Tennessee Valley Authority, 1101 Market Street, Chattanooga, TN 37402

CNL-16-198

December 8, 2016

10 CFR 2.101
10 CFR 52.15

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

Clinch River Nuclear Site
NRC Project No. 785

Subject: Submittal of Supplemental Information Alternate Cooling Water Systems in Support of Early Site Permit Application for Clinch River Nuclear Site

References:

1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016

2. Letter from TVA to NRC, CNL-16-134, "Schedule for Submittal of Supplemental Information in Support of Early Site Permit Application for Clinch River Nuclear Site," dated August 11, 2016

3. NRC Presentation, "Discussions Related to TVA's Planned Submittal of Information to Supplement its May 12, 2016 Early Site Permit Application," public meeting held on September 15, 2016

By letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. In addition, and consistent with interactions with NRC staff, TVA identified certain aspects of the application that it intends to supplement. By letter dated August 11, 2016 (Reference 2), TVA provided a plan for submitting the identified supplemental information. At a public meeting held on September 15, 2016, the NRC staff discussed various topics related to TVA's planned supplemental information (Reference 3). One of the topics discussed at the public meeting was related to alternate cooling water systems.

The enclosure to this letter contains a description of the supplemental information related to alternate cooling water systems, including a markup of the affected Environmental Report sections. These changes will be incorporated in a future revision of the early site permit application.

There are no new regulatory commitments associated with this submittal. If any additional information is needed, please contact Dan Stout at (423) 751-7642.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 8th day of December 2016.

Respectfully,

J. W. Shea Digitally signed by J. W. Shea
DN: cn=J. W. Shea, o=Tennessee Valley Authority, ou=Nuclear Licensing, email=jwshea@tva.gov, c=US
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J. W. Shea
Vice President, Nuclear Licensing

Enclosure:

Supplemental Information Regarding Alternate Cooling Water Systems

cc (with enclosures):

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cc (without enclosures):

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Supplemental Information Regarding Alternate Cooling Water Systems

By letter dated May 12, 2016 (Reference 1), Tennessee Valley Authority (TVA) submitted an application for an early site permit for the Clinch River Nuclear (CRN) Site in Oak Ridge, TN. In addition, and consistent with interactions with NRC staff, TVA identified certain aspects of the application that it intends to supplement. By letter dated August 11, 2016 (Reference 2), TVA provided a plan for submitting the identified supplemental information. At a public meeting held on September 15, 2016, the NRC staff discussed various topics related to TVA's planned supplemental information (Reference 3). One of the topics discussed at the public meeting was related to alternate cooling water systems.

This enclosure contains supplemental information related to alternate cooling water systems, including a markup of the affected Environmental Report (ER) sections. These changes will be incorporated in a future revision of the early site permit application.

Supplement Item (SI) AltSys 1 (from Reference 3)

ER 9.4.2.2.1 states that there are no viable alternatives for the general location of the proposed intake structure and that any alternative intake configurations would result in increased costs and environmental impacts. However, insufficient information is provided for the staff to use as a basis for the evaluation of alternate intake system impacts, or, a comparison of the impacts of alternate systems to the impacts of the proposed intake system. A more thorough description of alternatives is necessary (e.g., intake system alternatives consistent with NUREG-1555, Section 9.4.2, that may be feasible could include an intake on Melton Hill reservoir or the use of a Ranney well system) and an evaluation of environmental impacts, as compared to the impacts of the proposed intake.

TVA Response

ER Subsection 9.4.2.2.1 is being supplemented with information regarding the consideration of alternative intake systems. The supplemental information in ER Subsection 9.4.2.2.1 includes an evaluation of the environmental impacts of the alternative system designs as compared to the proposed circulating water system.

SI AltSys 2 (from Reference 3)

ER 9.4.2.2.3 states that no alternative water sources were evaluated because the proposed supply is readily available and can be used without adverse impacts to other users. However, NUREG-1555, Section 9.4.2, directs that even when no adverse impacts have been identified for the proposed system, alternative circulating water systems must be evaluated in the depth necessary to judge their environmental equivalence. Examples of water supply alternatives consistent with NUREG-1555, Section 9.4.2, that may be feasible could include sources such as groundwater or the City of Oak Ridge. Compare the impacts of the alternative water supplies to the impacts of the proposed water supply.

