Watts Bar Nuclear Plant Unit 2

Watts Bar Nuclear Plant (WBN) Unit 2
Pre-Submittal Meeting for Proposed Revision to WBN Unit 2 Capsule Withdrawal Schedule

December 14, 2021

TVA TENNESSEE VALLEY AUTHORITY

Agenda

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- Proposed Changes to WBN Unit 2 Capsule Withdrawal Schedule
- Basis for Proposed Changes
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- Schedule for Submittal
- Closing Remarks

Opening Remarks

- Pursuant to Title 10 of the Code of Federal Regulations (10 CFR), Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," Paragraph III.B.3, Tennessee Valley Authority (TVA) is requesting Nuclear Regulatory Commission (NRC) approval of a revision to the reactor vessel surveillance capsule removal schedule for Watts Bar Nuclear Plant (WBN) Unit 2.
- The WBN Unit 2 Capsule Withdrawal Schedule is described in Table 4.0-1 of the WBN Unit 2 Pressure Temperature Limits Report (PTLR) (Appendix B to TVA System Description Document SDD N3-68-4001, “Reactor Coolant System”)
- Proposed change revises the withdraw schedule for reactor vessel surveillance capsule W along with the latest data regarding lead factors, effective full power years (EFPY), and expected neutron fluence, as well as the deletion of “EOC 5” from the Capsule W schedule line to allow planning of capsule withdrawal based on parameters that are directly applicable to ASTM E-185-82.
- Proposed changes are needed to support the WBN Unit 2 Cycle 5 refueling outage (U2R5) scheduled for fall 2023.

Background

- The last revision to the WBN Unit 2 capsule withdraw schedule was submitted to the NRC on September 5, 2017 (ML17248A420) and approved by the NRC on November 20, 2017 (ML17312A260).
    - Requested NRC approval to revise the surveillance capsule withdrawal schedule for Capsule U from the first refueling outage in fall 2017 (WBN U2R1) to the subsequent outage in the spring of 2019 (WBN U2R2).
- Current version of the WBN Unit 2 PTLR was submitted to the NRC on December 16, 2020 (ML20351A248).
- ASTM E-185-82, “Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels,” is the applicable standard for WBN Unit 2 in accordance with Section 5.2.4.3 of the WBN dual-unit Updated Final Safety Analysis Report (UFSAR). Because the proposed change satisfies the requirements of ASTM E-185-82, TVA has determined that a license amendment is not required, which is consistent with the guidance of NRC Administrative Letter (AL) 97-04, "NRC Staff Approval for Changes to 10 CFR Part 50, Appendix H, Reactor Vessel Surveillance Specimen Withdrawal Schedules."

Current WBN Unit 2 Capsule Withdrawal Schedule

System Description Document	REACTOR COOLANT SYSTEM Unit 1 / Unit 2 QA Record	SDD-N3-68-4001 Rev. 0044 Page 254 of 268

Appendix B
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TABLE 4.0-1
Watts Bar Unit 2 Surveillance Capsule Removal Schedule [a]

Capsule	Orientation of Capsule	Lead Factor	Removal Time	Expected Capsule Fluence ($n/cm^2, E > 1.0$ MeV)
U	Dual 34°	4.80	2.61 EFPY (EOC 2)	0.7714×10^{19}
W	Single 34°	4.87	6.91 EFPY (EOC 5)	1.901×10^{19} [b]
X	Dual 34°	4.80	Note (c)	Note (c)
Z	Single 34°	4.87	Note (d)	Note (d)
V	Dual 31.5°	4.15	Note (d)	Note (d)
Y	Dual 31.5°	4.15	Note (d)	Note (d)

Notes:

(a) This information is taken from the withdrawal schedule contained in Appendix F of WCAP-18191-NP (Ref. 1). EOC = End-of-Cycle

(b) Approximate Fluence at vessel inner wall at End-of-Life (32 EFPY).

(c) Capsule X should be removed between 11.6 EFPY and 13.5 EFPY if possible. Capsule X must be removed between EOC 6 and 13.5 EFPY in order to satisfy the recommendations of the third capsule end-of-license per ASTM E185-82 (Ref. 7). See WCAP-18191-NP (Ref. 1) for additional details. This removal EFPY should be re-visited at a later date, such as after Capsules U and W are removed.

(d) Capsules Z, V, and Y should remain in the reactor. If additional metallurgical data is needed, withdrawal and testing of these capsules should be considered.

