

INDEPENDENT SPENT FUEL STORAGE INSTALLATION  
WATTS BAR NUCLEAR PLANT

**FINAL ENVIRONMENTAL ASSESSMENT**  
Rhea County, Tennessee

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## Acronyms and Abbreviations

<b>BMP</b>	Best Management Practices
<b>CFR</b>	Code of Federal Regulations
<b>CLWR</b>	Commercial Light Water Reactor
<b>DOE</b>	Department of Energy
<b>EA</b>	Environmental Assessment
<b>EIS</b>	Environmental Impact Statement
<b>EPA</b>	Environmental Protection Agency
<b>EPRI</b>	Electric Power Research Institute
<b>FES</b>	Final Environmental Statement
<b>FONSI</b>	Finding of No Significant Impact
<b>FSAR</b>	Final Safety Analysis Report
<b>GEIS</b>	Generic Environmental Impact Statement
<b>GHG</b>	Greenhouse Gas
<b>ISFSI</b>	Independent Spent Fuel Storage Installation
<b>MSL</b>	Mean Sea Level
<b>NAAQS</b>	National Ambient Air Quality Standards
<b>NEPA</b>	National Environmental Policy Act
<b>NPDES</b>	National Pollutant Discharge Elimination System
<b>NRC</b>	Nuclear Regulatory Commission
<b>PMF</b>	Probable Maximum Flood
<b>PMP</b>	Probable Maximum Precipitation
<b>RCRA</b>	Resource Conservation and Recovery Act
<b>SEIS</b>	Supplemental Environmental Impact Statement
<b>SQN</b>	Sequoyah Nuclear Plant
<b>SWPPP</b>	Storm Water Pollution Prevention Plan
<b>TRM</b>	Tennessee River Mile
<b>TVA</b>	Tennessee Valley Authority
<b>WBN</b>	Watts Bar Nuclear Plant



## CHAPTER 1 – PURPOSE AND NEED FOR ACTION

### 1.1 Introduction

This environmental assessment (EA) has been prepared to analyze the Tennessee Valley Authority's proposal to construct and operate an Independent Spent Fuel Storage Installation (ISFSI). The EA is a site-specific analysis of potential impacts that could result from implementing the proposed action and provides information for determining whether significant impacts could result from TVA's proposal. If the EA's analysis shows that significant impacts will result from the actions, then an environmental impact statement would be prepared for the project. If not, TVA will issue a Finding of No Significant Impact (FONSI) statement.

### 1.2 Background

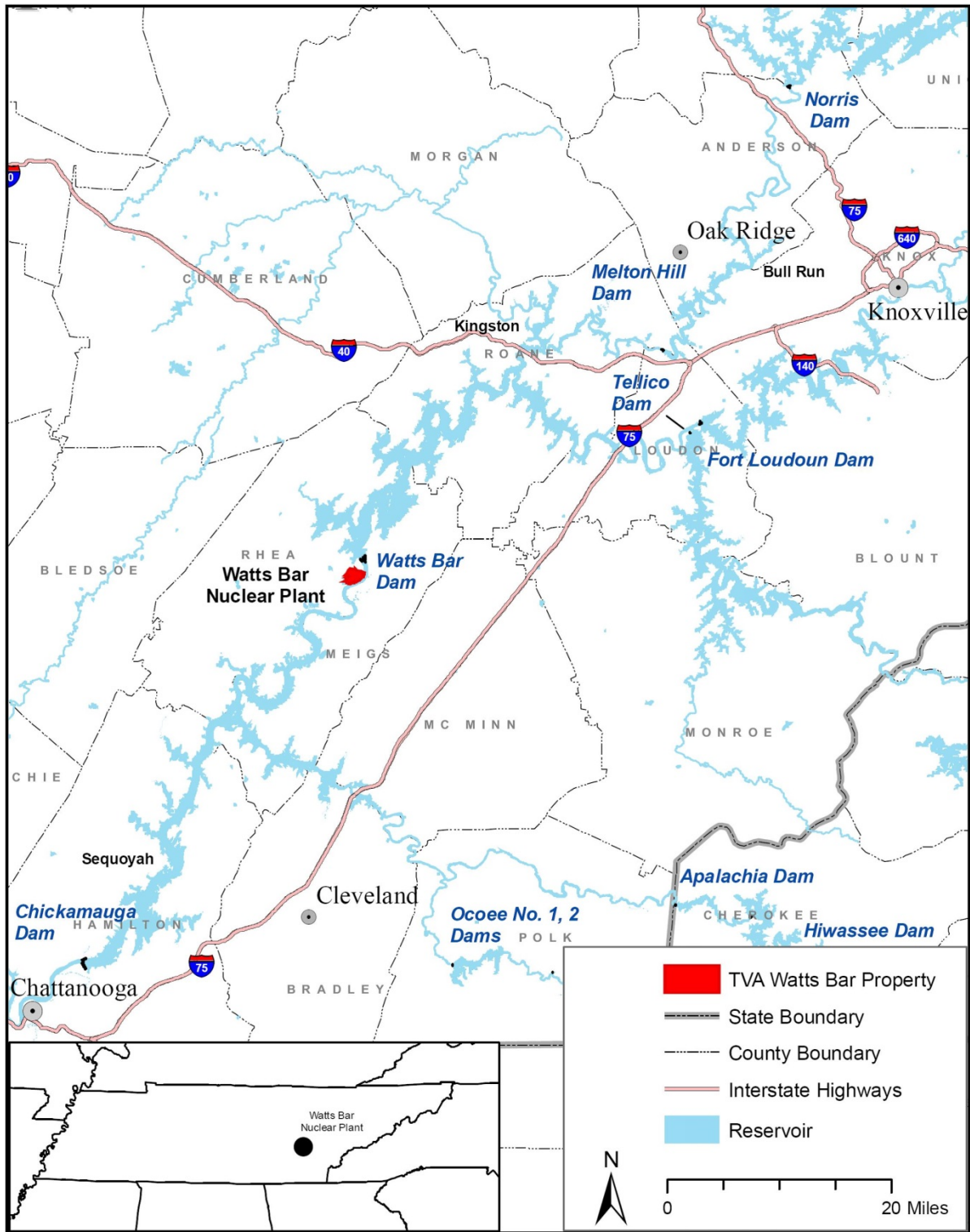
The Tennessee Valley Authority proposes to construct and operate an ISFSI at the Watts Bar Nuclear Plant (WBN) in Rhea County, Tennessee (see Figure 1.1). An ISFSI is a facility designed and constructed for the dry storage of spent nuclear fuel and other radioactive materials. ISFSIs are licensed by the Nuclear Regulatory Commission (NRC) under 10 Code of Federal Regulations (CFR) Part 72. The facility at WBN would be composed of a vendor-supplied dry cask storage system and a concrete storage pad facility, with supporting infrastructure. The proposed WBN storage pad facility would be comprised of two separate pads: one pad holding up to 80 dry storage casks would be completed by 2016 and would be about 1/2 acre in size, and a second, similarly-sized storage pad would be constructed at the site in 15 to 20 years to hold up to 100 additional casks.

The proposed location of the ISFSI at WBN is a slightly elevated lawn adjacent to the plant's existing northern protected area perimeter and just northwest of the plant's emergency diesel generators. The site has been previously graded and is currently transected by a small gravel road.

The primary activities to be performed for this project would be as follows:

1. Modifications to the existing WBN Auxiliary Building necessary to handle, lift, load, seal, and transport the dry spent fuel storage modules;
2. Construction of a haul path from the WBN Auxiliary Building to the ISFSI pad;
3. Construction of the ISFSI facility, which includes pads, drainage systems, fire hydrants, contingency shield walls, landscaping, a cask fabrication pad, an equipment storage building, and a perimeter road;
4. Modifications to existing security infrastructure to include the ISFSI within the plant's protected area; and
5. Operation of the associated handling, hauling, and storage facilities for at least 60 years after plant operations cease up to an indefinite period.

Figure 1.1 Location of Watts Bar Nuclear Plant



Map Location: \\knxknx\p6\gis\projects\Ruth\_Horton\Watts Bar Site Location.mxd



Under the proposal, project construction activities would begin in late summer 2014 and would last until late 2015 or early 2016.

In 2007, as part of its supplemental review for the completion of a second unit at WBN, TVA generally analyzed the impacts of constructing and operating an ISFSI facility at WBN to support the continued operation of WBN Unit 1 and of Unit 2. This EA updates that review and considers site-specific impacts more fully.

### **1.3 Purpose and Need**

The purpose of the proposed action is to provide additional on-site storage capacity for spent nuclear fuel at WBN to support continued operation of the plant. Additional storage capacity at WBN is necessary because plans for permanent storage at a Federally-operated, off-site spent fuel repository are uncertain and the capacity of the existing WBN spent fuel pool is not adequate to support the long-term operation of the plant.

Currently, spent fuel from operation of the WBN Unit 1 nuclear reactor is stored in specially-designed storage racks within a steel-lined, concrete spent fuel pool inside the WBN Auxiliary Building. As of February 2014, the WBN spent fuel pool is at almost 75 percent capacity. Additional spent fuel storage capacity is needed by 2017 to support Unit 1 operations alone. Additional capacity is also needed to accommodate spent fuel from operations of Unit 2 (current progress on the WBN Unit 2 construction supports a December 2015 start date).

In its initial planning of WBN operations, TVA planned for spent fuel to be reprocessed off-site. Later, it was assumed that such reprocessing was unlikely and that on-site storage was needed until the Department of Energy (DOE) completed a mined, geological repository for permanent storage. Soon after, DOE and TVA identified ISFSI facilities as a viable and preferred way to provide additional on-site storage capacity at TVA's nuclear plants. Uncertainty remains as to the availability of the DOE repository for permanent storage, including where such a facility will be sited and when the facility would be in operation. Accordingly, this EA assesses the potential impacts of a range of periods for on-site storage of spent nuclear fuel at WBN, including indefinitely.

The storage of spent nuclear fuel from operations at WBN was first addressed in TVA's 1972 *Final Environmental Statement for WBN*, which assumed that spent nuclear fuel from the plant would be shipped to a reprocessing plant in South Carolina. In 1993, upon additional review of that document, TVA determined that such reprocessing was unlikely and that storage of spent fuel would be on-site until DOE completed a mined geological repository for high-level waste and spent nuclear fuel, as mandated by the Nuclear Waste Policy Act of 1982.

The need to expand on-site spent fuel storage at TVA nuclear plants was addressed in 1999 in the DOE's *Final EIS for the Production of Tritium in a Commercial Light Water Reactor (CLWR EIS)*, wherein a general analysis of potential impacts from construction and operation of a "generic" dry cask ISFSI for WBN Unit 1 and other TVA nuclear plants was completed. TVA adopted this EIS and its Record of Decision in May 2000. Since 2000, TVA has approved the construction and operation of an ISFSI at the Sequoyah and Browns Ferry Nuclear Plants.

TVA supplemented previous WBN environmental reviews in 2007 to consider the completion of a second unit at WBN. In its review of Unit 2, TVA supplemented, incorporated by reference, and tiered from the substantial environmental record previously prepared for actions related to the construction and operation of WBN. The *Final Supplemental Environmental Impact Statement for Completion and Operation of Watts Bar Nuclear Plant Unit 2 (TVA WBN Unit 2 SEIS)* incorporated by reference the ISFSI impact analysis of the *CLWR EIS*; provided additional analysis on spent fuel storage associated with operation of WBN Unit 2; and assumed that a Holtec International (Holtec) dry cask storage system would be utilized at WBN.

TVA would utilize the NRC's General License to store spent fuel at an ISFSI outdoor dry storage facility. A General License is an option available to all 10 CFR Part 50 power licensees to store spent fuel outside of the spent fuel pool at an ISFSI. A General License under 10 CFR Part 50 authorizes power licensees to store spent fuel outside of the spent fuel pool in cask designs approved by NRC.

#### **1.4 Decision to be Made**

Based on the information in this EA as well as engineering and cost information, TVA will determine whether to construct and operate an ISFSI at WBN. The EA discloses the environmental consequences of implementing the proposed action and a no action alternative. The FONSI statement, if applicable, will indicate a determination on the significance of the impacts analyzed in this EA. TVA's decision and the rationale for that decision will be stated in the FONSI.

#### **1.5 Related Environmental Reviews and Consultation Requirements**

This EA relies on and incorporates by reference previous impact analyses, consistent with 40 CFR Parts 1502.21, 1502.20 and 1508.28. Specifically, the EA tiers to and incorporates by reference the spent fuel storage impact analyses in the 2007 *TVA WBN Unit 2 SEIS* and the *CLWR EIS*, completed by the DOE in 1999 and adopted in 2000 by TVA. The *CLWR EIS* evaluated the environmental impacts associated with producing tritium at five nuclear plants, including WBN, and identified ISFSI facilities as the most viable means to expand on-site storage capacities at those plants. The *TVA WBN Unit 2 SEIS* tiers from and updates fuel storage analysis of the *CLWR EIS*. Both EISs addressed the need for onsite storage of spent nuclear fuel and the potential environmental impacts associated with an ISFSI at WBN in varying levels of detail.

The EA incorporates analysis of potential impacts of extended spent fuel storage at existing nuclear plants from DOE's *Final EIS for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain (Yucca Mountain EIS)*, and analysis and WBN environmental setting information from the NRC's *Final Environmental Statement Related to the Operation of Watts Bar Nuclear Plant, Unit 2, Supplement 2 (NRC WBN Unit 2 FES)*, completed in May 2013, and from TVA's *Fukushima Response Strategy EA*, completed in March 2013.

