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10 CFR 72.7

August 13, 2012

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Duke Energy Carolinas, LLC
Oconee Nuclear Station, Units 1, 2, and 3
Docket Nos. 72-40, 50-269, 50-270, 50-287
Request for Exemption from Certain Requirements of
10 CFR 72.212(a)(2), 72.212(b)(5), 72.212(b)(11) and 72.214

References:
(1) NRC Certificate of Compliance for Spent Fuel Storage Casks Issued to Transnuclear, Inc., Certificate No. 1004, Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Amendment No. 9, Effective Date April 17, 2007.

(2) Transnuclear letter dated February 9, 2011, "Application for Amendment 13 to Standardized NUHOMS® Certificate of Compliance No. 1004 for Spent Fuel Storage Casks, Revision 0."

(3) NRC letter dated February 14, 2012, to Mr. Donis Shaw, Transnuclear Licensing Manager, "First Request for Additional Information for Review of Amendment No. 13 to the Standardized NUHOMS® System (TAC NO. L24519)."

Duke Energy Carolinas, LLC (Duke Energy) requests U. S. Nuclear Regulatory Commission (NRC) approval of an exemption to certain requirements of 10 CFR 72.212(a)(2), 72.212(b)(5), 72.212(b)(11) and 72.214 pursuant to 10 CFR 72.7. The regulations require, in part, compliance to the terms and conditions of the NUHOMS® Certificate of Compliance (CoC) 1004 (Reference 1). The CoC conditions require the general licensee to meet the requirements of the Technical Specifications (TS) for the NUHOMS® storage system (Attachment A to the CoC).

This requested exemption pertains to Technical Specification (TS) 1.2.1, "Fuel Specifications," and the "Zircaloy-clad" requirement in the following associated tables:

- Table 1-1i, "PWR Fuel Specification for Fuel to be Stored in the Standardized NUHOMS®-24PHB DSC."
- Table 1-2n, "PWR Fuel Qualification Table for Zone 1..."
- Table 1-2o, "PWR Fuel Qualification Table for Zone 2..."
- Table 1-2p, "PWR Fuel Qualification Table for Zone 3..."

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A detailed discussion of this exemption request is provided in the Enclosure and Attachment to this letter. Duke Energy believes this exemption is justified and will reduce the risk of substantial exposure during loading operations of the NUHOMS® storage system at Duke Energy's Oconee Nuclear Station (ONS).

Loading and storage of the NUHOMS® -24PHB System under the provisions of the exemption, if approved, will be consistent with elements of a pending license amendment request submitted by Transnuclear, Inc. (Reference 2). However, based on the current NRC review schedule (Reference 3), approval of the amendment is not expected until early 2013.

Duke Energy requests NRC approval of this exemption request by December 31, 2012, to support a loading campaign from the ONS Unit 1 and 2 spent fuel pool planned to begin in early January 2013.

Please note that NRC approval of the aforementioned CoC amendment (Reference 2) would obviate the need for this exemption. However, based on discussion with the NRC Staff, it is not anticipated that the license amendment will be approved and effective in time to support Duke Energy's anticipated loading schedule; hence, this exemption is necessary.

The exemption would continue to apply to all NUHOMS® -24PHB Systems loaded under CoC Amendment No. 9 (Reference 1) (up to 10 more loadings to complete Phase 6 of ONS's Independent Spent Fuel Storage Installation (ISFSI)); however, following NRC approval and subsequent implementation at ONS of Amendment No. 13 (Reference 3), the exemption would not be required for future -24PHB System loadings.

There are no regulatory commitments contained within this exemption request.

If you have any questions or require additional information, please contact Stephen C. Newman, Senior Engineer, Oconee Nuclear Station Regulatory Affairs Group, at (864) 873-4388.

Sincerely,

Thomas D. Gray for

T. P. Gillespie, Jr.

Enclosure
Attachment

xc: w/enclosure/attachment

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Enclosure

Request for Exemption from Certain Requirements of Title 10 of Code of Federal Regulations Part 72.212(a)(2), 72.212(b)(5), 72.212(b)(11) and 72.214

1. Request for Exemption

Duke Energy hereby requests an exemption from certain requirements of 10 CFR 72.212(a)(2), 72.212(b)(5), 72.212(b)(11) and 72.214 that require compliance with the terms and conditions of the NUHOMS® CoC (Reference 1) (Note: "References" in this enclosure refer to Section 7.0 of this enclosure.) This exemption, if approved, would apply to all -24PHB Systems loaded under CoC No. 1004, Amendment No. 9 (up to 10 more loadings to complete Phase 6 of ONS's Independent Spent Fuel Storage Installation (ISFSI)); however, the exemption would not be required for future cask loadings following NRC approval and subsequent implementation at ONS of the license amendment proposed by Transnuclear (Reference 2).

