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DETERMINATION OF NEPA ADEQUACY

PRODUCTION OF TRITIUM IN A COMMERCIAL LIGHT WATER NUCLEAR REACTOR (WATTS BAR NUCLEAR PLANT)

TENNESSEE VALLEY AUTHORITY

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In partnership with the U.S. Department of Energy's National Nuclear Security Administration (DOE/NNSA), the Tennessee Valley Authority (TVA) is considering increasing production of tritium in two reactors at TVA's Watts Bar Nuclear Plant (WBN) using tritium-producing burnable absorber rods (TPBARs). In March 2016, the DOE/NNSA completed, and TVA adopted a Final Supplemental Environmental Impact Statement (SEIS) for the *Production of Tritium in a Commercial Light Water Nuclear Reactor* (81 FR 11557; March 4, 2016).

Based on the Final SEIS, DOE/NNSA issued a Record of Decision (ROD) on June 22, 2016 (81 FR 40685), and TVA issued a ROD on April 5, 2017 (82 FR 16655). The RODs stated that TVA intends to implement Alternative 6 analyzed in the Final SEIS.

Because TVA is preparing to submit a license amendment request (LAR) to the Nuclear Regulatory Commission for the increase of tritium production at WBN, the TVA Nuclear program requested that TVA's NEPA Program review the Final SEIS to determine whether this prior analysis provides adequate coverage under the National Environmental Policy Act (NEPA) for increased tritium production at WBN. The review considered whether the current TVA proposal is adequately analyzed in the SEIS and whether new information or circumstances that should be considered by DOE/NNSA and TVA have emerged since the completion of the SEIS in 2016.

Specifically, TVA Nuclear and NEPA compliance specialists independently reviewed the SEIS to determine if TVA's proposal to irradiate 4,992 TPBARs at WBN (2,496 in each reactor) is substantially different from alternatives analyzed in the SEIS such that the environmental analysis would differ from the analysis of alternatives in the SEIS. In addition, TVA specialists reviewed whether significant new information or circumstances relevant to environmental concerns have a bearing on the current proposal or its impacts.

The review is necessary to determine whether additional, supplemental review and analysis is required. This memorandum has been prepared to document this evaluation and TVA's determination of NEPA adequacy. This review and documentation satisfies procedural requirements of the Council on Environmental Quality's NEPA regulations at 40 CFR 1502.9(d)(4) and TVA's NEPA procedures at 18 CFR 1318.101(d).

Relevant NEPA Documents

Numerous DOE/NNSA and TVA NEPA documents are applicable to this review for NEPA adequacy. The main NEPA document germane to this determination of NEPA adequacy is the DOE/NNSA's *Final SEIS for the Production of Tritium in a Commercial Light Water Reactor* (DOE/EIS-0288-S1) issued in February 2016. The 2016 Final SEIS supplemented an EIS prepared by DOE/NNSA in 1999 that analyzed the potential environmental impacts of irradiating up to 3,400 TPBARs per reactor operating on an 18-month fuel cycle (*Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor, 1999, DOE/NNSA*).

As described in great detail in the 2016 Final SEIS (chapter 1.1), after 1999, TVA requested that the number of TPBARs to irradiate per fuel cycle be reduced because of the higher-than-previously-expected rate of permeation. TVA proposed to irradiate up to a total of 2,500 TPBARs every 18 months in one or more TVA reactors. Subsequently, DOE/NNSA and TVA identified the need to conduct supplemental environmental analysis and initiated the SEIS in September 2011. The SEIS updates information provided in the 1999 EIS to include: (1) an analysis of the potential environmental impacts associated with TPBAR irradiation based on a more conservative estimate of the tritium permeation rate; (2) NNSA's revised estimate of the maximum number of TPBARs necessary to support the current tritium supply requirements; and (3) a maximum production scenario of irradiating 5,000 TPBARs every 18 months, which NNSA might require as a contingency capability to compensate for potential future shortfalls in the event of a reactor outage.

The following NEPA documents are also directly related to the proposal. These are described in much greater detail in the 2016 Final SEIS (chapter 1.6):

- *Tennessee Valley Authority, Watts Bar Nuclear Plant, Unit 1; Environmental Assessment and Finding of No Significant Impact* (67 FR 54826; August 26, 2002) addresses TVA's request to NRC to irradiate up to 2,304 TPBARs in Watts Bar 1.
- *Final Supplemental Environmental Impact Statement for the Completion and Operation of Watts Bar Nuclear Plant Unit* 2 (June 2007) addresses the completion and operation of Watts Bar 2 to meet the need for additional electricity for the TVA system and to maximize the use of existing assets. TVA prepared the SEIS to update the extensive previous environmental record pertinent to that proposed action.
- *Final Environmental Assessment for an Independent Spent Fuel Storage Installation at the Watts Bar Nuclear Plant* (June 2014) addresses TVA's proposal to construct and operate an independent spent fuel storage installation at the Watts Bar site. The WBN facility consists of a vendor-supplied dry cask storage system and a concrete storage pad facility with supporting infrastructure.
- *Categorical Exclusion for the Watts Bar Tritiated Water Storage Tank System* (October 2011) addresses the construction and operation of a 500,000-gallon tritiated water tank and associated pumps and piping at WBN to support tritium production activities.

Other NEPA records, including those listed in chapter 1.6, address operation of WBN and may have some relation to TVA's tritium production there. However, those NEPA reviews did not prove to be directly relevant to the review of NEPA adequacy for the current TVA proposal.

TVA notes minor improvements or maintenance actions at WBN are necessary from time to time to address systems relating to tritium production and additional site-specific environmental review of these minor improvements or maintenance actions at WBN are undertaken to ensure compliance under NEPA. Generally, additional site-specific reviews of actions are common when TVA implements minor actions necessary to implement broader program decisions such as the decision to increase production at WBN. This "tiering" of analysis approach is consistent with the Council on Environmental Quality's NEPA regulations at 40 CFR 1501.11 and 40 CFR 1508.1(ff).