TVA also incorporates recent analysis of the environmental impacts of extended spent fuel storage at existing facilities from the September 2013 NRC *Waste Confidence Generic Environmental Impact Statement (Waste Confidence Draft GEIS)*. The NRC published a Proposed Rule in the *Federal Register* on September 13, 2013, which revises NRC's generic determination on the environmental impacts of continued storage of spent fuel beyond a reactor's licensed life for operation and prior to ultimate disposal. Because waste

confidence is relevant to storage of spent nuclear fuel at WBN, portions of the NRC's recent analysis provides important information for TVA's review. TVA carefully reviewed the Draft GEIS and identified relevant information and analyses useful to TVA's review of the WBN ISFSI project. Only this information and analyses have been referenced in the EA. TVA has not identified any activities related to operation of ISFSIs that would be inconsistent with those discussed in the Draft GEIS. In addition, the proposed ISFSI at WBN is fully consistent with the example at-reactor ISFSIs therein. The NRC's waste confidence rulemaking is not within the scope of TVA's analysis of the proposed ISFSI at WBN.

Also relevant to this EA is analysis of the potential environmental impacts of activities regarding decommissioning nuclear power plants found in the NRC's 2002 *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities Regarding the Decommissioning of Nuclear Power Reactors (Decommissioning GEIS)*. This EA incorporates this analysis by reference because the eventual decommissioning of the WBN is assumed under each alternative analyzed.

### **1.6 Scoping and Public Involvement**

By incorporating previous analyses and information, this EA will be limited in scope to project- and site-specific information to address issues not previously addressed by the referenced documents. Based upon these earlier reviews, the construction and operation of an ISFSI at WBN has the potential to significantly impact only a few environmental resources or otherwise require updating. These are:

- Geology, Soils and Seismicity
- Floodplains and Flood Risk
- Water Use and Quality
- Waste Management
- Human Health (Radiological Concerns)
- Postulated Accidents
- Greenhouse Gas Emissions and Climate Change

Extensive environmental analyses have been conducted for WBN since 1972 and the presence of resources within the WBN site is well understood. Within the ISFSI project area, there exist no cultural sites, special status species or their habitat, wetlands, or aquatic and terrestrial ecologic resources that may be affected by the proposal. Based on the proposed location of the ISFSI pads, impacts on these environmental resources are not expected to be different from impacts addressed in the earlier reviews. Nor is there a need to update the previous analyses of these resources.

TVA released the draft WBN ISFSI EA for a 30-day public review on April 7, 2014. One set of comments was received from the Tennessee Chapter of the Sierra Club, Tennessee Environmental Council, Bellefonte Efficiency and Sustainability Team/ Mothers Against Tennessee River Radiation, End Nuclear Dumping in Tennessee, and Nuclear Information and Resource Service. TVA has revised portions of the EA to address concerns raised by these groups relating to the potential impacts of terrorism attacks or sabotage; the need to incorporate hardened on-site storage principles into the ISFSI design; and the selection of Holtec as the dry cask storage system provider.

TVA also revised the EA to address concerns raised about the storage of high burnup spent fuel (see Chapter 3.6.2.2). High burnup fuels are fuels with more enriched uranium to capture greater amounts of energy; high burnup spent fuel is more radioactive and hotter

than conventional spent fuel. TVA reviewed the report cited by the commenters (Alvarez 2014) and notes that in a number of instances the report omits important information about the findings of organizations that have studied storage of high burnup spent fuel. For instance, the Alvarez report draws upon selective statements made by the Electric Power Research Institute (EPRI) and the National Academy of Sciences without acknowledging that the two groups have concluded that storing high burnup fuels in dry storage is safe.

The commenters also questioned the appropriateness of incorporating analyses from the NRC's Waste Confidence Draft GEIS and requested that TVA consider input they provided to NRC relating to Draft GEIS. However, the commenters failed to explain how their comments to NRC pertain to TVA's ISFSI proposal or to information and analysis in this EA, so no response is provided.

### **1.7 Necessary Permits or Licenses**

TVA would utilize the NRC's General License for the operation of Watts Bar Nuclear Plant to store spent fuel at an on-site ISFSI. In compliance with the Clean Water Act, the proposed activities would fall under WBN's National Pollutant Discharge Elimination System (NPDES) permit (TN0020168) and the Tennessee Storm Water Multi-Sector General Permits (TNR051343 and TNR050000). Because the construction of the ISFSI would disturb an area greater than one acre within a single watershed within the WBN site, TVA would apply for a Construction Storm Water Permit from the Tennessee Department of Environment and Conservation.

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## CHAPTER 2 - ALTERNATIVES

This chapter includes a description of the No Action and the Proposed ISFSI Alternatives and provides a summary comparison of the predicted environmental effects of these two alternatives on the human environment.

### 2.1 Description of Alternatives

TVA is considering two alternatives. Alternative A is the No Action Alternative and Alternative B represents the Proposed ISFSI Alternative. Because the proposed action tiers from the earlier reviews of storage alternatives that identified an ISFSI facility at WBN as preferable, others are not considered further.

#### 2.1.1 Alternative A – The No Action Alternative

Under this alternative, TVA would not construct and operate an ISFSI at WBN. TVA would continue to utilize the existing spent fuel pool for cooling and storage until the pool reaches its capacity. Because capacity in the spent fuel pool is limited, additional activities that produced spent fuel at the plant would have to cease within a decade (i.e., TVA would have to cease operating both WBN reactors), unless another method of storage becomes available which is not expected. After operations cease, spent fuel would continue to be stored in the spent fuel pool for an unknown period. TVA already has decided to complete and operate Unit 2 along with the continued operation of Unit 1. Accordingly, this alternative fails to meet the purpose of the proposed action and is deemed unreasonable.

#### 2.1.2 Alternative B – The Proposed ISFSI Alternative

The Proposed ISFSI Alternative under consideration is the construction and operation of an ISFSI at WBN in order to provide storage of spent fuel. This alternative includes construction of an ISFSI facility (which includes two ISFSI pads, a cask fabrication pad, an equipment storage building, drainage systems, fire hydrants, contingency shield walls, perimeter road, and landscaping); construction of a haul path from the WBN Auxiliary Building to the ISFSI site; modifications to the existing WBN Auxiliary Building necessary to handle, lift, load, seal, and transport the dry spent fuel storage modules; and necessary modifications to the WBN security apparatus, including the relocation of protective area fencing. During project construction activities, a temporary parking and laydown site would be established. Construction activities would begin in late 2014 and would last until late 2015 or early 2016, with one exception: one of the ISFSI pads would be constructed in 15 to 20 years.

TVA proposes to install a dry storage system developed by Holtec, a vendor with multiple systems approved by the NRC. The Holtec HI-STORM FW system is a cylindrical overpack system licensed by NRC to meet stringent design standards for on-site storage, in accordance with 10 CFR Part 72, and offsite transportation, in accordance with 10 CFR Part 71. The system is a vertical concrete cylinder design which consists of interchangeable canisters. Each dry storage cask is approximately 15 feet tall and 11 feet in diameter and, on the pads, would be separated by approximately 5 feet. TVA proposes to utilize up to 180 of these casks, each with a capacity of 37 spent fuel assemblies. The first ISFSI pad, to be completed in late 2015 or early 2016, would hold 80 dry storage casks, accommodating 2,960 spent fuel assemblies. The second pad, to be completed in 15 to 20 years, would hold up to 100 casks. Once operational, both pads could eventually accommodate a total of

6,660 spent fuel assemblies, which would provide minimum capacity to store all life of plant spent fuel.

To store 80 casks, the first ISFSI pad would be rectangular, in a 10 x 8 array, and approximately 0.5 acre in size (about 180 feet by 147 feet). During construction of the first pad, TVA would disturb up to approximately 5 acres.<sup>1</sup> Once operational, the ISFSI footprint (including the first pad, all support facilities, drainage systems, fire hydrants, contingency shield walls, and perimeter road) would be approximately 1.5 acre in size. The second pad would be constructed adjacent to the first pad (likely on its northern or western edge), would be slightly larger than the first pad, and would increase the total footprint of the ISFSI facility by up to 1 acre (note, the precise location of the second pad will be determined at a later date).

As noted above, the project area is located at WBN on a previously graded, slightly elevated lawn area adjacent to the plant's existing northern protected area perimeter and just northwest of the plant's emergency diesel generators. The proposed site lies approximately 200 yards distance from the WBN Auxiliary Building. A gravel road approximately 30 feet across lies atop the hill and transects the site. See Figures 2.1 and 2.2. The selected site is currently within the owner-controlled area; the site would be included within the protected area of the plant once the ISFSI becomes operational. The location falls within the boundary of the environmental impact study area of the 2007 *TVA WBN Unit 2 SEIS*.

Eighty to 100 workers would be on site at the peak of construction activities, during concurrent work in constructing the ISFSI facility and haul road, and in modifying the Auxiliary Building, the railroad bay floor, and the security components. Fewer workers would be on site during construction of the second ISFSI pad. During routine operations, one employee would be onsite to monitor the operations of the ISFSI at a maximum of 24 hour intervals. During loading campaigns, about 10 workers would be involved in the week-long process, working primarily within the Auxiliary Building.

Major components of the Proposed ISFSI Alternative include:

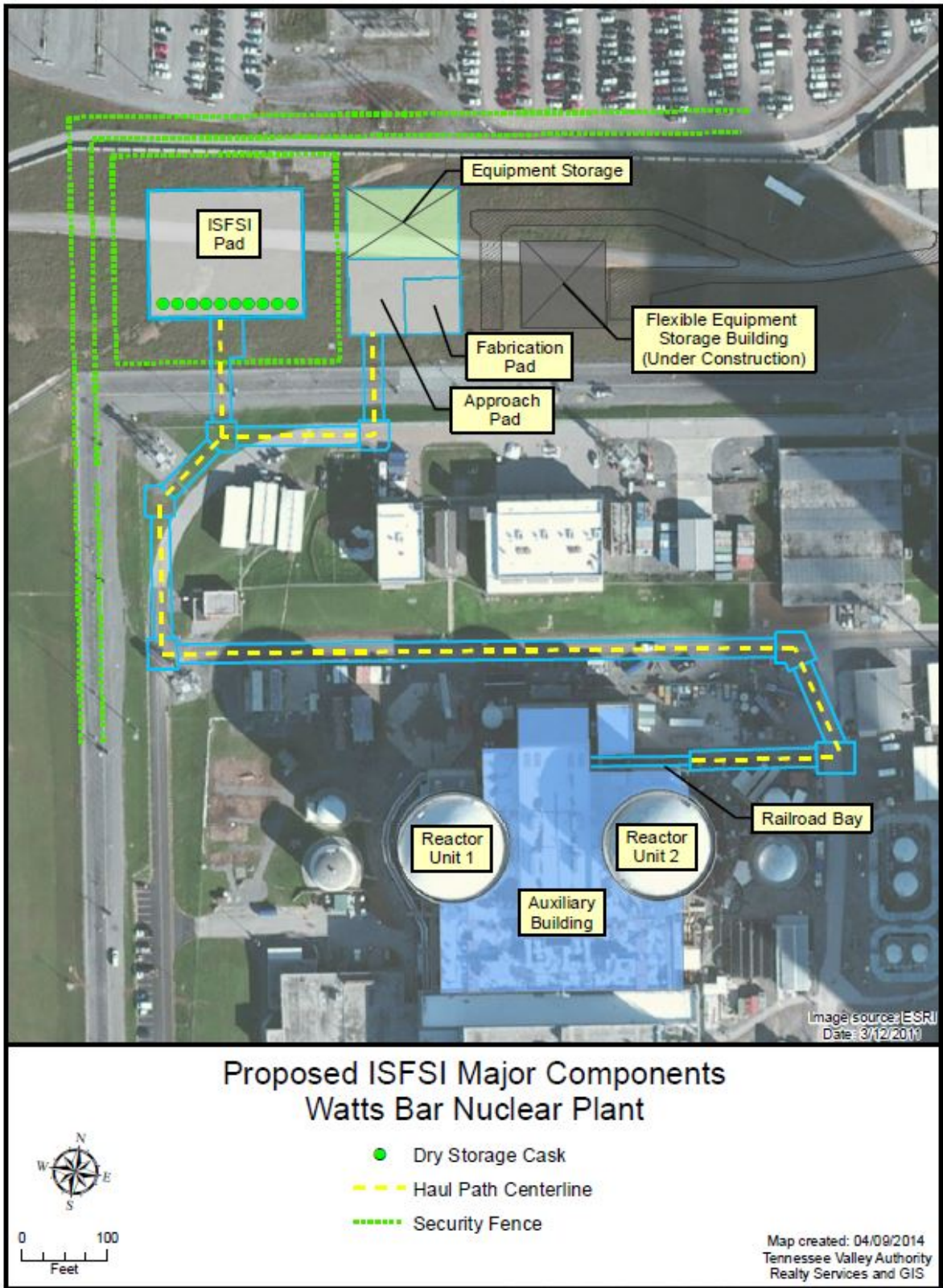
- **Two ISFSI Pads:** As described above, a two to three foot thick concrete pad would be constructed by early 2016 at a site satisfying the capacity requirements for the WBN ISFSI. A second, similarly-sized concrete pad would be constructed in 15 to 20 years adjacent to the first pad.<sup>2</sup> An equipment storage building, cask fabrication pad, and other support systems would also be included.
- **Auxiliary Building Modifications:** Modifications to the north side of the Auxiliary Building will be necessary under this alternative to handle, lift, load, seal, and transport the dry spent fuel storage modules. For instance, modifications to the railroad bay floor may be required to support additional weight. An upgraded, single-

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<sup>1</sup> In the *TVA Watts Bar Unit 2 SEIS*, TVA's analysis assumed a 1.3-acre ISFSI footprint with 2.2 acres of total disturbance; DOE's 1999 *CLWR FEIS* assumed a 1.3-acre ISFSI footprint with 5.3 acres of total disturbance.