2. Background

The NUHOMS® system provides for the horizontal, dry storage of canisterized spent fuel assemblies (SFAs) in a concrete horizontal storage module (HSM). The cask storage system components for NUHOMS® consist of a reinforced concrete HSM and a dry shielded canister (DSC) containment vessel with an internal basket assembly which holds the SFAs.

The HSM is a low profile, reinforced concrete structure designed to withstand all normal condition loads as well as the abnormal condition loads created by earthquakes, tornadoes, flooding, and other natural phenomena. The HSM is also designed to withstand abnormal condition loadings postulated to occur during design basis accident conditions such as a complete loss of ventilation.

The structural features of the DSC design depend, to a large extent, on the postulated design basis transfer cask drop accident. The DSC shell, the redundant closures on each end, and the DSC internals are designed to ensure that the intended safety functions of the system are not impaired following a postulated transfer cask drop accident. The limits established for equivalent decelerations due to a postulated drop accident are intended to be bounding. They envelop a range of conditions such as the transfer cask handling operations, the type of handling equipment used, the transfer cask on-site transport route, the maximum feasible drop height and orientation, and the conditions of the impacted surface.

Each NUHOMS® system model type is designated by NUHOMS®-XXY. The two digits (XX) refer to the number of fuel assemblies stored in the DSC, and the character (Y) is a P for PWR, or B for BWR, to designate the type of fuel stored. A fourth character (T) is added, if applicable, to designate that the DSC is intended for transportation in a 10CFR71 approved package. The number of HSMs to be erected at any one time depends on individual plant discharge rates and storage capacity needs, and will be addressed by the licensee.

Certificate of Compliance 1004, Amendment 9 (Reference 1) conditions require the general licensee to meet the requirements of the Technical Specifications (TS) for the NUHOMS® System (Attachment A to the Certificate of Compliance). TS 1.2.1, "Fuel Specifications," and following associated tables specify requirements for the fuel assemblies to be loaded in the 24PHB System's dry shielded canister (DSC):

- Table 1-1i, "PWR Fuel Specification for Fuel to be Stored in the Standardized NUHOMS®-24PHB DSC."
- Table 1-2n, "PWR Fuel Qualification Table for Zone 1..."
- Table 1-2o, "PWR Fuel Qualification Table for Zone 2..."
- Table 1-2p, "PWR Fuel Qualification Table for Zone 3..."

Duke Energy requests an exemption from the "Zircaloy clad" verbiage requirement in TS Tables 1-1i, 1-2n, 1-2o, and 1-2p (the actual TS Tables are shown in an Attachment to this Enclosure). This requirement, generally understood to refer to Zircaloy-2 or Zircaloy-4 cladding, precludes the storage of Babcock and Wilcox (B&W) Mark B11 and Mark B11A fuel assemblies which have M5 cladding[1] (Reference 3).

In lieu of this requirement, Duke Energy is requesting to apply a more generic interpretation of the "Zircaloy clad" requirement depicted in these tables that includes the B&W M5-cladded fuel assemblies described previously.

3. Justification for Granting the Exemptions

The specific requirements for granting exemptions to 10 CFR Part 72 licensing requirements are set forth in 10 CFR 72.7, "Specific Exemptions," which states: "The Commission may, upon application by any interested person or upon its own initiative, grant such exemptions from the requirements of the regulations in this part 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."

The following factors are relevant to this exemption request:

A. The ONS ISFSI regulations cited in this exemption request, 10 CFR 72.212(a)(2), 72.212(b)(5), 72.212(b)(11) and 72.214, are contained within 10 CFR Part 72 of the Commission's regulations. The Commission has the legal authority to issue exemptions for the ONS ISFSI as provided in §72.7.