Discussion of NEPA Adequacy Criteria

In accordance with Council of Environmental Quality NEPA procedures at 40 CFR 1502.9 and TVA implementing procedures at 18 CFR 1318.101(d), the NEPA Program must evaluate and document whether the proposed activities described above to increase tritium production at WBN are already covered under an existing NEPA review or whether significant new information or circumstances have emerged that warrant supplement. The following discussion addresses four criteria for making this determination.

1. Is the new proposed action essentially similar to the previously analyzed action?

Yes. The current proposal by TVA to irradiate 2,496 TPBARs at each of WBN's two reactors falls within the scope of the 2016 SEIS analysis and is essentially the same as the proposal that prompted DOE/NNSA to initiate a supplemental NEPA analysis in 2011. The SEIS considered the irradiation of up to 5,000 TPBARs at the WBN site (up to 2,500 TPBARs per reactor).

In both the 1999 EIS and the 2016 SEIS, tritium production at both the WBN plant and at the Sequoyah Nuclear Plant was considered (although TVA has never proposed to produce tritium at the Sequoyah site). As noted above, the analyses of the EIS and SEIS varied by the number of TPBARs that would be irradiated and by the estimates and assumptions used in their analyses. In the 2016 SEIS, six alternatives and a no action alternative were analyzed by DOE/NNSA.

TVA's current proposal of irradiating 2,496 TPBARs at each WBN reactor (4,992 in total) every 18 months is essentially the same as Alternative 4. Under Alternative 4, described on page 2-10 of the SEIS, TVA would only use the Watts Bar site to irradiate a maximum of 5,000 TPBARs every 18 months. Because TVA would irradiate a maximum of 2,500 TPBARs in any one reactor, this would involve use of both Watts Bar reactors. The only difference in the current proposal and Alternative 4 of the SEIS is that four fewer TPBARs would be irradiated in each WBN unit under the current proposal.

2. Are the previously analyzed alternatives adequate for the new action?

Yes. As discussed under criterion #1 above, the proposal is analyzed under Alternative 4 of the SEIS.

3. Are there effects that would result from the new action that were not addressed in the previous NEPA documents?

The proposed action is essentially the same as the action reviewed in the 2016 SEIS. During the review for NEPA adequacy, TVA Nuclear and NEPA specialists examined whether the latest design and operation plans for increasing production of tritium at WBN differed from those described in the SEIS such that there could be environmental effects that were not addressed in the SEIS or that differed from those environmental effects previously analyzed. To do this, reviewers determined whether key analytical assumptions about tritium production at WBN included in the SEIS remain valid. Of the issues under review, the following were particularly important to the reviewers because they addressed issues with the greatest potential to result in some environmental effect:

(a) Tritium requirements and the expected tritium permeation rate,
(b) TPBAR capture efficiency,
(c) Amount of spent fuel that was projected to be generated at WBN,
(d) Effect of tritium production on a typical fuel cycle at WBN, and
(e) Method of batch releases of liquid radioactive (rad) waste.

Generally, TVA specialists found that the SEIS included a conservative, bounding analysis for most topics and therefore, the anticipated effects of the current proposal fell within this bounding analysis, as discussed below.

a. Tritium requirements and the expected tritium permeation rate

TVA reviewed the proposal to determine whether there have been any modifications to the TPBAR design since the 2016 SEIS that would impact the permeation rate relied upon in the SEIS.

While the current TPBAR design (referred to as a Mark 9.2 TPBAR design) includes significant design changes from the design of prior cycles (referred to as a multi-pencil Production Design), the average annual release rate per Mark 9.2 TPBAR is similar to that estimated for the multi-pencil Production Design TPBARs of previous WBN Unit 1 cycles. The assumptions used in the SEIS remain valid and are conservative and bounding because the Mark 9.2 TPBAR design is similar to the previous design.

As noted on page 1-8 of the SEIS, "the analysis of potential impacts [in Chapter 4 of the SEIS] is based on an assumed high and thus conservative permeating rate of 10 curies of tritium per TPBAR." As stated on page 1-9, "NNSA, the Laboratory, and TVA have determined that a tritium permeation rate of 10 curies of tritium per TPBAR per year is the best estimate to ensure that the analyses in this SEIS would reasonably be expected to bound uncertainties in relation to future operations. By analyzing this higher tritium permeation rate, NNSA is confident that the SEIS provides a reasonable, but conservative and bounding, analysis of the potential environmental impacts from tritium production in the Watts Bar and Sequoyah reactors."

In November 2021, the Pacific Northwest National Laboratory (PNNL) confirmed this analytical assumption remains bounding for the proposed TPBAR design. TVA agrees the assumptions related to permeation rates used in the SEIS remain valid and are conservative and bounding.

b. TPBAR capture efficiency

TVA reviewers confirmed previous assumptions from the 1999 EIS and the SEIS regarding TPBAR capture efficiency remain valid.

The SEIS states that, "…as the number of TPBARs in a reactor increases, tritium production efficiency is expected to decrease such that each TPBAR would produce less than 1 gram of tritium" based on a PNNL estimation. (page 1-6). PNNL has verified efficiency decreases with increases in TPBARs. In 2013, PNNL concluded as the number of TPBARs increase in a reactor core, past some number of TPBARs, the average quantity of tritium produced will decline. This occurs because with increasing numbers, less optimal (for tritium production) core loading patterns must be used. The PNNL's 2013 analysis appears to indicate the average production per TPBAR should be expected to start dropping at about 1,700 TPBARs in a core, with an average level of about 0.85 grams per TPBAR being expected at 2,300 TPBARs per core. The PNNL analysis of TPBAR capture efficiency remains valid.

c. Effects on the amount of spent fuel generated

TVA must design fuel assemblies for each cycle to determine the equilibrium core design to allow for tritium production. For the 2,496 TPBAR proposal, TVA's current design would result in 36 additional fuel assemblies every 18 months for each WBN reactor. Given that the SEIS assumed up to 41 additional fuel assemblies, the SEIS provides a conservative bounding analysis of the 2,496 TPBAR equilibrium core designs.