<sup>2</sup> The precise location of the second ISFSI pad will be determined at a later date. Because it will be constructed in an area adjacent to the first ISFSI pad (most likely at its northern or western edge), for the sake of this analysis TVA assumes that the second pad's site characteristics (e.g., elevation, soils and groundwater characteristics) are the same as those of the first ISFSI pad.

Figure 2.1 Location of Proposed ISFSI at WBN (Subject to Minor Design Changes)



failure proof, 125-ton overhead crane would move the loaded cask or transfer overpack to the existing railroad bay for vertical handling of the cask or transfer of the canister into a pre-positioned storage overpack located on a cask transporter with a deck-to-ground clearance of about 1 foot. Following this transfer, the loaded transporter would move along a route to the final storage location on an ISFSI pad with a ground clearance of less than 1 foot en route.

- **Haul Path:** A haul path road approximately 1600 feet in length would be constructed from the Auxiliary Building to the ISFSI pad. The proposed path extends west from the Auxiliary Building along an existing roadway toward the security fencing and then turns north to the proposed ISFSI location. A majority of the path would be constructed on currently disturbed grounds and along existing roadway, to minimize new disturbance. The existing roadway's asphalt would be removed during construction and replaced with reinforced concrete to support the weight of the casks during hauling. The haul path will tie into the ISFSI pad location approximately 100 feet north of the current protected area perimeter. See Figure 2.1.
- **Security Facility Relocation:** Under this alternative, the relocation of WBN security perimeter and equipment would be necessary to accommodate the new ISFSI site within the protected area of the plant. The ISFSI would be within the site's protective area. The project will incorporate the existing security system and its components. All security changes will meet the TVA Physical Security Plan.
- **Operations:** Once ISFSI operations begin, the fuel discharge rate for each unit is projected to be approximately 89 fuel assemblies every 18 months. Thus, dry storage casks will be required for approximately 178 spent fuel assemblies every 18 months. Cask delivery requirements therefore vary between a sufficient number for an individual cycle (i.e., store approximately 89 spent fuel assemblies) and a sufficient quantity to support two outages spaced six months apart.

The normal operation of the ISFSI would begin with the transfer of fuel from the spent fuel pool to the ISFSI facility. Moving the spent fuel into dry cask storage consists of a series of carefully controlled and monitored steps developed based on cask manufacturer specifications and WBN fuel handling procedures. The transfer operations to place the assemblies into canisters would be handled within the spent fuel pool.

First, a nested canister and transfer cask would be lowered into a cask loading area within the spent fuel pool. Spent fuel assemblies would be loaded from the spent fuel pool into the canister remotely by crane and then the transfer cask would be lifted from the pool. The canister is dried, backfilled with helium to a positive atmospheric pressure, and sealed. Testing is performed to ensure the efficiency of the drying process. The transfer cask provides radiological shielding during this process. Monitoring is performed to ensure that radioactivity is confined and that the canister and transfer cask are operating as designed.

The loaded transfer cask would then be moved to the Auxiliary Building railroad bay and placed atop a concrete lined overpack utilizing a mating device, referred to as the stackup position. The mating device drawer is opened and the canister housing the fuel assemblies is downloaded into the storage overpack cask. The transfer cask is removed and the overpack lid is installed.



The loaded cask would then be moved by a specially-constructed vertical cask transporter from the WBN Auxiliary Building to the onsite ISFSI pad. The cask is then placed in its designated location for storage operations.

Fuel would be transferred to an ISFSI pad throughout the period of operation of the WBN Units 1 and 2. After WBN operations cease, it is assumed that all spent fuel would be transferred from the spent fuel pool to an ISFSI pad within 10 years of the end of operations. The transfer of all spent fuel would occur prior to decommissioning completion and before the WBN operation license's termination. It is assumed that the spent fuel pool would receive routine maintenance in order to serve as the storage transfer system for recasking and cask replacement as needed.

During ISFSI operation, TVA would conduct routine monitoring and surveillance per regulatory and license requirements. The inspection program would include visual inspection of the vent screens to ensure the air inlets and outlets are free of obstruction, and annual visual examination of the accessible external surface or the overpack. The HI-STORM FW system is totally passive by design, requiring minimal maintenance primarily due to the effects of weather. Typical of such maintenance would be the reapplication of corrosion-inhibiting materials on accessible external surfaces. In addition, after Holtec's License Renewal, WBN will have an essential site-specific aging management program beyond the basic required maintenance program.

Alternative B includes two scenarios of the length of time that continued storage at the WBN site will be needed before the spent fuel is sent to a permanent repository off-site.<sup>3</sup>

- **Short-term Storage:** 60 years of continued storage at the ISFSI facility after the end of the WBN licensed life of operation (assumed to be 40 years), after which an off-site, permanent, geologic repository is assumed to become available. Because storage of spent fuel at the WBN ISFSI would begin in 2016, short-term storage scenario assumes that some spent fuel would be stored at the ISFSI pads for up to 100 years. Fuel would be transferred to an ISFSI pad throughout the period of operations of the WBN Units 1 and 2. After operations cease, it would be approximately 10 years before all spent fuel would be transferred to an ISFSI pad. Under this scenario, storage would remain on site while the components of the WBN plant that are not required for storage of spent fuel are decommissioned. After 100 years, TVA would transfer ownership of the spent fuel and it would be transported off-site to a permanent repository. TVA would decommission the ISFSI facility and other remaining components of the plant used for storage.
- **Indefinite Storage:** In this scenario, continued storage at the WBN ISFSI facility would extend indefinitely; a permanent, off-site, geological repository may never become available. Under this storage scenario, TVA assumes that the WBN ISFSI

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<sup>3</sup> In previous environmental analyses, TVA assumed that a permanent off-site facility would be completed by the end of licensed operations at both WBN units. The Proposed ISFSI Alternative's two storage length scenarios are similar to the three timeframes analyzed in the NRC's *Waste Confidence GEIS*; TVA presents two timeframes in this EA rather than three because the indefinite storage scenario encompasses the NRC GEIS's long-term scenario.

pad would be replaced every 100 years. Replacement would include the construction of a new pad, replacement of storage casks, and the transfer of canisters to new casks within the existing WBN spent fuel pool.

In 100 years, the proposed ISFSI pads would be replaced by one pad sited on land east of and immediately adjacent to the proposed ISFSI location; this is currently the site of the Flex Equipment Storage Building (FESB)<sup>4</sup> which would no longer be present because it would not be needed after decommissioning of WBN. After the first replacement, it is assumed that the site of the ISFSI pad would alternate between the two adjacent locations at the end of each 100-year cycle. Once a replacement pad is constructed and operating, the old facility would be demolished and the land reclaimed. Construction of a replacement pad and demolition of the existing facility is anticipated to take about two years; TVA assumes that fewer construction workers would be needed for these activities than those needed for the initial construction activities because initial activities include work on other ISFSI components (e.g., haul path construction and Auxiliary Building modifications). The facility would be maintained for the next 100 years (*Yucca Mountain EIS*, p. 7-22).

TVA also assumes a 100-year replacement cycle for spent fuel canisters and casks. This assumption is reasonably conservative and is consistent with the analytical assumptions of DOE's study of the Yucca Mountain storage facility (*Yucca Mountain EIS*) and NRC's waste confidence analysis (*Waste Confidence Draft GEIS*) and is supported by the service life of the HI-STORM FW. The assumption, however, does not mean that replacement of the storage systems and facilities will definitely be needed every 100-years to maintain safe storage (*Waste Confidence Draft GEIS*, p. 1-16). Replacement would depend on an assessment of the actual condition of the storage system and facility at the time.

In this scenario, the WBN spent fuel pool would be maintained as a facility to have in reserve for future use in the replacement of the inner canister of a dry storage cask. Construction or operation of a dry transfer system is not a component of the proposed action; should one be deemed necessary in the future, its construction and use would be subject to additional NEPA review.

Under Alternative B, it is assumed that TVA would maintain institutional control over the spent fuel for the duration of storage at WBN and as necessary to ensure public health and safety. Institutional control will be both active (monitoring, surveillance, remedial work) and passive (land use control), and involve not only checking or monitoring, but also ensuring that corrective or enforcement measures are taken if the results of the checking or monitoring indicate an unsatisfactory situation. Future mandates for controls and extended storage would be expected to evolve over time, but as license holder for the WBN ISFSI, TVA would implement all mandated changes to maintain compliance with future regulation and maintain the health and safety of the public. Maintenance of institutional control of the ISFSI and its location is facilitated by the fact that TVA is a federal entity whose authority over TVA-controlled lands is mandated by the U.S. Congress. TVA is a federally owned agency in corporate form, created by Congress in 1933 (16 USCA § 831 et seq.). Because it is a federal agency, institutional control is presumed to endure indefinitely.

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<sup>4</sup> An FESB is a facility utilized in unlikely events to ensure key safety functions of core cooling, containment integrity, and spent fuel cooling; the facility includes portable pumps, generators, and associated emergency equipment.

**Figure 2.2 General ISFSI Location at WBN (View West)**

### **2.1.3 Alternatives Considered but Eliminated From Further Discussion**

In its review of potential ISFSI sites, TVA identified four locations within the WBN boundary. However, three locations were eliminated from further consideration because of the safety concerns relating to their close proximity to the WBN cooling towers or to the Tennessee River. At the proposed location, five options were considered for siting the ISFSI pads. The selected option best addressed project requirements, security and cost considerations, and compatibility with the siting of a FESB building in the immediate vicinity. None of these locations offered environmental advantages compared to the proposed location.

As noted above, TVA received comments on the draft EA during the public review which included the request to change the design of the ISFSI facility to implement hardened on-site storage principles in order to improve the safety and security of spent fuel storage. TVA considered the principles listed in the comment letter and found that they are largely consistent with TVA's proposal. For instance, under the Proposed Action spent fuel would be removed from spent fuel pools to temporary, dry cask storage as close to the reactors as possible; a monitoring program would be implemented; the facility would be secured from threats originating from outside the site boundary; and the design of dry storage would address the risk of "severe" terrorist attacks. TVA considers other principles suggested as unreasonable. For instance, the commenters request that TVA provide sensitive information about the operations of the facility to the public and local and state governments on a

regular basis. Features of hardened on-site storage related to reprocessing of fuel and operation of the spent fuel pool fall outside the scope of this EA.

TVA has considered other alternatives for increasing spent nuclear fuel storage capacity at WBN including re-racking of spent fuel with higher density racks and chose construction of a dry cask storage system as the best way to increase storage capacity at this site. As noted above, this EA tiers from the *TVA WBN Unit 2 EIS* and the DOE’s *CLWR EIS* which determined that an ISFSI facility is the most viable means to expand on-site storage capacity at WBN as well. Therefore, consistent with 40 CFR Parts 1502.21, 1502.20 and 1508.28, no other type of on-site storage facilities are included in this EA.

## 2.2 Comparison of Alternatives

The environmental effects anticipated under the two alternatives considered are compared and summarized below in Table 2.1.

**Table 2.1. Summary and Comparison of Alternatives by Resource Area**

Resource Area	Impacts From No Action	Impacts from Proposed ISFSI Short-Term Storage	Impacts from Proposed ISFSI Indefinite Storage
Geology, Soils, & Seismicity	Small	Small <i>(Moderate Cumulative Impacts)</i>	Small <i>(Moderate Cumulative Impacts)</i>
Floodplains	Small	Small	Small
Water Use and Quality	Small	Small	Small
Waste Management	Small	Small <i>(Moderate Cumulative Impacts)</i>	Small <i>(Moderate Cumulative Impacts)</i>
Human Health (Radiological Concerns)	Small	Small	Small
Postulated Accidents	Small	Small	Small
Greenhouse Gas Emissions & Climate Change	Small	Small	Small

## 2.3 Mitigation

Design and construction of an ISFSI at a TVA reactor site will fully conform to all applicable NRC regulatory design and licensing criteria:

- The dry cask storage haul path, pads, and support systems would be designed to adequately support the static and dynamic loads of the stored casks, considering potential amplification of earthquakes through soil-structure interaction, and soil liquefaction potential or other soil instability due to vibratory ground motion.
- All regulatory requirements for waste management—including requirements for treating radioactive materials in the form of both effluents and direct radiation, and requirements limiting offsite doses from the ISFSI during normal and anticipated occurrences—would be met.

- Reactor site parameters, including analyses of earthquake intensity and tornado missiles, would be enveloped by the cask design bases as documented in the applicable cask Certificate of Conformance and related NRC Safety Evaluation Report. Additional calculations may be performed as required by 10 CFR Part 72. Measures would be taken to protect the spent fuel against the design basis threat of radiological sabotage. In this regard, TVA would comply with all security orders issued after the September 11, 2001 terrorist attacks that relate to ISFSIs. The WBN ISFSI pads would also be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, lightning, hurricanes, floods, tsunamis, and seiches, without impairing its capacity to perform safety functions.
- TVA would implement a Storm Water Pollution Prevention Plan to address potential impacts from construction activities.