B. The requested exemption items introduce no undue risk to the public health and safety. The NRC has previously considered acceptability of cladding types for spent fuel storage and determined a broader limitation is warranted. This is reflected in Interim Staff Guidance (ISG) 11, Revision 3 (Reference 4) which provides technical review guidance to materials reviewers and specifies criteria that should be met. The following statements excerpted from ISG-11, Revision 3 are relevant:

   i. *"The following acceptance criteria and review procedures are designed to provide reasonable assurance that the spent fuel is maintained in the configuration that is analyzed in the storage SARs. These criteria are applicable to* ***all commercial spent fuel burnup levels and cladding materials*** *[emphasis added]."*

[1] M5 is AREVA's proprietary variant of Zr1Nb which was approved by the USNRC for PWR reactors (Reference 3).

ii. "The staff believes that this guidance will allow ***all commercial spent fuel that is currently licensed by the Nuclear Regulatory Commission (NRC) for commercial power plant operations*** *[emphasis added] to be stored in accordance with the regulations contained in 10 CFR Part 72."*

Since B&W 15x15, Mark B11 and Mark B11A fuel assembly designs are both licensed for operation in ONS's reactors with M5 cladding material, there is reasonable assurance the spent fuel will be maintained in the configuration analyzed in the NUHOMS® SAR.

C. The requested exemption is consistent with elements of a pending license amendment request submitted by Transnuclear, Inc. (Reference 2) that is currently under NRC review. In that request, the "Zircaloy clad" restriction has been deleted from the Physical Parameters sections of Table 1-1i, "PWR Fuel Specifications for Fuel to be Stored in the Standardized NUHOMS® -24PHB DSC", and "Zircaloy clad" has been replaced by "zirconium alloy" in Tables 1-2n, 1-2o, and Tables 1-2p which specify cooling times for Zones 1,2, and 3, respectively.

D. The requested exemption items are consistent with providing for the common defense and security. The ONS ISFSI will continue to be physically protected under Duke Energy's Physical Security Plan, and the exemption request does not affect the confinement of the spent fuel stored at the ISFSI facility.

E. Duke Energy seeks this exemption from the cited Commission rules to allow loading spent fuel into the NUHOMS® storage system with minimum radiological exposure to the workers during handling, preparation, and transfer operations.

Absent the ability to load Mark B11 and Mark B11A fuel designs, ONS will exhaust its current inventory of older "Zircaloy" fuel designs during the 2013 loading campaign from the ONS 1 and 2 spent fuel pool. Some of the older "zircaloy" fuel assemblies are needed for subsequent loadings after Amendment 13 is approved in order to meet the decay heat zoning requirements. If these assemblies are not available, the NUHOMS® canisters will likely have to be "short-loaded" (i.e., loaded with fewer than the allowed 24 spent fuel assemblies). This, in turn, will necessitate additional NUHOMS® loadings resulting in additional worker exposure.

4. Conclusion

Duke Energy concludes that the requested exemption from certain requirements of the 10 CFR 72.212(a)(2), 72.212(b)(5), 72.212(b)(11) and 72.214 regulations, allowing storage of M5 cladding associated with B&W 15x15, Mark B11 and Mark B11A fuel designs, is justified. Such an exemption meets the specific exemption requirements of 10 CFR 72.7. The requested exemption item is authorized by law, will not endanger life or property, and is consistent with the common defense and security. The requested exemption is consistent with elements of a license amendment request that is currently under NRC review (Reference 2). Furthermore, granting this exemption will result in fewer additional NUHOMS® loadings and reduced radiological exposure due to the

reduced quantity of NUHOMS® storage units at the ONS Independent Spent Fuel Storage Installation.

5. Environmental Consideration

Pursuant to the provisions of 10CFR 72.7, Duke Energy is requesting an exemption, consisting of two elements, from certain requirements under the 10 CFR 72.212(a)(2), 72.212(b)(5), 72.212(b)(11) and 72.214 regulations. If the proposed exemption is approved, NUHOMS® canisters will not have to be "short-loaded" in future loading campaigns (i.e., loaded with fewer than the allowed 24 spent fuel assemblies). This, in turn, will result in fewer additional NUHOMS® loadings and reduced radiological exposure due to the reduced quantity of NUHOMS® storage units at the ONS Independent Spent Fuel Storage Installation.

Additionally, the proposed exemption does not affect the type of radioactive effluents or the quantity or type of nonradioactive effluents entering the environment.

Therefore, there is no significant environmental effect associated with the proposed exemption.

6. Precedent

Currently, other NUHOMS® storage systems included in CoC No. 1004 permit storage of fuel designs with cladding other than "Zircaloy." These include the similar NUHOMS® -24PTH System (Reference 1, Table 1-1i) and the NUHOMS® -32PTH1 System (Reference 5, Table 1-1aa).