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TVA Response

ER Subsection 9.4.2.2.3 is being supplemented with information regarding the consideration of alternative water supplies. The supplemental information in ER Subsection 9.4.2.2.3 includes an evaluation of the environmental impacts of the alternative water supplies as compared to the proposed water source.

References:

1. Letter from TVA to NRC, CNL-16-081, "Application for Early Site Permit for Clinch River Nuclear Site," dated May 12, 2016

2. Letter from TVA to NRC, CNL-16-134, "Schedule for Submittal of Supplemental Information in Support of Early Site Permit Application for Clinch River Nuclear Site," dated August 11, 2016

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Supplemental Information Regarding Alternate Cooling Water Systems

ER Subsection 9.4.2.2.1 is being revised as indicated. Strikethroughs indicate text to be deleted. Underlines indicate text to be added.

9.4.2.2.1 Intake System

~~There are no viable alternatives for the general location of the proposed intake structure. To avoid intake of heated water from the discharge, the structure is located on the upstream portion of the CRN Site, and the discharge is located on the downstream portion. The specific location is to be determined following final facility design based on navigational needs, protection of the intake structure and other design considerations, as well as economic considerations associated with ease of access.~~

~~As shown in Figure 3.4-2, the proposed intake structure is located directly on the shoreline, at surface water level. Any potential alternative configurations, such as intake from a pipe extending out into the reservoir, or intake from a canal dug into the bank, would result in increased costs for the additional infrastructure, as well as increased environmental impacts associated with excavation. Therefore, alternative conceptual configurations of the intake structure were not considered.~~

<u>9.4.2.2.1.1 Intake Location</u>

<u>The CRN Site is located on a peninsula on the north shore of the Clinch River arm of Watts Bar Reservoir (Figure 2.1-2), between approximately Clinch River Mile (CRM) 14.5 and CRM 19 (Reference 9.4-7; Reference 9.4-8). As discussed in Subsection 3.3.1, the proposed location of the intake structure is at approximately CRM 17.9, which is near the upstream edge of the CRN Site. Potential alternative intake locations evaluated include Melton Hill Reservoir, a location between Melton Hill Reservoir and CRM 17.9, a location on the CRN Site between CRM 17.9 and CRM 14.5, and a location on the Clinch River arm of Watts Bar Reservoir downstream of CRM 14.5.</u>

<u>As shown in Figure 2.1-3, the cooling towers are not situated directly on the Clinch River arm of the Watts Bar Reservoir, or on any other surface water source. To supply make-up water to the cooling towers, the water must be conveyed from its source to the cooling towers through either a water supply pipeline or canal. Either a pipeline or canal would require ground disturbance during construction, resulting in impacts to terrestrial and aquatic ecology, as well as water quality, air emissions, and land use impacts. The longer the distance, the greater these impacts would be. Therefore, the optimal intake location would minimize the length of the required pipeline or canal.</u>

<u>As shown in Figure 4.1-1, the cooling towers are located within the area which would be permanently cleared for the plant. This permanent clearance area comes closest to bordering the reservoir on the eastern, upstream side of the peninsula, between approximately CRM 17.5 and 17.9. In the remainder of the CRN Site, there is a buffer of land which will not be disturbed between the reservoir and the permanently cleared area. The optimal intake location would minimize the amount of temporary ground disturbance and land use outside of the permanent clearance area.</u>

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Supplemental Information Regarding Alternate Cooling Water Systems

As discussed in Subsection 5.3.2.1, one objective of the hydrothermal analysis was to verify that the intake for the CR SMR Project is located far enough upstream to minimize the potential for blowdown being recirculated into the intake. To achieve this, the optimal intake location would be as far upstream of the discharge as feasible.

The proposed intake location would result in a 2498 ft long pipeline, and would not require any additional ground disturbance or land use outside of the permanent clearance area for the plant. An intake at other locations within the CRN Site would require a pipeline length of 6558 to 7147 ft. Although an intake on the western side of the CRN Site would result in shorter pipeline than the proposed intake location, it would not accomplish the objective of being located as far upstream of the discharge as possible, and could potentially result in recirculation of heated water. Also, an intake on the western side of the CRN Site would require a pipeline or canal to be constructed outside of the permanent clearance area. An intake outside of the CRN Site would require a pipeline or canal with a minimum length of 6558 ft. An intake directly on the north side of Melton Hill Reservoir would require a pipeline or canal with a minimum length of 27,575 ft, and a pipeline or canal with a length of 24,824 ft would be required to reach an intake on the south side of Melton Hill Reservoir.