The SEIS addresses the 41 additional fuel assemblies in several sections. A discussion is introduced in a text box entitled "Additional Spent Nuclear Fuel" on page 2-22. According to the SEIS' summary of impacts of Alternative 4, "Irradiation of 5,000 TPBARs would generate no more than 82 additional spent nuclear fuel assemblies every 18 months over the No-Action Alternative if TVA irradiated 2,500 TPBARs in each of the Watts Bar reactors. On an annual basis, this would increase spent nuclear fuel generation at Watts Bar by about 48 percent in comparison with the No-Action Alternative." (chapter 2.5.6, p. 2-30) In its summary of the impacts of Alternative 6, the SEIS states that, "Irradiation of 2,500 TPBARs would generate no more than 41 additional spent nuclear fuel assemblies every 18 months over the No-Action Alternative if TVA irradiated all 2,500 TPBARs in a single reactor. On an annual basis, this would increase spent nuclear fuel generation at Watts Bar by about 24 percent in comparison with the No-Action Alternative." (chapter 2.5.8, p. 2-33).

TVA reviewers verified that the assumptions in the SEIS regarding the management of spent fuel (page 1-15) remain valid. The necessary infrastructure is in place at WBN to manage an increased volume of spent nuclear fuel assemblies, including a dry cask storage facility and program that can manage potential effects (e.g., changes to burnup or heat loads of discharged feed assemblies). Thus, the SEIS analysis related to the management of spent fuel remains valid.

These waste generation figures are also relied upon in analysis relating to nuclear waste disposal and transport in comparison of environmental effects in SEIS Chapter 2 (e.g., Table 2.5, page 2-42) and in impact analysis in SEIS Chapter 4, Chapter 4.1.10 (Waste and Spent Nuclear Fuel Management).

d. Effects on a typical fuel cycle at WBN

TVA used its latest designs to review whether irradiation of 2,496 TPBARs at each WBN unit would impact a typical fuel cycle at the WBN units and whether the cycles would be affected in a way not addressed in the SEIS. The fuel cycle length or the Effective Full Power Days of the operating units would not be altered by production of tritium. Production of tritium, regardless of amount of TPBARs, does not change days a unit is operational. The length of a cycle is set prior to core design, and core designers use this parameter to design to specific cycle length. Increasing the number of TPBARs in a unit is equivalent to adding additional burnable poisons to the core, which means more fuel must be loaded (in the form of higher enrichments not to exceed 5% and additional fuel assemblies).

The operating cycle length is only mentioned in the SEIS twice and only in the context of being a "potential uncertainty" identified by DOE, PNNL, and TVA in determining it was necessary to assume in the SEIS a higher, more conservative tritium permeation rate of 10 curies per TPBAR per year. TVA does not consider the operating cycle length to be uncertain, however, and does not anticipate irradiation of 2,496 TPBARs at each WBN unit would affect the typical fuel cycle. Thus, the issue has no bearing on the review for adequacy of the SEIS.

e. Method of batch releases of liquid rad waste

It remains reasonable to assume that future releases of tritium-containing water, which would include tritium from TPBAR irradiation, would continue to be predominantly in batches, either through the normal radwaste batch releases after treatment through the radwaste treatment system or batch releases from previously treated water in the Tritiated Water Storage Tank (TWST). The TWST tank system, which will act as a reservoir and store additional volumes of treated tritiated water from Watts Bar Units 1 and 2, has enough capacity to store and release this water at appropriate times to enable TVA to better manage releases and continue to stay well within NRC and EPA regulatory limits.

Due to the much larger volume of the TWST at 500,000 gallons and the comparative volumes of the other radwaste tanks at less than 21,000 gallons, releases via the TWST will be of a greater volume and for a longer duration at a rate that meets all regulatory requirements. Although the total number of releases from the site will be less each year the total volume of liquid released per operating cycle will increase as the number of TPBARs increases toward 2,500 TPBARs.

The conclusions of the SEIS for potential impacts to surface water quality of Alternative 4 remain valid (chapter 4.1.5.5.1). The tank system continues to provide TVA with flexibility in how to best manage the releases of radwaste. TVA manages the release of radwaste according to a Strategic Plan that addresses administrative controls TVA may apply on releases to ensure effluents occur in a manner that avoids adverse effects to surface waters. Under the Strategic Plan, the concentration of tritium in the effluent flows would be consistent with analysis of the SEIS, which estimated an average tritium concentration of 691,000 picocuries per liter, which is well under the limit of 10 million picocuries per liter in the Watts Bar operating license and the plant's established envelope for safe operations (see SEIS, page 4-23). In addition, the management of effluent under the Strategic Plan would not alter the conclusion in the SEIS that the tritium concentration in the discharge plume would quickly diffuse into river flows such that there would be no significant impacts to drinking water. (See SEIS, page 4-23)

TVA also notes that the description of the TWST in the SEIS did not fully acknowledge the benefits of its design. The TWST includes an overflow annulus to protect against uncontrolled releases, which renders the worst-case scenario analyzed in the SEIS exceedingly unlikely. The "tank within a tank" design of the TWST is not mentioned in the SEIS discussion of the worst-case accident scenario (chapter 4.1.12) although it is mentioned elsewhere (e.g., page 2-17). In April 2021, TVA formally changed the TWST's calculation classification and documented the TWST as qualifying as a protective tank; the tank is an outdoor liquid radwaste tank that has an exterior overflow annulus with a greater capacity than the internal tank. Having an overflow annulus with a greater capacity than the interior tank protects the environment in the event of an uncontrolled release. In the review of the SEIS, TVA specialists found that the SEIS does not acknowledge the expected benefits that the overflow annulus provides (i.e., reducing the potential for uncontrolled water releases into the Tennessee River).