7. References

1. NRC Certificate of Compliance for Spent Fuel Storage Casks Issued to Transnuclear, Inc., Certificate No. 1004, Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Amendment No. 9, Effective Date April 17, 2007.
2. Transnuclear letter dated February 9, 2011, "Application for Amendment 13 to Standardized NUHOMS® Certificate of Compliance No. 1004 for Spent Fuel Storage Casks, Revision 0."
3. NRC letter dated February 4, 2000, Revised Safety Evaluation (SE) for Topical Report BAW-10227P: "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel" (TAC No. M99903).
4. Spent Fuel Project Office, Interim Staff Guidance - 11, Revision 3, "Cladding Considerations for the Transportation and Storage of Spent Fuel," dated November 17, 2003.
5. NRC Certificate of Compliance for Spent Fuel Storage Casks Issued to Transnuclear, Inc., Certificate No. 1004, Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Amendment No. 10, Effective August 24, 2009.

Attachment

Applicable sections from Technical Specifications
Amendment No. 9

Table 1-1i
PWR Fuel Specification for Fuel to be Stored in the Standardized NUHOMS®-24PHB DSC

Title or Parameter	Specifications
Fuel	Only intact, unconsolidated B&W 15x15 (with or without BPRAs), WE 17x17, WE 15x15, CE 14x14, and WE 14x14 (all without BPRAs) Class PWR fuel assemblies or equivalent reload fuel manufactured by other vendor, with the following requirements
Maximum No. of Reconstituted Assemblies per DSC with Stainless Steel rods	4
Maximum No. of Stainless Steel Rods per Reconstituted Assembly	10
Maximum No. of Reconstituted Assemblies per DSC with low enriched uranium oxide rods	24
Physical Parameters (without BPRAs)	
Maximum Assembly Length (unirradiated)	165.785 in (standard cavity) 171.96 in (long cavity)
Nominal Cross-Sectional Envelope	8.536 in
Maximum Assembly Weight	1682 lbs
No. of Assemblies per DSC	≤ 24 intact assemblies
Fuel Cladding	Zircaloy-clad fuel with no known or suspected gross cladding breaches
Physical Parameters (with BPRAs)	
Maximum Assembly + BPRA Length (unirradiated)	171.96 in (long cavity)
Nominal Cross-Sectional Envelope	8.536 in
Maximum Assembly + BPRA Weight	1682 lbs
No. of Assemblies per DSC	≤ 24 intact assemblies
No. of BPRAs per DSC	≤ 24 BPRAs
Fuel Cladding	Zircaloy-clad fuel with no known or suspected gross cladding breaches
Nuclear Parameters	
Maximum Fuel Initial Enrichment	4.5 wt. % U-235
Maximum Initial Uranium loading per assembly	0.490 MTU
Allowable loading configurations for each 24PHB DSC	As specified in Figure 1-8 or 1-9
Burnup, Enrichment, and Minimum Cooling Time for Configuration 1 (Figure 1-8)	Table 1-2n for Zone 1 fuel; Table 1-2o for Zone 2 fuel; Table 1-2p for Zone 3 fuel
Burnup, Enrichment, and Minimum Cooling Time for Configuration 2 (Figure 1-9)	Table 1-2p for Zone 3 fuel
Minimum Cooling Time for BPRAs	5 years
Total Decay Heat per DSC	24 kW
Decay Heat Limits for Zone 1, 2 and 3 fuel	As specified in Figures 1-8 and 1-9.

Table 1-2n
PWR Fuel Qualification Table for Zone 1 with 0.7 kW per Assembly, Fuel With or Without BPRAs, for the NUHOMS®-24PHB DSC
(Minimum required years of cooling time after reactor core discharge)