The proposed intake location minimizes construction impacts, and minimizes disturbance outside of the permanent disturbance area, while still meeting the objective of avoiding recirculation of heated water. Most of the alternative intake locations would result in a greater level of construction impacts, as well as disturbance outside of the permanent disturbance area. An intake location on the western side of the CRN Site would result in a reduction in construction impacts, but would require disturbance outside of the permanent disturbance area, and would not meet the objective of being located as far upstream of the discharge as feasible. Therefore, the alternative intake locations are not environmentally preferable to the proposed intake location, and were not evaluated further.

9.4.2.2.1.2 Intake Pipe or Canal

As shown in Figure 3.4-2, the proposed intake structure is located directly on the shoreline, at surface water level. Alternative intake structures, including an intake pipe and intake canal, were considered.

An intake pipe would consist of a pipe extending out into the reservoir, and would withdraw water from the center of the reservoir instead of the shore. The type of inlet and size of the pipe could be selected and adjusted to manage the intake to keep cap entrance velocities below 0.5 feet per second (fps), as required by the Clean Water Act Section 316(b) Phase I requirements specified in 40 CFR 125.84. The inlet type and orientation could be adjusted to avoid creation of a vortex in order to minimize entrainment of aquatic biota and detritus. An intake canal would consist of a channel excavated into the riverbank. An intake canal places the intake pumps a distance inland from the reservoir, allowing intake velocities to be managed to comply with 316(b) requirements. The proposed shoreline intake structure is designed to keep flow velocities below 0.5 fps, complying with 316(b) requirements.

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As discussed in Subsection 4.2.1.1.2, there is legacy contamination within sediments in the reservoir, and TVA is party to an Interagency Agreement requiring coordination with other agencies for activities which could result in the disturbance, re-suspension, removal, and/or disposal of contaminated sediments in the reservoir. Installation of an intake pipe requires disturbance of sediments within the reservoir, resulting in water quality and aquatic ecology impacts associated with construction. Installation of a shoreline intake or an intake canal requires disturbance of sediments along the shoreline.

The three alternatives differ with respect to impacts associated with construction and with respect to land use during operations. Installation of an intake pipe would require dredging of a trench in the reservoir, placing crushed stone bedding underneath the pipe, backfilling the trench with sand or gravel, and then protecting the pipe with riprap. Installation of an intake canal would require excavation from the shoreline into the plant, which would result in water quality, terrestrial ecology, and air quality impacts during construction, and would require land use during operations. The proposed shoreline intake would minimize the need for excavation onshore, thus minimizing water quality, terrestrial ecology, and air quality impacts during construction, and minimizing land use needs during operations. Therefore, neither an intake pipe nor an intake canal alternative are environmentally preferable to the proposed shoreline intake, and were not evaluated further.

9.4.2.2.1.3 Radial Collector Wells

Radial collector wells, also known as Ranney wells, are a mechanism for withdrawing surface water by laterally projecting well screens through alluvial sediments adjacent to and underneath a surface water body. These wells protect aquatic life by withdrawing water at extremely low velocities through many feet of porous material. The system requires no excavation in the waterway, so there are no direct construction impacts to the reservoir. The withdrawn water is generally free of turbidity, reducing the need for water treatment; and the visual impact of the system is minimal, compared to a conventional shoreline intake system. However, the quantity of water that can be obtained from a radial collector well depends on the characteristics of the aquifer in which it is located. (Reference 9.4-9)

The highest yielding collector wells are constructed in coarse-grained outwash and alluvium deposits where the fines (clay, silt, fine sand) have been winnowed out, the saturated thicknesses of the unconsolidated formation are a minimum of 60 to 70 ft thick, and the well is located in close proximity to a surface water source that is rapidly hydraulically connected to the unconsolidated aquifer. The land requirement for such a well (one well) would be a parcel approximately 430 ft x 430 ft (184,900 ft2 [4.25 ac]). Typical spacing for collector wells is 1500 ft (Reference 9.4-9). Yields from collector wells constructed in ideal conditions would range from 10 to 15 million gallons per day (mgd). As discussed in Subsection 5.2.2.1.1, the expected water needs for plant operations range from an average of 26 mgd to a maximum of 44 mgd. If ideal conditions were present at the CRN Site, three to four wells would be required to meet the water needs for plant operations.