During the review of the SEIS, TVA reviewers also identified an additional notable instance in which the potential for adverse effects may be overstated. The description of greater than anticipated effects represent another example of a conservative, bounding analysis. The analysis of Transportation impacts (chapter 4.1.13) includes radiological impacts to the public and the transport crew from the radiation emitted by the package. TVA reviewers note that analysis for each alternative addressing the estimated number of latent cancer fatalities are now incorrect for both the number of years cited (22) and the resultant fatality calculations because nine years have passed since SEIS calculations were performed (2013). The SEIS estimates assume 22 years of exposure, based on WBN operating through 2035 (page 4-3). Because the actual period of time would be shorter, the impacts analyzed in the SEIS describe greater impacts than would be expected under the current proposal; the potential impacts of TVA's proposal would be less than stated in the SEIS.

4. Are there significant new circumstances or information relevant to environmental concerns that would substantially change the analysis in the existing NEPA documents?

TVA Nuclear and NEPA compliance specialists reviewed each of the environmental resource topics addressed in the SEIS and reviewed more recent data available to TVA for many resources to verify that information used to describe the baseline conditions of the affected environment had not substantially changed since the SEIS was prepared. Where there was updated information relevant to environmental concerns available, TVA reviewed the information and the SEIS, and provides the following summary of the review.

Water Resources: As stated in the 2016 SEIS, "The primary impact to water resources from any of the alternatives would be a change in the amount of tritium Watts Bar would release in liquid effluents." (Chapter 4.1.5, page 4-14). Because the potential impacts to water resources is a primary environmental concern relating to the proposal, TVA reviewed more recent data that is routinely gathered as discussed below.

a. Surface water quality monitoring

In the 2016 SEIS (chapter 3.1.5.1.2), Table 3-6 (Surface water quality monitoring near the Watts Bar site) provides findings from the 1999 EIS and "Recent sampling" of radiological and non-radiological parameters. TVA has obtained more recent information (through 2021) and updated SEIS Table 3-6 (Surface water quality monitoring near the Watts bar site) with the recent sampling results. See Attachment 1 below.

As shown in Attachment 1, beta (gross) and tritium sample results were slightly higher in recent sampling results than was noted in the 2016 SEIS. TVA found there are no remarkable findings among non-radiological parameters. The updated table indicates that values have not changed dramatically and are still within levels set for drinking water.

b. Discharge data

In the description of affected Water Resources (chapter 3.1.5.1.3, page 3-22), the SEIS states: "Over a typical year, discharges from Outfall 101 average about 43 cubic feet per second; when Watts Bar 2 becomes operational, TVA estimates the average will increase to about 80 cubic feet per second." In the Water Resources analysis (chapter 4.1.5) and Appendix E of the SEIS, several variables to encompass the expected range of discharge and river conditions at WBN were identified. The water discharge rate to Outfall 101 was identified as, "80 cubic feet per second (cfs) under normal plant operations and 175 cfs for periods of instances of curtailed discharges due to low river flow." (SEIS, page 4-15)

TVA obtained more recent flowrate data for Outfall 101 at WBN depicting the 24-hour average flowrates from January 1, 2017 to June 30, 2022. The 24-hour average discharge flowrate for this period was 77 cfs and the maximum 24-hour average flowrate was 212 cfs. The updated average discharge flowrate data is generally consistent with the rate identified in the SEIS.

c. Effects on tritiated wastewater

Since the completion of the SEIS, the PNNL provided TVA with new wastewater information, as shown in Table 1 below.

Table 1. Estimated Tritiated Wastewater *Per Unit*

	Maximum Reactor Coolant System Tritium Concentration in each Unit	Total Tritium Release per Unit/cycle	Gallons of H_2O used per Unit in cycle	Additional H_2O Volume per Unit
	μCi/g	Curies	gallons	gallons
0 TPBARs	2.4	1,196	290,196	
2500 TPBARs	15.7	10,756	290,196	
2500 TPBARs (feed/bleed)	8.0	10,756	387,822	97,626

The first row of the table provides data for a reactor that does not have any TPBARs. The tritium estimate (1,196 curies) would be from non-TPBAR sources that occur in pressurized water reactors (PWR), which would generate 290,196 gallons of tritiated wastewater. The second row provides data for a reactor with 2,500 TPBARs being irradiated for 18 months. During irradiation of TPBARs, a small amount of tritium permeates or weeps out of a TPBAR. The second row shows 10,756 curies of tritium would be released into the reactor coolant, the tritium concentration would peak at 15.7 μCi/g (microcuries per gram), and 290,196 gallons of water would be used during the 18-month cycle. However, for several reasons, TVA prefers to maintain the reactor coolant tritium concentration at 8 μCi/g or below during an 18-month cycle. As a result, water must be added and removed from the reactor coolant system to maintain the tritium concentration at 8 μCi/g. This practice, known as "feed and bleed," requires extra water. The final row of the table reflects the feed and bleed practice, using 387,822 gallons of water during an 18-month cycle. Therefore, the proposal to irradiate 2,500 TPBARs per unit would result in an additional volume of 97,626 gallons of water, generating a total of 387,822 gallons of tritiated wastewater per unit, and an additional volume of 195,252 gallons for two units and a total of 775,644 gallons of tritiated wastewater generated irradiating 2,500 TPBARs in both units.

TVA notes that the 2016 SEIS does not estimate the amount of tritiated wastewater that would be produced under each alternative. In addressing radwaste volumes, the SEIS provides total volumes, which include releases from turbine building sumps, floor drain collector sumps, groundwater sump, steam generator blowdown, and any changes in reactor power. The volume derived from the tritiated wastewater from a reactor cannot be separated from these totals with the data given in the SEIS. In other words, there can be no comparison of the estimates of tritiated wastewater provided by PNNL to the SEIS' analysis.