#### **2.4 The Preferred Alternative**

Alternative B, the Proposed ISFSI Alternative, is preferred by TVA.



## CHAPTER 3 – AFFECTED ENVIRONMENT AND POTENTIAL IMPACTS

This chapter presents the description of the relevant resources in the project area that are likely to be meaningfully affected by the alternatives as well as the predicted impacts of Alternative A (No Action) and Alternative B (Proposed ISFSI). As noted above, by incorporating previous analyses and information, this EA will be limited in scope to project- and site-specific information to address issues not previously addressed by the referenced documents.

### 3.1 Geology, Soils and Seismicity

#### 3.1.1 Affected Environment

As previously noted, the proposed ISFSI location falls within the WBN plant footprint and is an open, grassy area at the top of a gentle hill. The location has been previously disturbed and was graded during the initial plant construction. Other portions of the project area – the haul path and the Auxiliary Building – are located within the current security protected area and, thus, within a previously disturbed industrial setting.

In September 2013, soil borings were drilled at the ISFSI pad site and along the proposed haul path. The exploration of the proposed ISFSI pad site indicates the presence of some fill at the surface, atop natural soils consisting of alluvial soils, including clay, silt, sand and gravel. Soil borings along the haul pathway encountered clayey sand and sandy lean clay beneath the fill of the existing roadway.

The elevation of the ISFSI pad area currently ranges from approximately 734 to 740 feet above mean sea level (msl). Bedrock beneath the alluvial soils consists of shale occasionally interbedded with limestone and is approximately 25 to 35 feet below grade. The soft shale transitions to a medium hard to hard shale interbedded with limestone, approximately 50 feet below grade. Groundwater levels measured at the ISFSI pad area ranged from 721.4 to 721.9 feet elevation, approximately 13 to 19 feet below the surface. Along the haul pathway (which ranges in elevation from 728 to 734 feet) the bedrock is approximately 20 to 25 feet below grade.

The geologic hazards of the WBN ISFSI location are also considered to be features of the affected environment. The *TVA WBN Unit 2 SEIS* addresses the seismicity of the WBN region, stating that the basic conclusions of the WBN 1972 *Final Environmental Statement* and a 1995 *Final Supplemental Environmental Review (1995 FSER)* of WBN operations remain valid (*TVA WBN Unit 2 SEIS*, p. 71). These documents explain that the original design basis for WBN was based on the largest historic earthquake in the Southern Appalachian Tectonic Province (a magnitude 5.8 earthquake in 1897 in Giles County, Virginia) and that extensive studies relating to the performance of nuclear facilities since 1972 have confirmed that TVA's nuclear plants would perform very well during earthquakes much larger than the WBN's site design basis (*1995 FSER*, p. 43).

The soils and geological characteristics at the proposed ISFSI pad area were analyzed for this project to determine the seismicity of the site and the potential for liquefaction (the loss of strength and stiffness of soils saturated by water) that may result from a seismic event. It was concluded that a seismic event may result in the liquefaction of sandy soils from a depth of 10 feet to 30 feet below existing grade during an earthquake with an 0.4g

acceleration at the ground surface. Common ground failures resulting from a liquefaction event include: flow failure, lateral spread, ground oscillation and loss of bearing capacity. The analysis shows that the flat topography of the proposed ISFSI pad area would reduce the potential for lateral spreading or lateral flow. Liquefaction, however, may result in loss of bearing capacity and ground oscillation at the site.

### **3.1.2 Environmental Consequences**

#### **3.1.2.1 Alternative A (No Action)**

Under Alternative A, because TVA would not construct or operate an ISFSI at WBN, there would be no direct or indirect impacts to soils or geology because there would be no physical changes to the current conditions of the soils. Because a lack of additional storage capacity would require ending WBN operations, the decommissioning and demolition of WBN would result in impacts on soils during the demolition activities. Demolition would generate dust and require disturbance of soils in areas within WBN as the facility is taken down and removed. Small cumulative effects may result from these future activities.

#### **3.1.2.2 Alternative B (Proposed ISFSI)**

DOE and TVA have previously analyzed the potential effect of the ISFSI on-site storage and concluded that, because disturbances would be within the current plant footprint on land that has been previously disturbed, potential impacts related to soils and geology would be small (*Yucca Mountain EIS; TVA WBN Unit 2 SEIS*). Approximately 5 acres would be disturbed during the construction of the first ISFSI pad and associated structures and the haul path. The disturbed area would include a construction laydown site, where impacts would be temporary and where reclamation would take place once construction is completed. It is assumed that a portion of the same 5 acre area would be disturbed again during construction of the second ISFSI pad.

Soil exploration and liquefaction analysis of the ISFSI pad area indicate that remediation is necessary to address the potential liquefaction of soils during a seismic event. Vertical pilings will be utilized beneath the ISFSI pad to address liquefaction risk and minimize the potential effects. The potential for an accident associated with a postulated seismic event at WBN is discussed in Chapter 3.6 below.

Construction of the haul path and modifications to the Auxiliary Building would take place almost entirely on developed portions of WBN, areas currently paved or built upon. Some soil disturbance, however, is expected. The Auxiliary Building and a portion of the proposed egress pad adjacent to the Auxiliary Building fall within the radiological control area. Therefore, during modification of the Auxiliary Building and construction of the egress pad, any soils disturbed and removed from the radiological control area will be tested for radiological contamination before disposed, in accordance with standard construction practice at WBN. If soils are found to be contaminated, they would be treated as low-level radiological waste (see Chapter 3.4 below).

Impacts to soils and geology would be largely similar under the short-term and indefinite storage scenarios. After construction of the ISFSI facility, routine maintenance and monitoring activities of the ISFSI would continue, with no additional impacts on soils expected. Generally, continued storage and operation of the ISFSI is expected to have small impacts because extended storage would continue at existing sites where impacts on soils and geological structure have already been realized (*Yucca Mountain EIS*). In



addition, as noted by NRC in its *Waste Confidence Draft GEIS*, it is unlikely that operation of an ISFSI would have any effect on geology because there are no moving parts to an ISFSI that may affect the subsurface geology (p. 4-20).

At the end of the short-term storage period, operations at WBN would cease and decommissioning and demolition of the plant would begin. As under the No Action Alternative, demolition activities would result in disturbance of soils including the generation of dust and additional surface disturbances by large equipment.

The indefinite storage and operation of the ISFSI is not expected to have additional impacts on soils except for those associated with the periodic replacement of the ISFSI. During construction of the replacement pad and demolition of the existing pad, additional, temporary impacts to soils would result. At WBN, the replacement pad would be adjacent to the proposed ISFSI pads and impacts would be limited to these sites only and would be small. This conclusion is consistent with the NRC's *Waste Confidence Draft GEIS* analysis (pp. 4-21 to 4-22).

### ***Cumulative Impacts***

The WBN reservation is a large, high-density power plant where there are currently two construction projects taking place in the vicinity of the proposed ISFSI location: completion of Unit 2 and construction of the FESB. TVA is also undertaking several projects relating to its Fukushima Response Strategy, including construction of a Flood Mitigation Management System facility and large storage tanks to supply water for inventory makeup and decay heat removal in the event of a flood beyond the design basis flood. If built, these relatively small-scale structures may be constructed in an area adjacent to the FESB and, thus, in the vicinity of the proposed ISFSI pad area.

While few additional large-scale development activities are foreseeable, the overlapping impacts of all past, present and potential development at WBN create moderate impacts on the soils and geological resources of the site primarily due to past development of the WBN. Soils and geologic resources have been and would continue to be impacted as a result of these activities, though only small impacts may result from each project. The ISFSI proposal would have only minor impacts on soils and geological resources at WBN and would not have a significant incremental contribution to the cumulative impacts to soils and geology. This conclusion is supported by NRC's *Waste Confidence Draft GEIS*' analysis of cumulative impacts on geologic resources from continued on-site storage facilities (p. 6-25).

### ***Mitigation***

Appropriate best management practices (BMP) will be implemented during soil-disturbing construction activities to prevent erosion, runoff, and sedimentation. Dust emissions from open construction areas and unpaved roads would be mitigated by spraying water on the areas. The Construction Storm Water Permit application would include a Storm Water Pollution Prevention Plan (SWPPP) that would identify such measures. Under the SWPPP, TVA would also conduct inspections during construction to ensure that erosion and sediment controls are effective.

## 3.2 Floodplains and Flood Risk

### 3.2.1 Affected Environment

Floodplains are those low-lying areas along streams and rivers that are subject to periodic flooding. An area subject to a 1 percent chance of flooding in any given year is normally considered to be in the 100-year floodplain. Likewise, the 500-year floodplain is that area subject to a 0.2 percent chance of flooding in any given year. As a federal agency, TVA is subject to the requirements of Executive Order (EO) 11988, which regards Floodplain Management. The objective of EO 11988 is "...to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative." The EO is not intended to prohibit floodplain development in all cases, but rather to create a consistent government policy against such development under most circumstances. The EO requires that agencies avoid the 100-year floodplain unless there is no practicable alternative.

The WBN is located on the Chickamauga Reservoir between Tennessee River Mile (TRM) 528.0 and 528.6 and has a plant grade elevation of 728 feet msl. At TRM 528.6, the 100-year floodplain elevation is 697.4 feet msl and the 500-year floodplain elevation is 701.4 feet msl (*Fukushima Response Strategy EA*, p. 24).

The probable maximum flood (PMF) is a hypothetical river flooding event that may occur within a particular drainage area as a result of a sequence of related meteorological and hydrologic factors typical of extreme storms. The PMF is important because it serves as a design basis for flood potential at the WBN.<sup>5</sup> TVA's *Final Safety Analysis Report* (FSAR, 8/14/13) for WBN states that "[t]he probability of this combination in any given year is near zero and its recurrence interval is near infinity" (FSAR, p. 1.2-1). Flooding prediction modeling and calculations for WBN indicate that the plant grade elevation (728 ft msl) at WBN can be exceeded by a flood caused by large rainfall and seismically-induced dam failure.

The PMF elevation levels at the proposed ISFSI site are estimated to be:

- 739.2 feet msl baseline PMF
- 741.6 feet msl PMF with wind-driven waves

The elevation of the proposed ISFSI pad area is 740 feet msl; the elevation of the haul path ranges from 728 to 740 feet msl; and the grade elevation at the Auxiliary Building is 729 feet msl.

The Local Intense Precipitation event is another design basis storm for nuclear plants. In this storm scenario, the probable maximum precipitation is centered over the local plant area with intense rainfall for a shorter time period. At WBN, the design basis elevation value for this unlikely event is 729 feet msl.

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<sup>5</sup> In its response to the events at the Fukushima Dai-ichi plant in 2011, the NRC is reconsidering the design basis for flood events. TVA is currently reevaluating the PMF for the WBN site and will continue to fully comply with NRC design standards.

### **3.2.2 Environmental Consequences**

#### **3.2.2.1 Alternative A (No Action)**

Under the No Action Alternative, TVA would not construct or operate an ISFSI facility at WBN. Therefore, there would be no direct, indirect, or cumulative impacts to floodplains because there would be no physical changes to the current conditions or drainage pathways found within the current floodplains.

#### **3.2.2.2 Alternative B (Proposed ISFSI)**

None of the proposed facilities would be sited within the 100-year or 500-year floodplain, which would be consistent with EO 11988. Therefore, the Proposed ISFSI Alternative would not affect the function of the floodplain or impede or redirect flood flows. Under the indefinite storage scenario, the replacement of the ISFSI pad would occur every 100 years at a site adjacent to two proposed ISFSI pads. The adjacent site is east of the proposed pads' location and also above the 100- and 500-year floodplains. Therefore, the replacement pad would not affect the floodplain.

The elevations of the major components of the proposed ISFSI project vary. The ISFSI facility which includes storage pads, drainage systems, fire hydrants, contingency shield walls, landscaping, perimeter roads, a cask fabrication pad, and an equipment storage building would be above the probable maximum flood (PMF) level of 739.2 feet. However, the ISFSI facility would be below the controlling PMF elevation with wind-driven waves resulting. Construction and operations of an ISFSI would not alter the potential for a river flooding event like the PMF.

Under the Local Intense Precipitation event scenario at WBN, the local drainage would be from the plant area itself and from a 150-acre area north of the plant. Flow from the area west of the diesel generator building, in the area of the ISFSI pad, is in the west direction through a swale and across the low point in the access road. The swale and the roads have sufficient capacity to keep water surface elevations below the elevation of 729 feet at all buildings. The proposed ISFSI facility would not block the flow directly or indirectly through this swale. During construction activities, the site drainage paths adjacent to the site would not be disturbed to ensure PMP drainage. Therefore, the placement of the pads would not adversely affect probable maximum precipitation site drainage patterns with respect to the plant.

The risks and impacts to the ISFSI operations associated with an extreme flooding event such as the PMF are described in Chapter 3.6 below.

#### ***Cumulative Impacts***

There would be no cumulative floodplain impacts resulting from the Proposed ISFSI Alternative because the WBN plant does not fall in the 100- or 500-year floodplain and no development within the floodplains are foreseeable given requirements to avoid flood risk at nuclear power plants. All existing WBN structures, site characteristics, and activities were considered when the PMF and PMP values were calculated; future activities at WBN would be evaluated as they are identified to ensure that unacceptable increases to the site drainage elevation do not result.