Current WBN Unit 2 Capsule Withdrawal Schedule

- The current capsule removal schedule is based on WCAP-18191-NP, Revision 0, "Watts Bar Unit 2 Heatup and Cooldown Limit Curves for Normal Operation and Supplemental Reactor Vessel Integrity Evaluations," dated February 2020 (ML17289A327) and ASTM E-185-82.

Proposed Changes to WBN Unit 2 Capsule Withdrawal Schedule

TABLE 4.0-1
Watts Bar Unit 2 Surveillance Capsule Removal Schedule [a]

Capsule	Orientation of Capsule	Lead Factor	Removal Time	Expected Capsule Fluence (n/cm², E > 1.0 MeV)
U	Dual 34°	4.70 ~~4.00~~	2.0 ~~2.61~~ EFPY (EOC 2)	0.604 ~~0.7714~~ x 10^{19}
W	Single 34°	4.66 ~~4.07~~	7.0 ~~6.91 EFPY (EOC 5)~~	1.94 ~~1.901~~ x 10^{19} [b]
X	Dual 34°	4.69 ~~4.00~~	~~Note (c)~~	~~Note (c)~~
Z	Single 34°	4.69 ~~4.87~~	Note (d)	Note (d)
V	Dual 31.5°	4.04 ~~4.15~~	Note (d)	Note (d)
Y	Dual 31.5°	4.04 ~~4.15~~	Note (d)	Note (d)

7.0 EFPY to 13.7 EFPY

1.94 x 10^{19} to 3.88 x 10^{19} [b]

WCAP-18518-NP (Ref 12)

Notes:

(a) This information is taken from the withdrawal schedule contained in ~~Appendix F of WCAP-18191-NP (Ref. 1)~~. EOC = End-of-Cycle

(b) Approximate Fluence at vessel inner wall at End-of-Life (32 EFPY).

(c) Capsule X should be removed between 11.7 ~~11.6~~ EFPY and 13.7 ~~13.5~~ EFPY if possible. Capsule X must be removed between ~~EOC 6 and 13.5 EFPY~~ in order to satisfy the recommendations of the third capsule end-of-license per ASTM E185-82 (Ref. 7). ~~See WCAP-18191-NP (Ref. 1) for additional details.~~ This removal EFPY should be re-visited at a later date, such as after Capsules ~~U and~~ W ~~are~~ is removed.

(d) Capsules Z, V, and Y should remain in the reactor. If additional metallurgical data is needed, withdrawal and testing of these capsules should be considered.

(Add Text): This capsule should be withdrawn at the outage nearest to but following 7.0 EFPY of operation.

7.0 EFPY and 13.7 EFPY

(Add Text): In the event that Capsule W cannot be removed, then Capsule Z may serve as a backup and be removed instead during the same outage

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Proposed Changes to WBN Unit 2 Capsule Withdrawal Schedule

The basis for these updates is WCAP-18518-NP, Revision 0, “Analysis of Capsule U from the Watts Bar Unit 2 Reactor Vessel Radiation Surveillance Program,” dated March 2020 (ML20107F717). Specifically, TVA proposes to revise the WBN Unit 2 reactor vessel surveillance capsule removal schedule as follows:

- The lead factors for all six capsules have been revised.
- The removal EFPY and expected neutron fluence for Capsule U has been updated to reflect the actual conditions achieved when the capsule was removed during U2R2 in spring 2019.
- The projected EFPY and expected neutron fluence for capsules W and X have been revised. These plant parameters are key indicators when ensuring compliance with ASTM E185-82 scheduling criteria.
- EOC 5 has been deleted from the Capsule W schedule line.

Proposed Changes to WBN Unit 2 Capsule Withdrawal Schedule (cont'd)

- Note (a) is being revised to replace WCAP-18191-NP with WCAP-18518-NP.
- Note (b) is being revised to indicate that Capsule W should be withdrawn at the outage nearest to but following 7.0 EFPY of operation.
- Note (c) is being revised to reflect the projected EFPY for Capsule X and to delete the references to WCAP-18191-NP and Capsule U because it has been removed.
- Note (d) is being revised to reflect that Capsule Z has been identified as a backup to Capsule W in the event that Capsule W cannot be removed during an outage. This change is acceptable because the two capsules are radiologically equivalent.

