Request for Supplemental Information (non-proprietary)

By letter dated April 9, 2020, TN Americas LLC submitted to the U.S. Nuclear Regulatory Commission (NRC) a renewal application for the TN-68 Dry Storage Cask System, Certificate of Compliance No. 1027, pursuant to the requirements of Part 72 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 72).

This request for supplemental information (RSI) identifies additional information needed by the NRC staff in connection with its review of this renewal application. Each RSI below describes information needed by the staff to complete its acceptance review determination of the subject application.

<u>Materials RSI</u>

RSI-M1. Provide supplemental information that addresses the differences between the cladding alloys to demonstrate how the M5 cladding included in the Department of Energy (DOE) High Burnup Dry Storage Cask Research and Development Project can be used as a surrogate for the high burnup Zircaloy-2 clad fuel in the TN-68 Dry Storage Cask.

The supplemental information should address the differences between the high burnup Zircaloy-2 cladding and the M5 in the following areas: (1) the potentially higher hydrogen content in the cladding, (2) the higher fuel burnup, and (3) the lower threshold stress for reorientation. In addition, the supplemental information should address the maximum cladding temperatures for the TN-68 dry storage cask and the temperatures measured in the DOE High Burnup Dry Storage Cask Research and Development Project to show how it can be used as a surrogate. Additional information is provided below.

As background, the CoC No. 1027 Renewal Application High Burnup Fuel Aging Management Program Section 4.5.1 states:

> *The parameters of the surrogate demonstration program are applicable to the Design bases HBU fuel, as:*
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> - *maximum allowed burnup of the design-bases HBU fuel (i.e., 60.0 GWd/MTU) is on the order of the nominal burnup of the fuel in the surrogate demonstration program (i.e., 58 GWd/MTU),*
> - *the similar cladding texture between Zircaloy-2 and M5 of recrystallized annealed (RXA) and higher hoop stresses in the M5 PWR fuel cladding when compared to Zircaloy-2 BWR fuel cladding, M5 PWR fuel cladding can be considered an enveloping surrogate for Zircaloy-2 BWR fuel cladding, and*
> - *the cladding temperature of the HBU fuel is limited to the values in ISG-11 and the cladding temperature in the surrogate demonstration program is as close to the ISG-11 limits as practicable.*

The staff notes that, in addition to cladding texture and hoop stress, cladding hydrogen content as a result of fuel burnup, threshold stress, and temperature are important factors for hydride reorientation in spent fuel cladding. The staff is seeking information regarding the differences

between the high burnup Zircaloy-2 cladding and the M5 in the following areas:

1. A comparison of Zircaloy-2 and M5 cladding alloys in NUREG-2214 Section 3.6.1 shows that above 45 gigawatt-days per metric ton of uranium (GWd/MTU), the hydrogen uptake in Zircaloy-2 cladding is greater than the hydrogen uptake for M5 cladding (NRC, 2019), which leads to greater hydrogen content. In addition, the Zircaloy-2 cladding appears to have more variability in hydrogen uptake cladding when the fuel burnup exceeds 50 GWd/MTU (Geelhood and Beyer 2011) compared to M5 with a similar burnup (Hanson et al. 2016, Figure 3-11).
2. The actual maximum burnup for the M5 cladding in the DOE High Burnup Dry Storage Cask Research and Development Project is 53.5 GWd/MTU (Hanson et al. 2016 FCRD-UFD-2016-000063, Figure 6-1), whereas the maximum allowed burnup for the Zircaloy-2 cladding in the TN-68 Dry Storage Cask is 60 GWd/MTU as stated in the CoC No. 1027 Amendment 1 Technical Specifications (ML073050262).
3. A review of data in NUREG-2214 Section 3.6.1 indicates that the threshold stress for Zircaloy-2 is reported to be as low as 70 megapascals (MPa) which is substantially lower than the value of 90 MPa reported for the other Zirconium alloys used in fuel cladding (NRC 2019).
4. The DOE High Burnup Dry Storage Cask Research and Development Project uses a TN-32 Dry Storage Cask. The maximum measured temperature during loading and cask placement for the DOE High Burnup Dry Storage Cask Research and Development Project was 237°C [459°F] (Hanson 2018). The maximum fuel cladding temperature for the TN-68 dry storage cask is 343°C [649°F] as stated in Table 3-3 of the TN-68 renewal application (ML20100F295).

This information is needed to determined compliance with 10 CFR 72.240(c)(3).

<u>References</u>

Geelhood, K., and C. Beyer, “Hydrogen Pickup Models for Zircaloy-2, Zircaloy-4, M5™ And ZIRLO™,” Paper T2-011, 2011 Water Reactor Fuel Performance Meeting, Chengdu, China, Sept. 11-14, 2011 (ML12093A469).

Hanson, B.D., S.C. Marschman, M.C Billone, J. Scaglione, K.B. Sorenson, S.J. Saltzstein, “High Burnup Spent Fuel Data Project Sister Rod Test Plan Overview,” FCRD-UFD-2016-0000632016, PNNL-25374, April 29, 2016.

Hanson, B., “High Burnup Spent Fuel Data Project & Thermal Modeling and Analysis,” Presentation at the NWTRB Meeting, Albuquerque, NM October 24, 2018.

U.S. Nuclear Regulatory Commission, NUREG-2214, “Managing Aging Processes in Storage (MAPS) Report”, July 2019 (ML19214A111).