### **3.3 Water Use and Quality**

#### **3.3.1 Affected Environment**

Numerous environmental studies of the surface and ground water characteristics of WBN have been conducted that, in great detail, provide a description of the site's water resources. Those studies are incorporated herein as referenced below.

##### **3.3.1.1 Surface Water**

The WBN is located on the western shore of Chickamauga Reservoir on the Tennessee River, just south of the Watts Bar Dam. TVA's management of the Reservoir and Tennessee River results in fluctuating pool levels during the year, with higher levels during summer; water elevations in the reservoir vary between approximately 675 feet msl in winter and 682.0 feet msl in the summer (*NRC WBN Unit 2 FES*, pp. 2-5 and 2-6).

Watts Bar and Chickamauga Reservoirs on the Tennessee River provide cooling water for the WBN plant, including for cooling of the spent fuel pool. Only Chickamauga Reservoir receives discharge water. The surface water quality is generally good in the Tennessee River near the WBN site, with total dissolved solids ranging from 60 to 180 mg/L (*NRC WBN Unit 2 FES*, p. 2-11). Along the north side of the WBN, in the vicinity of the proposed ISFSI location, site drainage at the location of the pad varies because the pad sits atop the crest of a hill. Rain falling on the western portion of the pad would drain into the plant's storm water system to the west-southwest (which includes a construction runoff holding pond) and rain falling on the eastern portion would drain into system to the east-northeast. Surface waters drain to the Reservoir adjacent to WBN (*NRC WBN Unit 2 FES*, p. 3-12).

##### **3.3.1.2 Groundwater**

As documented in the *TVA WBN Unit 2 SEIS*, TVA determined that the descriptive information concerning groundwater resources in the vicinity of WBN presented in the 1995 *WBN Final Supplemental Environmental Review* remains accurate. Information is also provided in the description of groundwater resources in the NRC's May 2013 *WBN Unit 2 FES*, which shows that construction of WBN Units 1 and 2 and operation of Unit 1 has slightly altered the plant's water table (p. 2-7). However, at the site of the proposed ISFSI facility, along the north perimeter of WBN, recent soil explorations confirm that there is no groundwater aquifer below the proposed project site. TVA does not currently pump groundwater for use at the WBN site.

As stated in the *TVA WBN Unit 2 SEIS*, low levels of tritium were detected in groundwater at an on-site monitoring location in 2002. TVA located the source of the contamination and repaired the leak. The maximum tritium concentration observed in groundwater samples at the time were well below the NRC's reporting requirement levels. Some residual tritium will likely remain in the local groundwater until it decays or is diluted (groundwater at the WBN site is closely monitored and findings are routinely reported to NRC and the state of Tennessee). Eventually, this groundwater will migrate to the Tennessee River, where dilution will further reduce levels of tritium (*Fukushima Response Strategy EA*, p. 33).

#### **3.3.2 Environmental Consequences**

##### **3.3.2.1 Alternative A (No Action)**

Under Alternative A, no changes to current environmental conditions at WBN would occur and thus, there would be no change in the current condition for surface and ground waters. Eventually, without additional storage capacity, the WBN operations would cease and as a result, the impacts previously identified and analyzed by TVA in its 2007 review of the WBN

Unit 2 would end. These impacts include the hydrothermal effects of heated effluent from WBN to the Tennessee River and effects from chemical additives to raw water during operations under a National Pollutant Discharge Elimination System (NPDES) permit.

During decommissioning activities, TVA would adhere to BMPs in implementing a SWPPP and in compliance with the NPDES permit. By meeting the NRC's regulatory requirements on decommissioning activities, the impacts of decommissioning WBN would be small (*NRC WBN Unit 2 FES*, p. 46; *Decommissioning GEIS*, p. xvii).

The need for cooling water would be greatly reduced after decommissioning, except for the continued need to use water for cooling the WBN spent fuel pool, which would continue for an unknown period. NRC has found that such consumptive use for a spent fuel pool at a nuclear power plant "will not be detectable" (*Waste Confidence Draft GEIS*, p. 4-22). NRC also noted the potential for surface water contamination from discharge of groundwater but concluded that the potential impacts of spent fuel leaks on surface waters would be small (*Waste Confidence Draft GEIS*, p. 4-23).

### **3.3.2.2 Alternative B (Proposed ISFSI)**

Numerous environmental analyses have previously been conducted regarding the potential impacts of ISFSI construction and operations. A summary is provided below.

#### **Surface Water**

Under both storage scenarios, only small impacts to surface water use and quality would likely result from construction of the ISFSI at the WBN. In most cases, water for many of the construction activities, including concrete mixing, drinking water, cleaning, portable toilets, and fugitive dust control, would be brought from outside WBN (*CLWR FEIS*, pp. 2-49 and 5-95). Currently, potable water for the plant use is obtained from the Watts Bar Utility District.

During construction activities (including construction of the second pad in 15 to 20 years), necessary BMPs will be installed and properly maintained to minimize impact to surface water flow. These measures would address potential soil erosion so that water sedimentation into the storm drainage system and receiving waters is minimized. Rain waters would be routed to the existing storm water drains which provide sufficient capacity to convey waters. TVA's SWPPP addresses the practices to be implemented to address the construction at the ISFSI. TVA would prepare a separate SWPPP in the future to address construction of the second ISFSI pad.

Operations of the ISFSI under both storage scenarios would result in very minor demand for water use. The potential impacts on water quality would likewise be small (*Waste Confidence Draft GEIS*, p. 4-24). Under both scenarios, the continued use of the spent fuel pool for transferring spent fuel into new casks requires a continued demand for cooling waters.

#### **Short-term Storage (Surface Water):**

The potential impacts to surface waters from continued storage at WBN pertain primarily to water use needed for maintaining cooling to the spent fuel pool, which are the same as noted for the no action alternative (*Waste Confidence Draft GEIS*, pp. 4-22 and 4-23). However, the need for cooling waters would cease after operations at WBN cease at the end of the short-term storage timeframe.

No water is required or would be impacted by the dry cask storage system, given that it is a passive, air-cooling system. However, routine maintenance activities would require some water use. Some impacts to surface water may also result from inadvertent effluents during operations (e.g., grease from operating equipment, spills, and other contaminants). Increased impacts would be expected at the end of the short-term storage scenario as a result of construction activities during ISFSI demolition (*Waste Confidence Draft GEIS*, p. 4-23).

*Indefinite Storage (Surface Water):*

Under the indefinite storage scenario, the same impacts are anticipated as previously described. However, the continued use of the spent fuel pool would require the indefinite need for cooling water for the spent fuel pool. The periodic replacement of the ISFSI pad would temporarily increase impacts during demolition and construction activities every 100 years.

**Ground Water**

Impacts to groundwater during construction and continued storage at the WBN ISFSI are also expected to be small. Generally, ISFSIs do not disturb groundwater systems because they are surface structures with shallow constructed foundations (*Yucca Mountain EIS*, p. 7-24).

The soil borings taken at the proposed ISFSI pad location reveal that there is no aquifer beneath the site. As described in Chapter 3.1 above, groundwater levels at the ISFSI pad location ranged from 721.4 to 721.9 feet elevation, approximately 13 to 19 feet below the surface. TVA's design of the proposed ISFSI was refined based on hydrological calculations conducted at the proposed ISFSI location to remediate the liquefaction of the soils at the location. Specifically, pilings will be inserted into the ground as the pads are constructed to stabilize the foundation of the pad and remediate any soil liquefaction during a seismic event. These measures, however, would not affect groundwater use or quality.

During construction activities, including future construction of the second ISFSI pad, the excavation of the site may result in an increased risk of groundwater contamination from accidental spills or oil or fluid leaks from construction equipment, though such contamination is unlikely and would be more of a concern to surface water quality (*Yucca Mountain EIS*, p. 7.24).

*Short term Storage (Ground Water)*

Few groundwater impacts are anticipated from the continued storage of spent fuel at WBN. Surface waters would continue to be the source for consumptive use at WBN; TVA would not pump groundwater. Continued use of the spent fuel pool extends the very small risk of a ground water contamination occurrence but any radiological impacts that may result would be small according to the NRC (*Waste Confidence Draft GEIS*, pp. 4-25 and 26). During operations of an ISFSI (including routine maintenance and monitoring), NRC has stated that impacts on groundwater quality may be limited to "the infiltration of storm water runoff carrying grease and oil, and spills from operating equipment that supports the ISFSI" though the potential for such impacts during storage are considered "minimal" (*Waste Confidence Draft GEIS*, p. 4-27). These impacts would be prevented or minimized by the implementation of routine BMPs and compliance with TVA procedures.

*Indefinite Storage (Ground Water)*

Potential impacts to groundwater use and quality would occur during the periodic demolition and replacement of the ISFSI. Construction and demolition activities during those periods would have similar impacts as those described above. Because the spent fuel pool would continue to be used indefinitely for transfer from old casks to replacement casks, the potential for contamination of groundwater would continue but remain very unlikely.

***Cumulative Impacts to Surface and Ground Water***

A list of the past, present, and reasonably foreseeable projects and other actions in the vicinity of the WBN is provided in the *NRC WBN Unit 2 FES*' cumulative impacts analysis section (*NRC WBN Unit 2 FES*, Table 4-15, pp. 4-73 to 80). The cumulative effects of constructing and operating the WBN ISFSI on surface water use when added to the aggregate effects of these projects and actions are expected to be small. The NRC concluded that cumulative effects of all WBN operations and the other projects and activities on surface water consumption would "be unlikely to noticeably alter" surface water resources (*NRC WBN Unit 2 FES*, p. 4-84). Given the relatively small water use demands of the proposed ISFSI construction and operation, additional cumulative impacts beyond those described in the NRC document would not be noticeable.

As described above, impacts on surface water quality would also be small. However, considering all past, present and foreseeable project and activities, NRC concluded in May 2013 that there has been an adverse impact to surface waters of the Tennessee River (*NRC WBN Unit 2 FES*, p. 4-86) but the operations of WBN Unit 2 (only) would not be a significant contributor to impacts. When including the small impacts of the construction and operation of the ISFSI, the incremental impact of the Proposed ISFSI Alternative would be unnoticeable in comparison. This conclusion is consistent with the NRC's GEIS cumulative impact analysis and the definition of small impacts to surface water quality therein (*Waste Confidence Draft GEIS*, p. 6-28).

NRC also concluded that the cumulative impacts to groundwater use and quality from operation of WBN Unit 2 would be small, when combined with the list of past, present and foreseeable projects and activities (*NRC WBN Unit 2 FES*, pp. 4-86 and 4-87). Given that the incremental impacts of construction and operation of the WBN ISFSI on groundwater use and quality would be minimal and that the ISFSI proposal is a much smaller project than the Unit 2 operations, it is reasonable to conclude that the cumulative impacts of construction and operation of the WBN ISFSI would be small as well. These conclusions are supported by analysis in the NRC's *Waste Confidence Draft GEIS* as well (Chapters 6.4.7 and 6.4.8).

An additional, foreseeable project with potential impacts on groundwater is the installation of groundwater wells for replenishment of the large water storage tanks utilized in the proposed Flood Mitigation Management System design. The potential project would result in increased use of groundwater: approximately 50 gallons a minute per well from a depth of 200 to 500 feet. However, these withdrawals of groundwater would occur only occasionally, in the case of an unlikely flood beyond the design basis flood and for periodic flushing of the tanks, and would not significantly increase cumulative effects on groundwater in the WBN area.

### **Mitigation Measures and BMPs**

As described above, applicable BMPs would be implemented during construction and, if necessary, ISFSI operations to prevent erosion/sedimentation into storm drainage systems and receiving waters. These measures would likewise be implemented when, under the indefinite storage scenario, the ISFSI pad is demolished and replaced every 100 years. In the event of spills or leaks during operation, TVA would implement measures to clean and contain the affected area to minimize the potential for impacts to surface waters.

The BMPs implemented to address surface water impacts would also reduce the likelihood of groundwater contamination. TVA conducts a groundwater monitoring program at the WBN site to identify potential contamination of the groundwater from plant operations; this program would continue during continued on-site storage.

## **3.4 Waste Management**

### **3.4.1 Affected Environment**

In its NRC's *Waste Confidence Draft GEIS*, the NRC identified the following types of wastes that are generated by operations at nuclear facilities, including the storage of spent fuel:

- Low-level radioactive waste, which consists of both wet wastes and dry active waste. Dry active wastes include contaminated protective clothing, paper, rags, trash, equipment parts, and filters. Wet wastes include spent demineralizer or ion exchange resins and materials from equipment and floor drains and water cleanup systems (*Waste Confidence Draft GEIS*, p. 3-34). During normal plant operations, including spent fuel pool storage, the quantities of low-level radioactive waste may vary annually depending on the maintenance actions taken during those periods (*Waste Confidence Draft GEIS*, p. 3-34).
- Mixed wastes (wastes both radioactive and hazardous), which are generated in the storage of spent fuel include organics (e.g., waste oils and halogenated organics), metals (e.g., lead, mercury, chromium, and cadmium), solvents, paints, and cutting fluids (*Waste Confidence Draft GEIS*, p. 3-35). Mixed waste quantities from plant operations, including spent fuel storage, is considered "generally relatively small" (*Waste Confidence Draft GEIS*, p. 3-35).
- Hazardous wastes (as defined by EPA at 40 CFR Part 26a), which are generated at nuclear plants during storage operations include paints, laboratory packs, solvents, batteries (*Waste Confidence Draft GEIS*, p. 3-36). Quantities of hazardous wastes generated by operating nuclear plants are small in comparison with quantities at most industrial sites that generate such waste, according to the NRC's 2013 *Generic Environmental Impact Statement for License Renewal of Nuclear Plants (Licensing Renewal GEIS)*.
- Nonhazardous, nonradioactive waste includes construction and demolition debris; municipal solid waste (e.g., paper, plastics, garbage, etc.); sanitary waste; and waste generated for transmission line clearing and maintenance.