The new wastewater data provided by PNNL is informative but does not represent significant information relevant to environmental concerns.

<u>d. Water use</u>

During this review, TVA reviewers identified a statement describing the tritiated water storage tank's water discharge process that is erroneous. In Chapter 3.1.5.1.3, the following statement is made: "The tritiated water tank system would discharge to the cooling tower blowdown piping that leads to either Outfall 101 or the yard holding pond." (SEIS, page 3-21) In fact, water containing radwaste cannot enter the yard holding pond.

All radwaste is released to the cooling tower blowdown line to provide adequate dilution to ensure 10 CFR Part 20 limits are met. A flow element (0-FE-27-98) is used to ensure minimum flow exists before reaching Outfall 101. This flow element has an interlock that closes flow control valve (0-FCV-77-33) and isolates the discharge of radwaste when the dilution flowrate falls below the minimum amount; thereby preventing any radwaste being diverted to the yard holding pond when dilution is below the minimum required flow or when Outfall 101 is isolated.

Another inconsistency identified by reviewers in the SEIS was identified on page 3-23, where the following statement is made: "When Unit 2 is operational, the amount of water diverted to the yard holding pond will roughly double during periods of low river flow." TVA notes since the plant did not increase the cooling tower blowdown (CTBD) flowrate, the yard holding pond rate of rise during periods when the diffusers are isolated remains the same. This is another minor technical point. It is noted in the following sentence on page 3-23 that while doubling of waters into the pond increases the potential for pond overflow, TVA's operational controls would address this risk.

Figure 3-4 in the SEIS remains correct and continues to accurately depict how TVA utilizes the CTBD flow from the cooling towers. Since WBN Unit 2 became operational, TVA has decided to only use the blowdown weir from Unit 2, which is about the same flowrate as the Unit 1 blowdown flowrate when it was the only unit operating. To meet the required minimum dilution flow to make a radwaste discharge, TVA will isolate the Outfall 101 and thereby increase the volume of water held in the yard holding pond. Then, when TVA is ready to make the radwaste tank release, TVA opens Outfall 101 and the yard holding pond drains by gravity to combine with the Unit 2 blowdown water, such that the minimum flowrate of 30,000 gpm requirement (to make a radwaste release) is achieved.

TVA notes the water quality analysis in Chapter 4 primarily addresses the impacts associated with discharges into the Tennessee River, rather than impacts associated with managing waters within its WBN systems before discharge. Thus, this information on water flow within WBN does not affect the SEIS' findings on impacts to surface water quality.

e. Ecological Health (Surface Water Quality)

In Chapter 3.1.5.1.2 of the SEIS, TVA describes "ecological health" ratings for Watts Bar and Chickamauga Reservoirs. The ratings included in the SEIS cover the period from 1994 to 2010 for Watts Bar Reservoir and from 1994 to 2009 for Chickamauga Reservoir (SEIS Figure 3-3). During this review for NEPA adequacy, TVA reviewed more recent ratings of ecological health of these reservoirs to determine whether the ecological health discussion in the SEIS remains valid.

Since 2010, Watts Bar Reservoir received either Fair or Good ratings. The two Good ratings occurred in 2018 and 2020. The ecological health score of 2020 (the last year for which TVA has a rating) is the reservoir's highest on record at 79. Since 2010, Chickamauga Reservoir received one Fair score (in 2011) and received five consecutive Good scores (from 2013, 2015, 2017, 2019, and 2021). TVA considers the ratings of both reservoirs since 2010 to be generally consistent with previous ratings and the description of the reservoir health presented in this section of the SEIS.

f. Groundwater Quality

In Chapter 3.1.5.2.2, the SEIS describes an incident of tritium leakage detected during groundwater monitoring at WBN. Since completion of the SEIS, TVA discovered additional instances of tritium in groundwater at WBN. On June 13, 2020, during routine monitoring, TVA samples of a groundwater well indicated an elevated tritium concentration of 28,540 picocuries per liter (pCi/L), with no gamma detected; the reporting limit for tritium in groundwater is 20,000 pCi/L. In response, TVA issued a voluntary communication to the NRC, state, and local agencies, and TVA identified and remediated the issue. In June 2022, the tritium concentration detected at the well was 8,805 pCi/L.

During confirmation sampling of the remediation measures, tritium was detected in two other groundwater monitoring wells in October 2021 at concentrations of 157,000 pCi/L and 747,000 pCi/L. These elevated concentrations indicated a new leak not related to June 2020 leak. Again, TVA issued a voluntary communication to the NRC, state and local agencies, identified the most likely source of the tritium leak, and remediated the issue by installing a new double-walled radwaste discharge line to prevent future leaks. In June 2022, the tritium concentrations detected in the two monitoring wells were 12,930 pCi/L and 10,070 pCi/L.

TVA reviewed the relevant environmental impact analysis in the SEIS (chapter 4.1.5). The SEIS analysis acknowledges the tritiated water storage tank, piping and equipment represent potential sources of spills and leaks but that the design (such as the double-walled discharge lines) would prevent or mitigate against such potential. The additional information about tritium leakage is indicative of the potential for impacts to groundwater from tritium production but does not change the SEIS findings that the design of the tritiated water storage tank will minimize the potential for impacts to groundwater (see SEIS, page 4-20). As exhibited by the two recent incidents, TVA will continue to take corrective actions to eliminate known sources of tritium contamination in WBN groundwater.

g. Fish Assembly Health

The SEIS includes data from 1993 to 2009 relating to reservoir fish assembly health near WBN (chapter 3.1.6.3.2; Table 3-10). TVA reviewed recent Reservoir Fish Assemblage Index (RFAI) scores (from 2010 to 2020) for the five locations in Watts Bar and Chickamauga Reservoirs. Only minor changes to the scores occur when incorporating scores from 2010 to 2020. In four locations, the overall score remains "good", but in one location (Chickamauga Reservoir forebay at Tennessee River Mile 472.3), the average falls from 42 (good) to 39 (fair) when including the 2010 to 2020 scores. TVA notes during the 2010 to 2020 period, the redbreast sunfish was reclassified from "indigenous" to "non-indigenous," which resulted in reductions in some previously reported RFAI scores.

