loaded in a new MPC, and the new MPC welded and tested. This option would entail a higher risk of canister handling accidents, and additional personnel exposure. This option would also generate additional radioactive contaminated material and waste from operations. For example, the lid would have to be removed, which would generate cuttings from removing the weld material that could require disposal as contaminated material. This radioactive waste would be transported and ultimately disposed of at a qualified low-level radioactive waste disposal facility, potentially exposing it to the environment. Based on the above, granting the requested exemption would reduce the opportunity for risks of canister handling accidents, additional personnel exposure, as well as reduce the opportunity for a potential release of radioactive material, compared to the alternative to the proposed action, as there will be no operations involving the opening of the MPC which confines the spent nuclear fuel. It will also generate less radioactive waste for disposal. Therefore, the requested exemption is otherwise in the public interest.

6.0 ENVIRONMENTAL CONSIDERATION

The NRC staff also considered in the review of this exemption request whether there would be any significant environmental impacts associated with the exemption. The NRC staff determined that this proposed action fits a category of actions that do not require an environmental assessment or environmental impact statement. Specifically, the requested exemption meets the categorical exclusion in 10 CFR 51.22(c)(25).

Granting an exemption from 10 CFR 72.212(a)(2), 10 CFR 72.212(b)(3), 10 CFR 72.212(b)(5)(i), 10 CFR 72.212(b)(11), and 10 CFR 72.214, would relieve the licensee from the inspection requirement found in CoC No. 1032, Attachment B, TS section 3.3, "Codes and Standards." With this requested exemption from these regulations, the licensee would be exempt from the requirement to repeat volumetric examination as required for the original weld on an approximately 7.5-in. portion of the repaired weld joining the canister baseplate to the canister shell of the HI-STORM FW MPC-37 Serial No. 234. Granting an exemption from 10 CFR 72.154(b) and 72.174 relieves the licensee from the recordkeeping requirements associated with retaining and having available documentary evidence of a complete volumetric examination of the subject weld. A categorical exclusion for inspection requirements is provided under 10 CFR 51.22(c)(25)(vi)(C), and a categorical exclusion for recordkeeping requirements is provided under 10 CFR 51.22(c)(25)(iv)(A). In both cases, the criteria in 10 CFR 51.22(c)(25)(i)-(v) must also be satisfied.

In its review of the exemption request, the NRC staff determined, that, in accordance with 10 CFR 51.22(c)(25): (i) granting the exemption does not involve a significant hazards considerations because granting the exemption neither reduces a margin of safety, creates a new or different kind of accident from any accident previously evaluated, nor significantly increases either the probability or consequences of an accident previously evaluated; (ii) granting the exemption would not produce a significant change in either the types or amounts of

any effluents that may be released offsite because the requested exemption neither changes the effluents nor produces additional avenues of effluent release; (iii) granting the exemption would not result in a significant increase in either occupational radiation exposure or public radiation exposure, because the requested exemption neither introduces new radiological hazards nor increases existing radiological hazards; (iv) granting the exemption would not result in a significant construction impact, because there are no construction activities associated with the requested exemption; and (v) granting the exemption would not increase either the potential for or consequences from radiological accidents because, even with the exemption, the canister will still be bounded by the FSAR analysis and will remain leak tight, and the exemption creates no new accident precursors at the SQN ISFSI.

Accordingly, the requested exemption meets the criteria for a categorical exclusion in 10 CFR 51.22(c)(25)(vi)(A) and (C).

7.0 CONCLUSION

Based on the foregoing considerations, the NRC staff has determined that, pursuant to 10 CFR 72.7, the exemption is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest. Therefore, the NRC grants the licensee an exemption from the requirements of 10 CFR 72.212(a)(2), 10 CFR 72.212(b)(3), 10 CFR 72.212(b)(5)(i), 10 CFR 72.212(b)(11), 10 CFR 72.214, 10 CFR 72.154(b), and 10 CFR 72.174 with regard to: (1) meeting the requirement to repeat volumetric examination as required for the original weld on an approximately 7.5-in. portion of the repaired weld in conformance with section III, subsection NB, of the ASME B&PV Code, 2007 Edition, and (2) maintaining and having available documentary evidence of the test for the service life of the canister. All other relevant requirements shall be met.