A description of WBN's waste management systems is included in the *NRC WBN Unit 2 FES* and in TVA's *Fukushima Response Strategy EA*. In summary, WBN operates a liquid



waste processing system and a gaseous waste processing system for processing liquid and gaseous radiological wastes. Some low-level radioactive waste is shipped to Oak Ridge, Tennessee for eventual disposal. Class B and C wastes are sent off site to the Sequoyah Nuclear Plant (SQN) for storage (*NRC WBN Unit 2 FES*, p. 3-16). Hazardous wastes generated at WBN are currently shipped to TVA's hazardous waste storage facility in Muscle Shoals, Alabama; TVA plans to utilize licensed commercial facilities for disposal of these wastes in the future. Universal wastes (such as non-alkaline batteries, pesticides, mercury-containing equipment, and bulbs) are collected for recycling and shipped to recycling firms listed on the TVA Environmental Restricted Awards List. There is an onsite landfill at WBN, but it is used infrequently (*Fukushima Response Strategy EA*, p. 22). Non-radioactive, non-hazardous wastes are categorized as general trash or special wastes. General trash is transported to the Rhea County landfill for disposal. Special waste is packaged in drums and/or roll-off boxes. Drums are transported to the TVA hazardous waste storage facility and boxes are transported to a local landfill after gaining Special Waste Approval from the Tennessee Department of Environmental and Conservation.

### **3.4.2 Environmental Consequences**

#### **3.4.2.1 Alternative A (No Action)**

Under the No Action Alternative, TVA would not construct or operate an ISFSI at WBN. The rates of solid waste generation would be similar to current conditions and waste management would continue to be implemented in compliance with applicable regulations and standard TVA practices. In the *TVA WBN Unit 2 SEIS*, TVA described radiological waste management activities at WBN and concluded that operation of both WBN units would result in insignificant impacts (p. 31).

Without an ISFSI at WBN, capacity for storing spent fuel in the existing spent fuel pool would be reached by 2017 and the plant would have to cease operations. Waste generation would decrease as the plant is decommissioned, though during demolition of the plant, large quantities of waste would be generated over a period of time. The spent fuel pool would be maintained for an unknown period resulting in a limited amount of waste (*Waste Confidence Draft GEIS*, p. 3-36).

#### **3.4.2.2 Alternative B (Proposed ISFSI)**

Construction and operation of an ISFSI at WBN would increase the amount of waste and debris generated. However, the amount generated would be only a small increase to that described in the *TVA WBN Unit 2 SEIS* in 2007.

During construction activities (including those to complete the second ISFSI pad), a large portion of waste generated would be construction debris, industrial solid waste, and other nonhazardous, nonradioactive waste. A large quantity of asphalt and concrete waste would be generated from the modifications of the Auxiliary Building and from removing the existing roadway's asphalt during construction of the haul path (as noted above, the existing roadway's asphalt would be replaced with reinforced concrete). These solid wastes would be placed in dumpsters and properly disposed of in the local landfill. Soil spoils would be properly placed in the site spoils pile or, if clean, may be sent off-site for use as fill dirt. All construction waste would be managed and disposed of in accordance with applicable regulations and TVA's Standard Programs and Processes for waste management (*CLWR EIS*, p. 5-97).

Once ISFSI construction is completed, normal operations of the ISFSI would be expected to generate small amounts of each type of waste. Routine maintenance and repairs to the ISFSI pads would result in solid and low-level radioactive wastes (*Yucca Mountain EIS*, p. 7-32). Small amounts of sanitary waste would result from the workers onsite for ISFSI construction and operations. Before plant operations cease, wastes from ISFSI operations would make up only a small fraction of the wastes generated by the overall operations of WBN (*Waste Confidence Draft GEIS*, p. 3-35).

Under both storage scenarios, waste generation would decrease as the plant is decommissioned, though during demolition of the plant, large quantities of waste would be generated over a period of time. During decommissioning, the WBN plant would require fewer plant systems to remain operable. It is assumed that approximately 100–200 employees would be onsite during decommissioning, which is 500–600 fewer than the permanent workforce previously onsite (*Decommissioning EIS*, p. 4-56). Maintenance and operation of these systems would generate less waste than during plant operation. After decommissioning the plant, activities necessary to continue on-site storage would be the primary source of waste.

Under the short-term storage scenario, wastes resulting from the operation of the spent fuel pool would end after all spent fuel is placed in dry storage casks and operation of the pool ceases. During indefinite storage, waste would continue to be generated from spent fuel pool operation. In addition, waste generation would temporarily and dramatically increase every 100 years as a replacement ISFSI is constructed and the existing pad is demolished.

In 2002, DOE estimated that the demolition of facilities once every 100 years “would generate, on average, an estimated 770,000 cubic meters (1 million cubic yards) of nonhazardous demolition debris, recyclable steel, and potentially a small amount of low-level radioactive waste if a dry storage canister were to fail while in storage” (*Yucca Mountain EIS*, p. 7-32). Because the ISFSI pads, canisters and other system components would be replaced every 100 years, the old ISFSI pad and storage canisters would be decontaminated and disposed of. The pad’s concrete, some of the location’s soils, and old canisters may become contaminated and require disposal as low-level radioactive waste (*Waste Confidence Draft GEIS*, p. 4-58). Indefinite storage would require routine maintenance and monitoring activities and would generate only minimal amounts of wastes (*Waste Confidence Draft GEIS*, p. 4-60).

### **Cumulative Impacts**

Previous environmental analysis conducted by the NRC assessed the potential cumulative effects on waste management from continued on-site storage of spent fuel. NRC considered the generation of low-level and mixed wastes and of nonradioactive waste from an area’s private, commercial, industrial and military sectors as well as generation from other nuclear and spent fuel storage activities. NRC concluded that the wastes generated under continued on-site storage, when combined with the impacts from other past, present, and foreseeable activities would be small when “local, regional, or national waste-management facilities experience *no noticeable* decreases in their capacity or operating lifespan from continued storage or other Federal or non-Federal activities” and moderate when “local, regional, or national waste-management facilities experience *noticeable* decreases in their capacity or operating lifespan” (*Waste Confidence Draft GEIS*, p. 6-50)

Small to moderate cumulative impacts on waste-management resources may result from the Proposed ISFSI Alternative, when added to the aggregate effects of other past, present

and foreseeable activities at WBN and around the region. The NRC's 2013 *WBN Unit 2 FES* operation includes a lengthy list of past, present, and reasonably foreseeable actions relevant to WBN power plant (pp. 4-74 to 4-80). Also to be considered are the numerous past, present and potential development projects at the WBN site. Under the no action alternative and both proposed storage scenarios, wastes would continue to be generated over at least a 40-year period from operations of the WBN Units 1 and 2 and, eventually, the decommissioning of the plant. Under the ISFSI indefinite storage scenario, waste generation would continue indefinitely, with waste generation increasing every 100 years during ISFSI replacement activities.

Many past, present, and foreseeable TVA projects in the region generate or will generate low-level waste and mixed wastes. Industrial and research activities in the vicinity of WBN also produce such waste (e.g., Oak Ridge Reservation). Under the no action alternative and the proposed ISFSI short-term storage scenario, impacts to waste management resources of low-level waste and mixed waste from all actions in the WBN area would be small because facilities capable of disposing these wastes are available nation-wide, thereby reducing impacts should capacity decrease locally or regionally. However, under the indefinite storage scenario, the capacity of many of these facilities is expected to eventually be reached or noticeably decreased creating a moderate impact. Low-level and mixed wastes generated by the WBN ISFSI proposal would not have a significant incremental contribution to these cumulative impacts.

Non-radioactive waste generation is ubiquitous, resulting from TVA actions at and away from its nuclear power plants, as well as from residential, commercial and industrial activities, including those past, present, and reasonably foreseeable projects and actions listed in the 2013 *NRC WBN Unit 2 FES*. Because non-radioactive waste disposal facilities are prevalent, these types of wastes are generally disposed of locally (e.g., at municipal landfills) or regionally. Past, present and foreseeable future actions are likely to result in nonradioactive waste management impacts in the WBN region resulting in decreased capacity or the need for new facilities. However, the incremental contribution to cumulative impacts of constructing and operating the WBN ISFSI under both storage scenarios would be minimal.

### ***Mitigation Measures and BMPs***

Implementation of standard waste management practices and compliance with applicable regulations and TVA standard procedures and practices governing the disposal of waste would minimize impacts. Any waste generated from activities at the ISFSI would be managed and disposed of using the waste management practices in place for the WBN and in accordance with regulatory requirements for disposal. The debris and wastes would be disposed of at licensed facilities capable of receiving such wastes, as required by federal and state regulations. It is assumed that such facilities would be available indefinitely and could accommodate any waste generated at WBN (*Yucca Mountain EIS*, p. 7-32).

## **3.5 Human Health (Radiological Concerns)**

### **3.5.1 Affected Environment**

Ensuring the health and safety of the public and workers is one of the primary considerations in allowing any nuclear facility to operate. Minimizing and monitoring radiation doses to workers and members of the public are the foremost of concerns.

According to NRC, background levels of radiation are ubiquitous. The average annual total effective dose that Americans are exposed to from natural and artificial sources other than spent fuel is approximately 620 millirems (mrem), with half occurring naturally (e.g., from soil, foods, radon and thoron, and space) and half from manmade sources (e.g., from medical procedures, nuclear medicine, and consumer products). In the vicinity of WBN, TVA has estimated that the expected background levels from natural sources is between 60 and 110 mrem per year, well below the NRC's average estimated dose from natural sources (*FSAR*, p. 11.6-2).

“Above background levels of radiation exposure, the NRC requires that its licensees limit maximum radiation exposure to individual members of the public to 100 mrem per year and limit occupational radiation exposure to adults working with radioactive material to 5,000 mrem per year” (*NRC Fact Sheet on Biological Effects of Radiation*). These NRC radiation dose limits and associated regulations are contained at 10 CFR Part 20. Regulations at 10 CFR Part 72.104(a) pertaining to dry cask storage establish 25 mrem per year as the exposure limit to members of the public.

In its 1972 analysis of WBN Unit 1 and the 2007 analysis of Unit 2, TVA analyzed the potential radiological effects to humans at and near the WBN. Estimates were given for exposure doses at WBN (to workers) as well as for areas within a 50-mile radius of WBN (to the general public). Only those within the 50-mile radius were considered in TVA's population dose analysis, which, using the 50-mile regional population projection for the year 2040, totals 1,523,385 persons. There are currently more than 4,000 employees including contract workers at WBN working on both the operation of Unit 1 and the construction of Unit 2.

### **3.5.2 Environmental Consequences**

#### **3.5.2.1 Alternative A (No Action)**

Under the No Action Alternative, TVA would continue to operate WBN in strict accordance with applicable NRC regulatory limits and standards. The spent fuel pool would remain as the only storage facility at WBN and there would be no potential risks associated with transferring spent fuel from the pool.

Under the No Action Alternative, radiological effects relating to WBN operations would continue. However, TVA found in its 2007 *WBN Unit 2 SEIS* that the impact of radiation exposure on individual members of the public from radioactive gaseous and liquid releases would be insignificant. TVA's analysis stated that the doses to the public resulting from the discharge of both radioactive liquid and airborne effluents from continued operations at WBN would likely be less than 2 percent of the NRC guidelines given in 10 CFR Part 50 Appendix I, and that there would be no new or different effects on the surrounding environment due to these releases than from those discussed in the 1972 *Final Environmental Statement (TVA WBN Unit 2 SEIS)*, p. 85). TVA's conclusion is supported by the May 2013 *NRC WBN Unit 2 FES*, wherein NRC concluded that operating both WBN units would be small (*NRC WBN Unit 2 FES*, p. 4-96).

Continued operations would continue to affect WBN workers. However, as also explained in the *TVA WBN Unit 2 SEIS*, dosage to workers are carefully monitored and managed to ensure they remain below NRC's regulatory limits. The NRC supports this conclusion in its May 2013 analysis, stating that based on TVA's adherence to regulatory limits, impacts to occupational radiation exposure would be small (*NRC WBN Unit 2 FES*, p. 4-58)

Under the No Action Alternative, operations at WBN would cease once current spent fuel storage capacity is met. The spent fuel pool would remain in operation and radiological effects of storage in the pool would be less than radiological effects from continued plant operations (*Waste Confidence Draft GEIS*, p. 4-64).

### **3.5.2.2 Alternative B (Proposed ISFSI)**

The construction and operation of an ISFSI at WBN would have radiological impacts from occupational and public doses. However, according to previous environmental analyses conducted by TVA (*TVA WBN Unit 2 SEIS*), DOE (*Yucca Mountain EIS*), and NRC (*NRC WBN Unit 2 FES* and *Waste Confidence Draft GEIS*), those impacts, summarized below, would remain well below the regulatory dose limits and thus, would be small.