TVA finds the minor change to fish assembly health is not a substantial change in the affected environment and has no bearing on the SEIS' environmental impact analysis in Chapter 4.1.6 (Biological Resources).

h. Waste management

In the paragraph of Chapter 3.1.10 that precedes Table 3-18 (Annual waste generation at the Watts Bar site), the SEIS states, *"The data in the table reflect actual wastes from Watts Bar 1 and expected wastes from Watts Bar 2, once that plant begins operation."* (SEIS, page 3-42). Table 3-18 identifies three categories of waste: hazardous waste, nonhazardous solid waste, and low-level radioactive waste. TVA continues to maintain data on hazardous waste and low-level radioactive waste at WBN but does not currently track the amount of nonhazardous solid waste generated at WBN annually.

The data on expected low-level radioactive wastes from Watts Bar included in Table 3-18 differs somewhat from data gathered since Unit 2 began operations. Hazardous waste generation averaged 6,424 pounds per year in the five years after WBN Unit 2 operations began (2017 to 2021), which is far less than the 9,059 pounds estimated in Table 3-18 of the SEIS. Low-level radioactive waste generation averaged 21,454 cubic feet (cu ft) in the five years after WBN Unit 2 operations began (2017 to 2021), which is higher than the 11,060 cubic feet figure estimated in Table 3-18 of the SEIS.

In the SEIS Table 3-19 (page 3-43), the total annual low-level radioactive waste amount (11,060 cu ft) is broken down into four types: spent resins and filter sludges (720 cu ft); filter cartridges (240 cu ft); compactable and uncompactable trash (10,000 cu ft); and contaminated oil (100 cu ft). The SEIS table was based on a 2007 document. TVA notes in 2020, there was 21,481 cubic feet of low-level radioactive waste generated: spent resins and filter sludges (262 cu ft); filter cartridges (206 cu ft); compactable and uncompactable trash (21,013 cu ft); and no contaminated oil. The figures from 2020 represent an update of Table 3-19 of the SEIS. Of the four types, the amount of trash represents the greatest variation from the 2007 document estimates.

The differences between the baseline data in the SEIS and more recent estimates are notable, but do not substantially alter the SEIS analysis of impacts relating to waste management. The information does not affect the SEIS' conclusion that TPBAR irradiation would generate small amounts of low-level waste and that there would be no impact on hazardous and nonhazardous waste generation (page 4-32, chapter 4.1.10.1).

As noted above, TVA has infrastructure in place to manage the increased volume of spent nuclear fuel assemblies.

i. WBN Workforce

The SEIS assumes once WBN Unit 2 became operational, the standard operating workforce population at WBN would be approximately 1,150 employees. TVA notes the current standard operating workforce is about 900 employees, according to 2022 estimates from TVA's Human Resources group, which renders the related 2016 SEIS analyses (e.g., human health and safety) to be conservative and bounding.

In one SEIS section, TVA reviewers found an inconsistency in the SEIS relating to the WBN workforce figure. The analysis of cumulative health impacts to the WBN workforce (chapter 5.3.4) assumes 879 workers at WBN rather than 1,150 employees. However, because the current standard operating workforce is about 900 workers, the analysis of 879 workers does not represent a substantial difference that renders the SEIS analysis insufficient.

j. Other Resources

TVA reviewers did not identify new information or circumstances relevant to other environmental issues, including cultural resources, geology/soils, climate/air quality, biological resources, socioeconomics, and infrastructure, that were substantial or warranted discussion in this document.

Coordination with DOE/NNSA

In May 2021, TVA met with DOE/NNSA to discuss the TVA proposal. During this meeting, DOE/NNSA requested information from TVA to help DOE/NNSA determine whether the 2016 SEIS adequately addresses the proposal. In August 2022, TVA again met with DOE/NNSA to provide the requested information and discuss its review of the adequacy of the previous NEPA documents. After conducting its own review of the information, DOE/NNSA issued a memorandum on September 30, 2022, to document their determination that TVA's "current proposal does not represent a substantive change to operations, activities, and associated impacts assessed in existing NEPA documentation. Accordingly, no further NEPA analysis of this TVA proposal is required." The DOE/NNSA memorandum, issued by the agency's NEPA program, affirms TVA's determination, documented herein, and is attached below (see Attachment 2).

During the interagency discussions, TVA and DOE/NNSA discussed whether the Records of Decision published by the agencies after the completion of the 2016 Final SEIS continue to accurately describe the decision to pursue the current proposal. Both agencies agreed that the current proposal is best represented in the SEIS as Alternative 4. Because the previous Records of Decision identified Alternative 6 as the alternative to be implemented, both agencies intend to prepare a new Record of Decision to clarify that the current proposal aligns more with the implementation of Alternative 4 of the Final SEIS than Alternative 6.

The decision to prepare a new Record of Decision meets NEPA's procedural requirements, but has no bearing on the determination whether the SEIS provides sufficient analysis for the current proposal. This document serves as the basis for the determination that the SEIS analysis is adequate for the current proposal.

Conclusion:

During this review of the adequacy of the SEIS, the TVA Nuclear group worked closely with TVA's NEPA Compliance staff to determine whether the Final SEIS completed in 2016 adequately addresses the current proposal to irradiate up to 5,000 TPBARs per year at WBN (2,496 TPBARs per unit). Consistent with 40 CFR 1502.9(d), TVA reviewed the SEIS to determine whether the current proposal is substantially the same as alternatives considered in the SEIS and whether significant new circumstances or information exist relating to environmental concerns that have a bearing on the current proposal or its impacts. TVA found that the proposal to irradiate up to 2,496 TPBARs at each WBN reactor every 18 months is addressed in the SEIS and is substantially the same alternative as presented as Alternative 4 of the SEIS.