Basis for Proposed Changes

- As previously noted, the basis for these updates is WCAP-18518-NP, Revision 0, which has been submitted to the NRC.
- Table 1 to ASTM E-185-82 lists the recommended number of surveillance capsules and their withdrawal schedule based on the anticipated shift in the reference nil-ductility transition temperature (ΔRT_{NDT}) at the end of life (EOL). For WBN Unit 2, the ΔRT_{NDT} at EOL (i.e., 32 EFPY) for all vessel forgings and welds will be less than 100°F. Therefore, only three surveillance capsules are required to be withdrawn.
- In accordance with Table 1 to ASTM E185-82, the second capsule should be removed when the first of the following criteria is satisfied as shown in Table 1 on next slide. Based on the information in Table 1, the limiting criterion for WBN Unit 2 is when the fluence will correspond to the approximate EOL fluence at the reactor vessel inner wall location. Table 2 on the next slide shows the fluence projection for the WBN Unit 2 surveillance capsules.

Basis for Proposed Changes (cont'd)

Table 1 WBN Unit 2 Capsule W Conformance to ASTM E185-82 Criterion	
ASTM E185-82 Criterion (whichever comes first)	WBN Unit 2 Capsule W Conformance
At 15 EFPY	Assuming 1.5 EFPY per cycle (i.e., 18-month cycles), 15 EFPY will not be reached until at least Cycle 11.
Fluence corresponds to the approximate EOL fluence at the reactor vessel inner wall location	Reference 5 states the EOL fluence at the reactor vessel inner wall location to be 1.94E+19 n/cm^2. Table 2 shows that Capsule W will reach this criterion after 7.0 EFPY of WBN Unit 2 operation.

Basis for Proposed Changes (cont'd)

Table 2
Fast Neutron Fluence Projections at the Geometric Center of the WBN Unit 2 Surveillance Capsules at the Core Midplane

EFPY	Neutron (E > 1.0 MeV) Fluence (n/cm^2)					
	Capsule U (34.0° Dual)	Capsule V (31.5° Dual)	Capsule W (34.0° Single)	Capsule X (34.0° Dual)	Capsule Y (31.5° Dual)	Capsule Z (34.0° Single)
0.74	2.57E+18	2.16E+18	2.56E+18	2.57E+18	2.16E+18	2.56E+18
2.0	6.04E+18	5.07E+18	6.00E+18	6.04E+18	5.07E+18	6.00E+18
7.0	-	-	1.94E+19	1.94E+19	-	1.94E+19
13.7	-	-	-	3.88E+19	-	-
32	-	7.84E+19	9.10E+19	9.16E+19	7.84E+19	9.10E+19
36	-	8.83E+19	1.03E+20	1.03E+20	8.83E+19	1.03E+20

Basis for Proposed Changes (cont'd)

- When planning a capsule withdrawal activity during a refueling outage, it is prudent to identify a backup capsule to target for withdrawal in the event that the originally planned capsule is unable to be withdrawn.
    - Capsule Z is radiologically equivalent to Capsule W because they have resided in the reactor for the same amount of time in symmetric "34.0° Single" locations. The estimated fluence for both capsules shown in Table 2 is the same.
    - A review of Table 6-8 in WCAP-18518-NP shows that the lead factors for Capsules W and Z are the same when compared in the same outage (4.66). Therefore, in the event that Capsule W cannot be removed, then Capsule Z may serve as a backup and be removed instead during the same outage.
- The basis for deleting EOC 5 from the Capsule W schedule line is that this information was originally included as a planning tool to assist the utility with withdrawing the capsule at the expected time. However, recent adjustments in lead factors, estimated EFPY to attain target fluence, and a reconciliation of actual accrued EFPY to date has shown that U2R5 is too early to satisfy the requirements of ASTM E-185-82. Therefore, the (EOC 5) information has been deleted from the schedule to allow planning of capsule withdrawal based on parameters that are directly applicable to ASTM E-185-82.

Precedent

The NRC has previously approved the following reactor vessel surveillance program capsule withdrawal schedule revisions for WBN:

- WBN Unit 2 [Safety Evaluation dated November 20, 2017 (ML17312A260)]
- WBN Unit 1 [Safety Evaluation dated March 27, 2014 (ML14083A247)]

Schedule Milestones

- December 14, 2021 - Pre-submittal meeting with NRC
- January 31, 2022 – Capsule Withdrawal Schedule Change Request Submittal – Request NRC approval within 12 months of submittal
- January 31, 2023 – NRC Approval (Requested)
- Following NRC approval, TVA will submit the revised WBN Unit 2 PTLR to NRC in accordance with the WBN Unit 2 Technical Specifications
- WBN Unit 2 Cycle 5 refueling outage (U2R5) scheduled for fall 2023

Closing Remarks

- Proposed changes to the WBN Unit 2 capsule withdrawal schedule are primarily based on information previously submitted to the NRC and are consistent with ASTM E-185-82.
- Proposed changes are needed to support the WBN Unit 2 Cycle 5 refueling outage (U2R5) scheduled for fall 2023


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