BU (GWd/MTU)	Assembly Average Initial U-235 Enrichment (wt %)																								
	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5
10	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
15	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
20	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
25	[redacted]	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
28	[redacted]	[redacted]	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
30	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.5	6.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
32	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
34	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	8.0	8.0	8.0	8.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
36	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	9.0	9.0	9.0	9.0	9.0	9.0	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
38	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	10.5	10.5	10.5	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	9.5	9.5	9.5	9.5
39	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	11.5	11.0	11.0	11.0	11.0	11.0	11.0	11.0	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
40	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	12.0	12.0	12.0	12.0	12.0	12.0	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.0	11.0	11.0
41	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	13.0	13.0	13.0	13.0	13.0	13.0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.0	12.0	12.0
42	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	14.5	14.5	14.0	14.0	14.0	14.0	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.0	13.0	13.0
43	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	15.5	15.5	15.5	15.0	15.0	15.0	15.0	15.0	14.5	14.5	14.5	14.5	14.5	14.5	14.0	14.0
44	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	17.0	16.5	16.5	16.5	16.5	16.0	16.0	16.0	16.0	16.0	15.5	15.5	15.5	15.5	15.5	15.5
45	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	18.0	17.5	17.5	17.5	17.5	17.0	17.0	17.0	17.0	17.0	16.5	16.5	16.5	16.5
46	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	18.8	18.7	18.5	18.5	18.3	18.2	18.1	18.0	17.9	17.8	17.7	17.6	17.5	17.4
47	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	20.1	20.0	19.9	19.6	19.6	19.5	19.4	19.2	19.1	19.0	18.9	18.8	18.7	18.7
48	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	21.4	21.3	21.1	21.0	20.8	20.8	20.7	20.5	20.4	20.3	20.2	20.1	20.0	19.9
49	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	22.7	22.6	22.4	22.3	22.1	22.1	21.9	21.8	21.7	21.6	21.5	21.4	21.3	21.2
50	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	23.7	23.6	23.5	23.4	23.3	23.2	23.0	22.9	22.8	22.7	22.6	22.5
51	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	25.0	24.9	24.8	24.6	24.5	24.4	24.3	24.2	24.0	23.9	23.8	23.7
52	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	26.3	26.2	26.0	25.9	25.8	25.7	25.6	25.4	25.3	25.2	25.2	25.0
53	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	27.5	27.3	27.2	27.1	27.0	26.9	26.8	26.7	26.5	26.4	26.4	26.2
54	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	28.8	28.6	28.5	28.3	28.2	28.1	28.0	28.0	27.8	27.7	27.6	27.5
55	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	29.9	29.8	29.7	29.6	29.5	29.3	29.2	29.1	29.0	28.9	28.8	28.7

Not Analyzed

- BU = Assembly average burnup
- Use burnup and enrichment to lookup minimum cooling time in years. For fuel assemblies reconstituted with up to 10 stainless steel rods only, if the lookup cooling time is less than 9.0 years then a minimum cooling time of 9.0 years shall be used. Licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for during fuel qualification.
- Round burnup UP to next higher entry, round enrichments DOWN to next lower entry.
- Fuel with an initial enrichment greater than 4.5 wt.% U-235 is unacceptable for storage.
- Fuel with a burnup less than 10 GWd/MTU is acceptable for storage after 5-years cooling.
- Example: An assembly with an initial enrichment of 3.75 wt. % U-235 and a burnup of 46.5 GWd/MTU is acceptable for storage after a 19.5 years cooling time as defined by 3.7 wt. % U-235 (rounding down) and 47 GWd/MTU (rounding up) on the qualification table.
- See Figure 1-8 for a description of cases.
- For assemblies fuel reconstituted with Zircaloy clad uranium-oxide rods use the assembly average enrichment to determine the minimum cooling time.

Table 1-2o
PWR Fuel Qualification Table for Zone 2 with 1.0 kW per Assembly, Fuel With or Without BPRAs, for the NUHOMS®-24PHB DSC
(Minimum required years of cooling time after reactor core discharge)