TVA did not identify any new circumstances or information relevant to environmental concerns that are significant and substantially change the analysis in the existing NEPA documents. Recent information reviewed by TVA in most cases confirmed TVA's previous description of the affected environment. In instances where recent information differed notably, that information does not substantially change the previous environmental analysis. In addition, TVA found that the SEIS continues to provide a conservative bounding analysis for a variety of key issues, including the amount of additional fuel assemblies, the expected tritium permeation rate, and waste generation.

Based on this evaluation, I conclude that the previous NEPA documentation, namely DOE's 2016 SEIS for the *Production of Tritium in a Commercial Light Water Nuclear Reactor* (February 2016), adopted by TVA on March 4, 2016, provides an adequate analysis of the potential impacts associated with TVA's proposal to increase production of tritium at WBN. The requirements, at 40 CFR 1502.9(d)(4) and 18 CFR 1318.101, for evaluating and documenting this determination have been met and additional supplemental NEPA documentation is unnecessary.

________________________________ 02/06/2023________________

Dawn Booker Date
Manager
NEPA Program

SEIS Reviewers:

Matthew Higdon
Role: NEPA compliance review, document preparation
Experience: B.A. History, M.S. Urban and Regional Planning; 19 years experience in NEPA compliance, NEPA project management, and natural resource planning.

Gordon Arent
Role: Technical review, document preparation
Experience: B.S. Business and Nuclear Technology, M.B.A.; 43 years nuclear experience, including 20 years in Regulatory Affairs, 14 years in Nuclear Plant Operations with a Reactor Operator and Senior Operator License, and additional experience in management of Quality Assurance, Performance Improvement, and Supply Chain.

Jack K. Bryant
Role: Technical review, document preparation
Experience: B.S. Mechanical Engineering; 35 years experience in PWR NSSS and BOP preoperational testing, System Engineering, and System Engineering management

Edward Woods
Role: Technical review, document preparation
Experience: B.S. Chemistry, M.S. Health Physics, M.B.A.; 40 years experience in PWR nuclear plant chemistry and radioactive effluent releases

Attachment 1 - Updated Table 3-6 of the SEIS
Surface-water quality monitoring near Watts Bar

Table 3-6. Surface-water quality monitoring near the Watts Bar site (page 3-17 of Final SEIS)

			Average water body concentration				
Parameter	**Unit of measure**	**Water quality criteria**	**1999 EIS**	**2016 SEIS Sampling[a,b]**		**Recent Sampling[i, j]**	
Radiological							
Alpha (gross)	picocuries per liter	15c,d	0.433	NA[e]		NA[e]	
Beta particles & photon emittters	millirem per year	4c,d	ND	ND		NR[h]	
Beta (gross)	picocuries per liter	Varies by nuclide	3.75	2.79		4.97[k] (TRM 503.8)	
Tritium	picocuries per liter	20,000[c,d]	<300[f]	378		810 (TRM 523.1)	
Nonradiological				Downstream (TRM 503.3)	Upstream (TRM 529.5)	Downstream (TRM 503.3)	Upstream (TRM 529.5)
Manganese	milligrams per liter	0.05[d,g]	0.06	0.043	<0.056	0.026	0.028
Nitrate (as N)	milligrams per liter	10.0[c,d]	0.253	NR	NR	0.305	0.285
Arsenic	milligrams per liter	0.010[c,d]	0.001	ND (<0.00099)	<0.0010	0.001	0.001
Barium	milligrams per liter	2.0c,d	0.142	NR	NR	NR	NR
Cadmium	milligrams per liter	0.005[c,d]	0.00014	ND (<0.00095)	ND (<0.00097)	NR	NR
Chromium	milligrams per liter	0.1c,d	0.0012	<0.0011	<0.0011	0.002	0.002
Lead	milligrams per liter	0.015[c,d] action level	0.0046	<0.001	<0.00096	0.0002	0.0002
Mercury	milligrams per liter	0.002[c,d]	0.00021	ND (<0.00019)	ND (<0.00044)	NR	NR
Nickel	milligrams per liter	0.1[d]	NR	ND (<0.0091)	ND (<0.0095)	0.0008	0.0007
Selenium	milligrams per liter	0.05[c,d]	NR	ND (<0.0019)	ND (<0.0019)	NR	NR
pH (acidity/alkalinity)	pH units	6.5–8.5[d,g]	7.8	8.2	7.8	7.55	7.87

NA = not available; ND = not detected; NR = not reported; < = less than; TRM = Tennessee River Mile.
[a] Radiological results from TVA (2010b, 2011i) for beta and tritium at two sampling locations. (1) Beta (gross) and tritium results are averages of the values reported in the 2009 and 2010 annual reports. (2) Consistent with the manner reported in the source documents, beta (gross) and tritium results are averages of only those results above detection limits. For the beta (gross) results, 37 of 52 samples over 2 years had results over the detection limit of 1.9 picocuries per liter. For the tritium results, only 3 of 52 samples over 2 years had results over the detection limit of 270 picocuries per liter. There were no results over detection limits for the 2009 sampling year.

[b] Non-radiological results from the EPA STORET Database (EPA 2011d) listing data collected between December 2003 and October 2008. (1) In instances where both positive detections and non-detections were reported over the various sampling events, the average value (in the table) was calculated using the reported detection limits for the non-detections and the result is a less-than (<) value. (2) In instances where no positive detections were reported, the entry is ND for not detected and the value in parentheses is the average detection limit shown with a less-than symbol (<).
[c] National Primary Drinking Water Regulations (40 CFR Part 141).
[d.] Rules of Tennessee, Department of Environment and Conservation, Bureau of Environment, Division of Water Supply – Chapter 0400-05-01, "Public Water Systems" (http://www.state.tn.us/sos/rules/0400/0400.htm).
[e.] 2016 sampling results for ambient levels of this parameter were not found, but during the 5 years of record (2006 through 2021), TVA reported that no detected quantities of gross alpha radioactivity were in the Watts Bar liquid effluents (TVA 2007b, 2008b, 2009b, 2010c, 2011j).
[f.] Below lower limit of detection of 300 picocuries per liter.
[g.] National Secondary Drinking Water Regulations (40 CFR Part 143).
[h.] 2021 Offsite Dose Calculation Manual.
[i.] Radiological Results from TVA 2021 Annual Radiological Environmental Operating Report.
[j.] Non-Radiological Results from How's My Waterway-Waterbody Report (EPA), 2016 through 2021.
[k.] Nuclear Regulatory Commission data from 2020.