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As discussed in Subsection 2.3.1.2.1.2.5, there are alluvial and river terrace deposits along the Clinch River arm of the Watts Bar Reservoir on the CRN Site, but these sediments are primarily silty clay with thin intercalated layers of quartzose gravel. With finer-grained sediments, well screens need to be installed with smaller slot sizes to stop the formation from entering and clogging the well. Smaller slot sizes result in lower productivity from each well. As discussed in Subsection 2.3.1.2.1.2.5, the thickness of the unconsolidated sand and clay alluvial deposits along the shoreline is approximately 32 ft. This is substantially thinner than the 60 to 70 ft needed for highly productive radial wells. A more comparable example of production from an aquifer of similar thickness, provided in Table V-1 of the American Society of Civil Engineers Design of Water Intake Structures for Fish Protection, is a range of 1 to 5 mgd for wells with a saturated thickness of 20 to 40 ft (Reference 9.4-9).

As shown on Figure 2.6-4, the alluvial aquifer at the CRN Site is limited to a narrow strip less than 500 to 1000 ft wide along the eastern, southern, and western edges of the CRN Site. Of these, the alluvial aquifer located on the western edge of the site is located adjacent to and downstream of the proposed discharge, so an intake at this location would potentially withdraw heated water, and would therefore not be technically feasible. The total area of alluvium on the eastern and southern edges of the site comprise a total of 26.2 ac.

Because the sediment type, thickness, and areal extent of the alluvial aquifer at the CRN Site fall short of the ideal conditions for Ranney wells, yields in the range of 10 to 15 mgd are not technically feasible. Assuming a production rate close to 5 mgd, approximately nine Ranney wells would be required. At 4.25 ac per well, an alluvial aquifer system of more than 38 ac in size (9 wells X 4.25 ac per well = 38.25 ac) would be required. Because only approximately 26 ac of alluvial aquifer are available on the site, Ranney wells are not technically feasible, and were not analyzed in detail.

ER Subsection 9.4.2.2.3 is being revised as indicated. Strikethroughs indicate text to be deleted. Underlines indicate text to be added.

9.4.2.2.3 Water Supply

CWS makeup water is to be withdrawn from the Clinch River Arm of the Watts Bar Reservoir. Reservoir water use is discussed in Section 3.3, and is summarized in Subsection 9.4.2.1.3. As discussed in Subsection 5.2.2.1.1, the expected water needs for plant operations range from an average of 26 mgd to a maximum of 44 mgd. The sufficiency of the water supply for facility operation and the impact of water use from the reservoir are analyzed in Section 5.2. Alternative water supply sources, including groundwater, the City of Oak Ridge water supply system, and wastewater flows, were considered.

~~The analysis in Section 5.2 demonstrated that the maximum expected water use from facility operations would require withdrawal of approximately 17 percent, and consumption of approximately 7 percent, of the minimum continuous flow released from Melton Hill Dam. In addition, the flow from Melton Hill Dam is a relatively small contributor to the overall amount of water available in Watts Bar Reservoir compared to the flow from Fort Loudon Dam. Inflows to Watts Bar Reservoir from the mainstream of the river are much greater than from its tributaries.~~

Therefore, Section 5.2 concluded that the Clinch River arm of the Watts Bar Reservoir has sufficient water to supply facility operations.

Section 5.2 also summarized the results of a Regional Surface Water Use Study which analyzed current and projected future water use in the Tennessee River watershed and in the portion of the Clinch River Basin upstream of the CRN Site (Reference 9.4-7). That analysis demonstrated that the maximum expected water withdrawal from plant operations is approximately 0.4 percent of total surface water withdrawals in the Tennessee River watershed, and that maximum consumptive water use is approximately 3.9 percent of total water consumption. The analysis concluded that there is sufficient water available to supply water use projections out to 2035.

Because surface water is readily available, and can be accessed without adverse impacts to other users, no alternative sources of water supply were evaluated.

9.4.2.2.3.1 Groundwater

Section 2.3 discusses regional groundwater use and site-specific groundwater occurrence. As discussed in Subsection 2.3.2.2.1, groundwater resources in the region are very limited. The total withdrawal of groundwater in the geographic area of interest, which is the five-County region surrounding the CRN Site, is 3.5 mgd. This is less than 10 percent of the operational water needs of the plant.