#### **Construction Activities**

During the peak of ISFSI construction activities, an estimated 80 to 100 additional workers will be on-site. In 2007, when TVA evaluated construction and installation of an ISFSI at WBN to support Units 1 and 2, TVA estimated that the total dose to workers would be 135 person-rem during construction. This estimation was based on the NUHOMS system and assumes a 0.5 mrem per hour dose rate (1500 man-hours per casks and 180 casks) and that only construction work performed subsequent to the loading of any storage modules with spent fuel may result in worker exposures from direct and skyshine radiation in the vicinity of the loaded horizontal storage modules (*TVA WBN Unit 2 SEIS*, p. 97). These doses would not exceed regulatory limits for workers and therefore would be insignificant.

The second ISFSI pad would be constructed in 15 to 20 years and sited adjacent to the first pad. During the second pad's construction, some casks will be present on the first pad. Therefore, potential doses to workers during construction of the second pad would be higher than during initial construction activities of the ISFSI facility. However, because doses to workers would be carefully monitored and would not exceed regulatory limits, impacts to these workers would be insignificant.

It should be noted that the HOLTEC system does not require construction activities in the vicinity of loaded casks for the initial 100 years of service. Construction of the replacement ISFSI pad and demolition of the existing pad every 100 years would result in occupational exposure from the existing ISFSI pad. However, time is a significant contributor to radioactive decay and temperature decrease of stored spent fuel. Many of the short-lived radioactive materials would be decayed to stable elements after 100 years and the direct radiation dose would be expected to have decreased in proportion to the decrease in curie content of the spent fuel in storage. Because the expected dose rates during construction of the replacement ISFSI pad would be significantly less than the initial construction of the WBN ISFSI facilities, it is conservative to assume the same occupational exposure in 100 years as the exposures of near term ISFSI construction activities. Doses during these periods of construction and demolition activities would likewise be insignificant.

#### **Operation of the ISFSI**

##### Occupational Workers

Operation of the ISFSI would result in exposing operating personnel to radiation sources and workers at the ISFSI would be required to perform occupational tasks that can expose them to radiation: handling (i.e., receiving, transferring, and moving) of the spent fuel;

security; inspection; and routine inspection and maintenance activities. During day-to-day operation of the ISFSI, only one employee will be present to monitor the facility at no greater than 24 hour intervals. Monitoring would entail looking at canisters to ensure there are no vent obstructions or other issues with potential to affect storage; these inspections would take less than 30 minutes and may be conducted from beyond the radiological controlled area boundary. During loading campaigns, primarily occurring in the Auxiliary Building, about 10 workers would take part.

Because TVA would be using a system similar at WBN to that currently in use at SQN and the fuel being loaded will be similar to what SQN has loaded, historical data from SQN for these activities has been determined to be appropriate. SQN experience has shown that occupational exposure for Operation of the ISFSI would be minor. This has also been supported by previous conclusions reached by TVA, DOE, and NRC (*TVA WBN Unit 2 SEIS*; *CLWR EIS*; and *Waste Confidence Draft GEIS*).

When WBN starts putting spent fuel into the ISFSI, plant operations would continue for up to 40 years. This new activity would fall under the controls of the plant operating license and the dose to the workers and members of the public would remain under the same controls. The dose calculations and exposure pathways would be controlled by the WBN *Offsite Dose Calculation Manual* and monitored by the WBN radiological environmental monitoring program.

During initial handling of the spent fuel, occupational workers would perform the necessary activities to transfer the spent fuel into the dry cask storage, while avoiding radioactive or nonradioactive effluents that may result from canister loading or transfer to dry cask storage operations. Canister loading and closure operations would be performed inside the WBN Auxiliary Building in a controlled and monitored environment. Radioactive effluent handling during canister loading operations, which include canister draining and drying of the spent fuel, helium backfilling, sealing, and closure operations, is in accordance with the 10 CFR Part 50 license and radioactive waste management procedures. During canister closure operations, the lines used for venting or draining are routed to the spent fuel pool or radioactive waste processing systems. Adherence to the procedures for canister closure ensure that there would be no release of gaseous, liquid, or solid materials outside the fuel handling building/Auxiliary Building or in the fuel handling area of the Auxiliary Building during transfer and storage.

Once moved from the WBN Auxiliary Building, the only exposure pathway from the WBN ISFSI would be by direct radiation. Once spent fuel is placed in dry cask storage, the spent fuel has no liquid to leak to the environment. Each dry cask is sealed with a helium cover gas and is not normally opened again, so no gaseous releases are expected.

As long as the plant is operating, the exposure pathways would stay the same as during normal operations except for the addition of the direct radiation from the operations of the ISFSI, which would be expected to be small and therefore an insignificant contribution to offsite dose. TVA has previously concluded that due to the small magnitude of the total potential dose, the radiation dose to workers from the ISFSI operation would be minor (*TVA WBN Unit 2 SEIS*, p. 99).

Once the WBN units are shut down and decommissioned (which occurs under both storage timeframe scenarios), the dose to occupational workers would be reduced to the dose associated only with the operation of the ISFSI. This would be a significant decrease from

the previous phases of WBN, and the resulting dose to occupational workers due to the ISFSI would be considered a small impact and would continue to be far below regulatory limits.

Under the short-term storage scenario, fuel would be transferred from the ISFSI pad to a permanent facility within 100 years. The radiological risks associated with transporting spent fuel are analyzed and described in NRC's February 2014 *Spent Fuel Transportation Risk Assessment* and are incorporated herein.

The periodic construction of a replacement ISFSI at WBN is assumed under the indefinite storage scenario. Construction of a replacement ISFSI at WBN would be expected to be a short-term and intermittent construction project. Replacement of the ISFSI facility would require disposal of few radioactive materials. Once all loaded canisters are transferred to replacement storage overpacks on a new ISFSI pad, the original ISFSI pad would be decommissioned in a short time frame. The decommissioning plan would be prepared and approved prior to any decommissioning, and, when considering the indefinite storage scenario, the site of the decommissioned ISFSI would be available for future use as a replacement ISFSI pad.

#### General Public

Potential impacts to the general public from the Proposed ISFSI Alternative would be small. The regulatory limit for public exposure of radiation from nuclear facilities is 25 mrem per year (10 CFR Parts 20 and 72). Historical data show that WBN's contributions due to direct radiation and effluent releases are significantly below the 25 mrem per year limit.

In 1999, DOE cited three studies of operating ISFSIs which estimated that the annual doses of radiation to the nearest members of the public in the WBN region were a small fraction of the regulatory limit (*CLWR EIS*, p. 5-98). In the DOE *Yucca Mountain EIS* (2002), it was estimated that the hypothetically maximally exposed offsite person during the first 100 years of storage would be exposed to approximately 0.20 mrem per year. For the indefinite storage scenario, after the first 100 years, the dose was estimated to decrease to approximately 0.06 mrem per year due to radioactive decay of the materials (*Yucca Mountain EIS*, p. 7-27). In comparison, as noted above, the average American is exposed to approximately 620 mrems annually from natural and artificial sources other than spent fuel.

Under both storage timeframe scenarios, the public dose estimates for spent fuel management in dry cask storage would be expected to be well below the required limits for dose to members of the public. Assuming a 100-year life expectancy for the proposed ISFSI itself (pertaining to both the short-term and indefinite storage scenarios), there would be an expected decrease in public dose due to the long and significant decay period after the first 100 years. As noted above, because time is a significant contributor to radioactive decay and temperature decrease of stored spent fuel, dose levels would continue to significantly decline due to decay beyond the first 100 years.

Under the indefinite storage scenario, a replacement ISFSI would be constructed and spent fuel would be recasked each 100 years due to potential aging or degradation of the ISFSI systems. Under this scenario, the dose to members of the public would be the same or less than the previous ISFSI offsite dose. DOE and NRC's analyses of the potential impacts to human health during indefinite storage show that impacts would be small (*Yucca Mountain EIS*, chapter 4.1.7.2 and *Waste Confidence Draft GEIS*, p. 4-67).

The additional public dose from decommissioning the ISFSI would be negligible and far below the level of dose received from plant decommissioning. Even multiple replacements (construction and re-cask operations) at the ISFSI resulting in dose exposure to members of the public would be maintained below limits in all cases. Each project required to support the continued operation of the ISFSI would be expected to remain small and insignificant.

### ***Radiation Monitoring***

The required monitoring for an ISFSI is stated in 10 CFR Part 72.104. While the WBN operating license is in effect, the Offsite Dose Calculation Manual program encompasses the area surrounding WBN and would provide a comprehensive monitoring program beyond the requirements of 10 CFR Part 72.104. The addition of extra direct radiation monitoring to verify the ISFSI requirement of annual dose equivalent would include potential dose from the operating facility and direct radiation from both the plant and from the ISFSI. TVA would conduct periodic radiation monitoring to verify that radiation levels remain within acceptable levels and cumulative impacts would be kept to a minimum.

### ***Non-radiological Impacts***

Implementation of extended storage at the WBN site under institutional control would not result in new or significantly increased non-radiological impacts. All impacts during the short-term storage of spent fuel in the spent fuel pool as well as the onsite ISFSI and indefinite dry cask storage would be considered small. These conclusions, drawn from the DOE *Yucca Mountain EIS*, indicate the impacts to be small because all disturbances anticipated with extended storage facilities, including operation and maintenance of the ISFSI, and construction of replacement ISFSI and decommissioning of the old, would be within the current plant footprint on land owned by TVA.

As noted by NRC in 2013, construction and operations of an ISFSI would expose workers to typical industrial hazards, and non-radiological occupation health impacts would be “minimal” largely due to preventative safety measures and maintenance activities required by the Occupational Safety and Health Administration and TVA’s safety policies (*Waste Confidence Draft GEIS*, p. 4-66).

### ***Cumulative Effects***

As explained above, all environmental reviews conducted for WBN Units 1 and 2 have concluded that the potential radiological impacts for workers and the public would be well below the regulatory limits. The potential radiological effects of the proposed ISFSI would also be small. DOE and NRC made similar conclusions based on their reviews of continued on-site storage of spent fuel.

In its 2007 *WBN Unit 2 SEIS*, TVA found that radiological effects of the second unit at WBN would have the same magnitude of effects as Unit 1. When *combining* the operations of the two reactors, TVA estimated that “the doses to the public resulting from the discharge of radioactive effluents from WBN would likely be less than two percent of the NRC guidelines given in 10 CFR Part 50 Appendix I, and that there would be no new or different effects on the surrounding environment due to these releases than from those discussed in the [1972 *Final Environmental Statement*]” (*TVA WBN Unit 2 SEIS*, pp. 76 and 77). Radiological impacts from the construction and operation of the WBN ISFSI would have far fewer environmental impacts than those of operations of both reactor units and incremental contributions to cumulative impacts would be small and insignificant.



### **Mitigation Measures and BMPs**

Occupational doses would be minimized by the use of shielding, distance, and reduced stay time around the material. TVA will continue to adhere to the strict regulatory requirements that ensure the health and safety of workers and the general public.

## **3.6 Postulated Accidents**

### **3.6.1 Affected Environment**

The review and analysis of postulated accidents is another primary consideration when addressing continued storage of spent fuel and is an important environmental issue. In this analysis, the term ‘accident’ refers to any unintended event that results in a release or a potential release of radioactive material to the environment (*TVA WBN Unit 2 SEIS*, p. 73). Numerous such studies have previously been completed that evaluate the potential for such accidents at WBN. This EA incorporates by reference the analysis of the *TVA WBN Unit 2 SEIS* (Chapter 3.12) as well as the *NRC WBN Unit 2 FES*. The NRC’s *Waste Confidence Draft GEIS* provides additional analysis of the potential environmental impacts relating to storage of spent fuel and is incorporated by reference and summarized as well.

The NRC’s *Waste Confidence Draft GEIS* extensively addresses three types of postulated accidents:

- Design basis events (events, such as system and structural failures, man-made hazards; and natural phenomena, used in the design to ensure the capability to prevent or mitigate consequences of accidents) (*Waste Confidence Draft GEIS*, p. 4-70);
- Design basis accidents, described as “postulated accidents used to set design criteria and limits for the design and sizing of safety-related systems and components” (*Waste Confidence Draft GEIS*, p. 4-68); and
- Severe accidents (beyond design accidents) that may “challenge safety systems at a level much higher than expected” (*Waste Confidence Draft GEIS*, p. 4-68).

In its May 2013 *WBN Unit 2 FES*, NRC provided a summary of the numerous environmental reports and impact statements that have previously evaluated the potential consequences of postulated accidents involving radioactive materials related to the construction and operation of WBN Units 1 and 2 (p. 6-1). Chapter 6 of the *NRC WBN Unit 2 FES* also includes the results of NRC’s “independent review of the consequences of postulated accidents for WBN Unit 2 based on changes occurring since the last NRC assessment.”

### **3.6.2 Environmental Consequences**

The analysis in this section provides a summary of findings from numerous previous environmental analyses of postulated accidents at WBN and/or at on-site ISFSIs, consistent with 40 CFR Part 1502.21. TVA finds these analyses to be relevant to the WBN ISFSI proposal. However, additional information related to seismic, flood, and man-made risks at the site of the proposed WBN ISFSI is provided.

#### **3.6.2.1 Alternative A (No Action)**

Under this alternative, no ISFSI would be constructed at WBN and operations would continue until the current spent fuel pool storage capacity is reached. As noted above,

numerous studies have analyzed the potential risks associated with postulated accidents at nuclear plants during operations of on-site ISFSIs. Each study has concluded that only small impacts are anticipated.