Attachment 2

Department of Energy National Nuclear Security Administration Memorandum: "NEPA Compliance for the Proposed Irradiation of up to 5000 TPBARs at Watts Bar Nuclear Plant" (September 30, 2022)

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Department of Energy
National Nuclear Security Administration
Office of the General Counsel

MEMORANDUM

DATE: September 30, 2022

FROM: James Sanderson, National Nuclear Security Administration (NNSA) National Environmental Policy Act (NEPA) Compliance Officer *James Sanderson*

TO: Marvin Adams, Deputy Administrator for Defense Programs

SUBJECT: NEPA Compliance for the Proposed Irradiation of up to 5000 TPBARs at Watts Bar Nuclear Plant

Under this proposal, and in partnership with the Department of Energy (DOE)/NNSA, the Tennessee Valley Authority (TVA) is considering increasing production of tritium in TVA reactors at the Watts Bar Nuclear Plant using tritium-producing burnable absorber rods (TPBARs). The current TVA proposal is essentially the same as the previously analyzed alternative 4 in DOE/NNSA's 2016 *Final Supplemental EIS for the Production of Tritium in a Commercial Light Water Reactor* (CLWR SEIS) (DOE/EIS-0288-S1). The CLWR SEIS alternative 4 assumes the irradiation of up to a total of 5000 TPBARs every 18 months at the Watts Bar Plant using the Watts Bar 1 and 2 reactors. Because TVA would irradiate a maximum of 2500 TPBARs in any one reactor, this would involve use of both Watts Bar reactors. Under this alternative, TVA would not irradiate TPBARs for tritium production at the Sequoyah Plant. Prior to this current proposal, DOE/NNSA published a Record of Decision (ROD) on the CLWR SEIS on March 4, 2016, in the *Federal Register* (81 FR 40685), in which DOE/NNSA chose Alternative 6 as the preferred alternative analyzed in the SEIS. Alternative 6 allows for the irradiation of up to a total of 5000 TPBARs every 18 months using TVA reactors at both the Watts Barr and Sequoyah Nuclear Plants.

Although the environmental impacts of this proposed action have been addressed in previous environmental impact statements, i.e., the 1999 *Final EIS for the Production of Tritium in a Commercial Light Water Reactor* (DOE/EIS-0288) and the 2016 CLWR SEIS, TVA staff noted new information or circumstances relevant to environmental concerns that could potentially have a bearing on the current proposal or its impacts. This new information was analyzed in an August 15, 2022 memorandum, i.e., *TVA Memorandum on Adequacy of DOE's 2016 SEIS for TVA's Proposed Action to Irradiate up to 5000 TPBARs at Watts Bar Nuclear Plant.* In this memo, TVA addresses their recent review of the 2016 CLWR SEIS to determine if additional environmental review under NEPA was needed, consistent with CEQ regulations at 40 CFR 1502.9(d).

During an interagency teleconference held in May 2021, DOE/NNSA requested information from TVA to help DOE/NNSA in its determination of the adequacy of the 2016 SEIS insofar as TVA's updated proposal. Additional information given to DOE/NNSA addresses anticipated effects on the amount of spent fuel to be generated at Watts Barr, the fuel cycle there, and the amount of tritiated wastewater estimated to be generated from TPBAR irradiation.

In terms of the amount of spent fuel to be generated at Watts Barr, TVA's current proposal would result in 36 additional fuel assemblies every 18 months. The SEIS assumed up to 41 additional fuel assemblies, so it provides a conservative bounding analysis of the approximately 2500 TPBAR equilibrium core designs. There would be additional spent fuel generated with the new proposal. However, TVA has ensured DOE/NNSA that it has infrastructure in place to manage the increased volume of spent nuclear fuel assemblies.

In regard to the new proposal's effects on the fuel cycle, the cycle length is only mentioned in the SEIS twice, and only in the context of being a "potential uncertainty" in determining if it was necessary to assume in the SEIS a higher, more conservative tritium permeation rate. TVA does not consider the operating cycle length to be uncertain, and it also does not anticipate that irradiation of up to 2500 TPBARs at each reactor would affect the typical fuel cycle. Thus, the issue has no bearing on the review for adequacy of the SEIS for any future TVA action to irradiate up to 5000 TPBARs at Watts Barr.

Lastly, the estimated amount of tritiated wastewater (due to permeation from the TPBARs into the cooling water) was not identified in the SEIS, as it is difficult to separate this out from other releases from such things as turbine building sumps, floor drain collector sumps, groundwater sumps, etc. However, in order to keep maximum tritium concentrations low, TVA will use a "feed and bleed" technique, which will require additional cooling water per fuel cycle. For various reasons, TVA would like to keep the maximum tritium concentration in each unit at 8 uCi/g. This will require an additional 97,626 gallons of water per unit in a fuel cycle. This will increase water usage by approximately 25% but is not expected to affect environmental impacts significantly.

The current proposal does not represent a substantive change to operations, activities, and associated impacts assessed in existing NEPA documentation. Accordingly, no further NEPA analysis of this TVA proposal is required.

James Sanderson
National Environmental Policy Compliance Officer
Office of General Counsel
Department of Energy/National Nuclear Security Administration

cc: Kyle Wilhelm, NA-192