Section 2.3 summarizes local and regional groundwater production. Subsection 2.3.2.2.1 describes wells and springs within a 2-mile (mi) radius of the site, and reports that nearly all wells were domestic wells with flow rates less than 10 gpm. As discussed in Subsection 2.3.1.2.1.1, individual well yields from wells completed in the principal aquifers range from about 11 to 350 gpm (0.016 to 0.504 mgd). If site conditions permitted groundwater production in the upper end of this regional range, a minimum of 88 such wells would be required to meet the water needs of plant operations. However, the reported data from wells within a 2-mi radius of the site suggest productivity would be at the lower end of the range. Productivity in the lower end of the range is also supported by results from the aquifer pump test conducted on the CRN Site, as discussed in Subsection 2.3.1.2.2.4.1. The test well was pumped at a constant rate of 14.5 gpm for 72 hours. If productivity in the range of 14.5 gpm can be expected, then more than 2700 wells would be required. The yield of individual wells may be improved through the use of radial collector well technology. However, given that the water needs for plant operations are up to more than 10 times the entire volume of groundwater production in the five county study area surrounding the CRN Site, providing a water supply for plant operations from groundwater resources, even using radial collector well technology, is not technically feasible.

9.4.2.2.3.2 City of Oak Ridge

Use of the City of Oak Ridge water supply system as the plant water supply was evaluated. The capacity of the City of Oak Ridge water supply system is 28 mgd, of which 10.2 mgd was withdrawn in 2005 (Reference 9.4-10). Based on average water supply requirements of 26 mgd, and maximum water supply requirements of 44 mgd, for plant operations, the City of Oak Ridge system does not have the capacity to supply plant operations. Therefore, the City of Oak Ridge is not a technically feasible alternative for the plant water supply.

9.4.2.2.3.3 Recycled Wastewater

Use of recycled wastewater flows in the local area was evaluated. Table 2.3.2-2 shows the wastewater returns in the surface water study area in 2010. The total return of public water supply in the seven-county area is 80.47 mgd. However, the majority of this return, more than 58 mgd, is located in Knox County. The closest of these return sources is approximately 14 mi east of the CRN Site. The total amount of return within Roane County is 3.0 mgd, substantially less than the 44 mgd needed to support plant operations. Outside of Roane County, the closest wastewater return is the Oak Ridge Wastewater Treatment Plant in Anderson County. The Oak Ridge plant returns 4.53 mgd, or approximately 10 percent of the water needs for operations, and is located approximately 7 mi from the CRN Site. Other wastewater sources would be located further from the CRN Site. Overall, the largest single wastewater source in the seven-County area is the Knoxville-Kuwahee Wastewater Treatment Plant, which returns approximately 29 mgd, and is located more than 21 mi east of the CRN Site.

Because there is no single source of wastewater with the capacity to support plant operations, multiple sources would need to be accessed. Each of these would require construction of a pipeline, ranging from 7 to more than 20 mi in length. The construction of each of these pipelines would have its own impacts, including land use, terrestrial ecology, water quality, and air quality impacts. Given these constraints, the use of wastewater is not environmentally preferable to the proposed water source, and no further evaluation of this option was considered.

As a result of the changes to ER Subsections 9.4.2.2.1 and 9.4.2.2.3, the following references are being revised/added to ER Subsection 9.4.4:

9.4.4 References

~~Reference 9.4-7. Tennessee Valley Authority, "Clinch River Small Modular Reactor Site Regional Surface Water Use Study," April 10, 2014.~~
Reference 9.4-7. Tennessee Valley Authority, "Final Environmental Impact Statement Watts Bar Reservoir Land Management Plan Loudon, Meigs, Rhea, and Roane Counties, Tennessee," February, 2009.

Reference 9.4-8. Watts Bar - Clinch Watershed Team, Final Watts Bar Reservoir Land Management Plan, Panel 4; Alternative B "Preferred", January 23, 2009.

Reference 9.4-9. American Society of Civil Engineers, Design of Water Intake Structures for Fish Protection, 1982.

Reference 9.4-10. U.S. Geological Survey, Public Water-Supply Systems and Associated Water Use in Tennessee, Website: http://pubs.usgs.gov/of/2010/1226/pdf/ofr2010-1226.pdf, 2005.