BU (GWd/MTU)	Assembly Average Initial U-235 Enrichment (wt %)																								
	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5
10	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
15	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
20	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
25	[redacted]	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
28	[redacted]	[redacted]	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
30	[redacted]	[redacted]	[redacted]	[redacted]	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
32	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
34	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
36	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	5.5	5.5	5.5	5.5	5.5	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
38	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.0	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
39	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.5	5.5	5.5	5.5	5.5	5.5	5.5
40	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.5	6.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
41	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0
42	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	7.0	7.0	7.0	7.0	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
43	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	7.5	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.5	6.5	6.5	6.5
44	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
45	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	8.0	8.0	8.0	8.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.4
46	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	8.2	8.1	8.0	8.0	7.9	7.8	7.8	7.7	7.7	7.6	7.6	7.5	7.5	7.4
47	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	8.7	8.6	8.5	8.4	8.4	8.3	8.2	8.2	8.1	8.0	8.0	7.9	7.9	7.8
48	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	9.2	9.1	9.0	9.0	8.9	8.8	8.7	8.6	8.6	8.5	8.5	8.4	8.3	8.3
49	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	9.8	9.7	9.6	9.5	9.4	9.3	9.2	9.2	9.1	9.0	9.0	8.9	8.8	8.7
50	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	10.2	10.1	10.0	9.9	9.8	9.7	9.6	9.6	9.5	9.4	9.3	9.3
51	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	10.9	10.8	10.7	10.6	10.5	10.3	10.3	10.2	10.1	10.0	9.9	9.9
52	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	11.6	11.5	11.3	11.2	11.1	11.0	10.9	10.8	10.7	10.6	10.5	10.5
53	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	12.4	12.2	12.1	12.0	11.9	11.8	11.6	11.5	11.4	11.3	11.2	11.1
54	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	13.2	13.1	13.0	12.8	12.7	12.5	12.4	12.3	12.2	12.1	12.0	11.9
55	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	14.1	13.9	13.8	13.6	13.5	13.4	13.2	13.1	13.0	12.9	12.8	12.6

Not Analyzed

- BU = Assembly average burnup
- Use burnup and enrichment to lookup minimum cooling time in years. For fuel assemblies reconstituted with up to 10 stainless steel rods only, if the lookup cooling time is less than 9.0 years then a minimum cooling time of 9.0 years shall be used. Licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for during fuel qualification.
- Round burnup UP to next higher entry, round enrichments DOWN to next lower entry.
- Fuel with an initial enrichment greater than 4.5 wt.% U-235 is unacceptable for storage.
- Fuel with a burnup less than 10 GWd/MTU is acceptable for storage after 5-years cooling.
- Example: An assembly with an initial enrichment of 3.75 wt. % U-235 and a burnup of 46.5 GWd/MTU is acceptable for storage after a 8.3 years cooling time as defined by 3.7 wt. % U-235 (rounding down) and 47 GWd/MTU (rounding up) on the qualification table.
- See Figure 1-8 for a description of zones.
- For assemblies fuel reconstituted with Zircaloy clad uranium-oxide rods use the assembly average enrichment to determine the minimum cooling time.

Table 1-2p
PWR Fuel Qualification Table for Zone 3 with 1.3 kW per Assembly, Fuel With or Without BPRAs, for the NUHOMS®-24PHB DSC
(Minimum required years of cooling time after reactor core discharge)

BU	Assembly Average Initial U-235 Enrichment (wt %)																								
(GWd/MTU)	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5
10	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
15	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
20	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
25		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
28			5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
30						5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
32							5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
34								5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
36									5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
38											5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
39											5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
40											5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
41											5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
42											6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
43											6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
44											6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
45			Not Analyzed										6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
46													6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
47													6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
48													6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
49													6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
50															6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
51															6.7	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
52															7.0	6.9	6.9	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
53															7.3	7.2	7.2	7.1	7.1	7.0	6.9	6.9	6.9	6.9	6.9	6.9
54															7.7	7.6	7.5	7.4	7.4	7.3	7.3	7.2	7.1	7.1	7.0	7.0
55															8.0	8.0	7.9	7.8	7.7	7.7	7.6	7.5	7.5	7.4	7.3	7.3

- BU = Assembly average burnup
- Use burnup and enrichment to lookup minimum cooling time in years. For fuel assemblies reconstituted with up to 10 stainless steel rods only, if the lookup cooling time is less than 9.0 years then a minimum cooling time of 9.0 years shall be used. Licensee is responsible for ensuring that uncertainties in fuel enrichment and burnup are correctly accounted for during fuel qualification.
- Round burnup UP to next higher entry, round enrichments DOWN to next lower entry.
- Fuel with an initial enrichment greater than 4.5 wt.% U-235 is unacceptable for storage.
- Fuel with a burnup less than 10 GWd/MTU is acceptable for storage after 5-years cooling.
- Example: An assembly with an initial enrichment of 3.75 wt. % U-235 and a burnup of 46.5 GWd/MTU is acceptable for storage after a 6.2 years cooling time as defined by 3.7 wt. % U-235 (rounding down) and 47 GWd/MTU (rounding up) on the qualification table.
- See Figure 1-8 and 1-9 for a description of zones.
- For fuel assemblies reconstituted with Zircaloy clad uranium oxide rods use the assembly average enrichment to determine the minimum cooling time.