Without additional storage capacity, spent fuel would remain in the WBN spent fuel pool once operations are ceased. In its 2013 *Waste Confidence Draft GEIS*, NRC generically analyzed the potential environmental risk of design basis events at spent fuel pools. NRC found that the risk of these postulated design basis events involving storage at spent fuel pools are small (p. 4-83). Criticality accidents, fuel assembly or cask drops, and natural phenomena hazards (including earthquakes, floods, tornadoes or hurricanes, and climate change) were studied. In its May 2013 *WBN Unit 2 FES*, NRC also concluded that risks associated with operating both units at WBN are small (p. 4-99).

The NRC analysis further supports TVA and DOE's previous studies that concluded that environmental risks of design basis events at WBN operations, including storage in the spent fuel pool, are small (*TVA WBN Unit 2 SEIS*). Consistent with regulatory requirements, the WBN spent fuel pool design includes seismically qualified pool structures, racks, and cooling systems that would help protect it during postulated design basis events. These protections have been further enhanced following the September 11, 2001 terrorist attacks and the Fukushima event.

In the *TVA WBN Unit 2 SEIS* analysis (Chapter 3.12), TVA also concluded that risks of a severe accident at WBN are small (p. 2-4). In addition, "increased risk from Unit 2 operation would be extremely low. Risk of and potential impacts from a terrorist attack on WBN are not expected to increase significantly due to completion of WBN Unit 2. Because WBN is an existing, operating nuclear facility, the risks and potential consequences of a terrorist attack already exist, and safeguards have been taken to protect against such risks" (*TVA WBN Unit 2 SEIS*, p. S-4).

### **3.6.2.2 Alternative B (Proposed ISFSI)**

Under this alternative, spent fuel would be transferred from the spent fuel pool into a dry cask storage system regularly. The environmental risks from postulated accidents during ongoing operations of WBN and at the spent fuel pool would be the same under this alternative as under the no action alternative. Under the short-term storage scenario, the spent fuel pool would be decommissioned once the spent fuel is removed from the WBN ISFSI and transferred for off-site storage. Under the indefinite storage scenario, the spent fuel pool would be maintained and would be used every 100 years for transferring assemblies from old casks to new, replacement casks. Therefore, potential risks associated with on-site dry cask storage would persist indefinitely whereas risks in the short-term storage scenario would cease once spent fuel is transported off-site.

In the 1999 *CLWR EIS*, the DOE analyzed the environmental impacts of postulated accidents associated with constructing and operating a generic dry cask ISFSI. The *CLWR EIS* includes a detailed table addressing the environmental impacts of accidents at ISFSIs; see Table 5-51 on pp. 5-101 and 5-102. In the *TVA WBN Unit 2 SEIS*, TVA concluded that an ISFSI is the recommended means for continued storage of spent fuel onsite and found that the *CLWR EIS* analysis of postulated accidents applied to TVA's proposal to utilize an ISFSI at WBN and stated:

The *CLWR EIS* analyzed the postulated accidents that could occur at a [WBN] ISFSI and concluded that the potential radiological releases would all be well within regulatory limits. The impact of the calculated doses, which were approximately 50 mrem or less for different scenarios, were compared with the natural radiation dose of about 300 mrem annually received by each person in the United States (*CLWR EIS*). The storage casks proposed for use at WBN for a two-unit operation would be of similar or better design than those analyzed in the mid-1990s, and any accident doses resulting from such a postulated event would be consistent with doses previously determined. (*TVA WBN Unit 2 SEIS*, p. 99)

Recent NRC analyses further support the conclusions made by DOE in 1999 and TVA in 2007. In its *Waste Confidence Draft GEIS* (chapters 4.18.1 and 4.18.2), NRC concluded that the environmental risks associated with postulated design basis events for dry cask storage systems, including hazards from natural phenomenon such as earthquakes, floods, and tornadoes, are considered to be small (p. 4-84). In addition, NRC concluded that “environmental impacts of design basis accidents are small because all licensees must maintain engineered safety features that ensure that the NRC dose limits for these accidents are met” (*Waste Confidence Draft GEIS*, p. 4-69).<sup>6</sup> TVA’s existing and planned at-reactor ISFSIs, including the proposed ISFSI for WBN, are fully consistent with those described in the *Waste Confidence Draft GEIS*.

TVA is aware of concerns regarding the storage of high burnup fuel and the performance of cladding during storage. TVA generates high burnup fuel at WBN with burnup levels in line with current U.S. industry averages. Eventually, TVA would store the high burnup spent fuel at the WBN ISFSI. Numerous studies support the conclusion that long-term storage of high burnup fuel is safe and in compliance with NRC regulations. Since 2003 the Electric Power Research Institute (EPRI) has conducted multiple research projects that examined the long-term performance of high burnup fuel in storage. The research, documented in more than a dozen reports, form a sound, technical basis for the safe storage of high burnup fuel over an extended period of time (see Attachment A for a list of the reports).

The nuclear industry is committed to obtaining confirmatory data to validate the research and is currently working with the Department of Energy and EPRI on a demonstration project that will obtain real-time data on the performance of high burnup fuel in storage. The project will load an instrumented cask with well characterized high burnup fuel and will reopen the cask after 10 years or longer. At that time the fuel will be visually and physically examined. As a result of this research project, significant data should be available before most of the high burnup fuel currently in casks has been in storage for 20 years. In addition, the research project will provide ongoing data that will ensure that storage of high burnup fuel continues to protect the health and safety of the public. TVA will continue to review the findings of the demonstration project over its duration. Under the Proposed ISFSI

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<sup>6</sup> TVA’s assesses impacts from postulated accidents consistently with the NRC *Waste Confidence Draft GEIS*: “The consequences of a severe (or beyond-design-basis) accident, if one occurs, could be significant and destabilizing. The impact determinations for these accidents, however, are made with consideration of the low probability of these events. The environmental impact determination with respect to severe accidents, therefore, is based on the risk, which the NRC defines as the product of the probability and the consequences of an accident. This means that a high-consequence low-probability event, like a severe accident, could still result in a small impact determination, if the risk is sufficiently low” (pp. 4-68 and 4-69).

Alternative, TVA would take action to implement any needed corrective actions and ensure that the dry cask storage system continues to operate safely.

TVA's proposed ISFSI pads would be designed to rigorous seismic and flooding criteria, as required by the NRC regulations. Moreover, the significant robust protection from external events has been demonstrated by real world events, including the August 23, 2011 Mineral, Virginia earthquake near the North Anna nuclear power plant and the March 11, 2011 earthquake and subsequent tsunami that damaged the Fukushima Dai-ichi nuclear power plant. Neither event resulted in significant damage to or the release of radionuclides from the dry cask storage containers. TVA is taking actions to implement the requirements of the NRC's orders and other requirements following the Fukushima event, including requirements for seismic and flooding reevaluations. TVA's actions and plans are consistent with the statements in the *Waste Confidence Draft GEIS* and further demonstrate that the TVA ISFSIs will comply with all regulatory requirements to ensure safe and environmentally sound spent fuel storage.

Information relevant and specific to the proposed WBN ISFSI pad location that supplements the previous analyses relates to the site's seismicity, flood risk, and security:

### ***Seismicity of the ISFSI Site***

TVA's analysis specific to the proposed WBN ISFSI further supports these findings. As described in Chapter 3.1 above, the seismic and liquefaction analyses of the proposed ISFSI area highlights the need for ISFSI design features to remediate the potential risk of failures at the ISFSI site during a seismic event. In response to the analysis, TVA's design of the ISFSI pads was modified to include vertical pilings to be inserted beneath the pad to address potential liquefaction. Without the remediation, the liquefaction analysis showed that excessive settlement and potential structural damage could result at the site. Because the ISFSI pad is located on a flat area, the potential for damage resulting from lateral spreading or flow structure is less than damage resulting from loss of weight bearing capacity and ground oscillation.

Appendix A of 10 CFR Part 50 requires that nuclear power plants be protected against natural phenomena such as earthquakes. Utilizing the site design criteria, TVA's WBN ISFSI would be designed and constructed to seismic Category I standards, ensuring that the structures, systems, and components would withstand the maximum potential earthquake stresses for the region. These design and construction standards apply to all WBN operations. In its 2007 review of WBN Unit 2 operations, TVA concluded that no seismic effects would result from operations at WBN because the seismic capacity of WBN exceeds the minimum-level required by NRC (*TVA WBN Unit 2 SEIS*, p. 72).<sup>7</sup> The Auxiliary Building in which the spent fuel pool is located is a seismic Category I structure that is designed and built to withstand the maximum potential earthquake stresses for the region. The application of the design criteria at 10 CFR Part 50 provides "reasonable assurance that the plant can be constructed and operated without undue risk to health and safety of the public" (*Waste Confidence Draft GEIS*, p. 4-72). Such criteria and standards also ensure that spent fuel storage in the spent fuel pool at the Auxiliary Building and at the ISFSI can be done safely during the short-term storage timeframe and indefinitely.

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<sup>7</sup> NRC is currently reevaluating seismic design basis as part of its review of the accident at the Fukushima Dai-ichi nuclear facility in 2011. As part of their review, NRC has requested TVA and other licensees to reevaluate the seismic characteristics of plants. TVA is currently completing its reevaluation for the WBN site and will continue to fully comply with NRC design standards.

A recent paper prepared by one of the NRC Staff's lead structural engineers and reviewers (acting in individual capacity as an engineer) further supports the robust nature of ISFSIs. The paper concluded, with "a high degree of confidence," that spent fuel assemblies stored in ISFSI locations within the most seismically-active regions in the Central and Eastern U.S. will not pose undue radiological hazard, in large part because greater seismic inertia loads are bounded by other design loads (Tripathi 2013). According to the paper, "[t]he built in defense-in-depth for the analysis/design of these casks, and rigorous construction and periodic maintenance of these facilities required by the applicable regulations provide reasonable assurance that these facilities are safe" (Tripathi 2013).

Accordingly, TVA concludes that the potential for structural failure as a result of soil liquefaction at the WBN ISFSI is small because the structures, systems and components would be designed to withstand seismic events. Thus, the environmental impacts of such a failure to the health and safety of the public would be small.

### **Flooding Risk**

As stated above in Chapter 3.2, the elevations of the major components of the proposed ISFSI project vary, with only the ISFSI pads sited above the probable maximum flood (PMF) level of 739.2 feet. However, the environmental risks associated with extreme floods at nuclear plants and ISFSIs are expected to be small because the safety-significant structures, systems and components of the plants and ISFSIs are designed to be protected against the design basis flood. Under the Proposed ISFSI Alternative, TVA would utilize the Holtec HI-STORM system, which is licensed by NRC to meet stringent design standards. Spent fuel storage structures, equipment, and operating procedures are designed to assure safety so that extreme flood conditions do not adversely affect safe storage of spent fuel at a spent fuel pool or ISFSI. In addition, the plant is designed to have the capability for safe shutdown for floods exceeding plant grade level (*Waste Confidence Draft GEIS*, p. 4-73).

A PMF event has the potential to impact the ISFSI in a variety of ways. The ISFSI pads would be above the PMF elevation level but below the PMF elevation with wind-driven wave action. Although a site specific analysis of potential flood velocities for WBN has not yet been performed, one would be performed before casks are loaded on the proposed ISFSI pad, in compliance with 10 CFR Part 72 and the requirements of the Holtec Certificate of Compliance. Section 3.4.5 of the Certificate of Compliance, Appendix B requires that the maximum permissible velocity of the floodwater not be exceeded. The Holtec HI-STORM FW FSAR states in Section 3.4.4.1.1 that the upper bound flood velocity for these systems is 30.8 feet/second. A review of TVA's *10 CFR 72.212 Evaluation Report for SQN* shows that the worst-case flood velocity value for the PMF at SQN was calculated to be 4.86 feet/second. Therefore, even assuming that the flood water velocity at WBN is 2 or 3 times that at SQN, the casks would not be expected to move.

Though flood waters associated with wind-driven waves would not be expected to move casks on the pad, receding flood waters may deposit mud and debris on the casks or pads that could interfere with the air flow through the casks. In addition, soil erosion around the pad foundation, haul path, and other components may result. Fencing, security structures and equipment, and the equipment storage building would likely require repairs or reconstruction. Impacts due to receding flood waters would be similar to surface water impacts described in Chapter 3.3 above. These impacts would require a variety of response actions, including cleaning, site stabilization, and temporary demolition and construction

activities to the ISFSI support facilities. Cleaning activities to ensure that air flows through the casks would be prioritized and would occur in a timely manner.

TVA is taking numerous actions to address the potential risk to its nuclear power plants from a PMF event, including modifying numerous reservoir dams to improve safety capabilities in the event of a PMF (see *TVA Dam Safety Modifications at Cherokee, Fort Loudon, Tellico and Watts Bar Dams Final EIS*). As noted above, TVA is also implementing the requirements of the NRC's orders and other requirements following the March 2011 Fukushima event. As part of that strategy, for example, the FSEB is being constructed adjacent to the proposed ISFSI site to house emergency generators that will ensure power supply to the plant in the event of such a flooding event (see TVA's *Fukushima Response Strategy EA*, March 15, 2013).

### **Terror and sabotage**

Implementing the Proposed ISFSI Alternative would require several modifications to the WBN security apparatus including a limited expansion of the security perimeter to include the ISFSI within the WBN protected zone. The WBN ISFSI would be designed in compliance with NRC regulations requiring physical protection of stored spent nuclear fuel (10 CFR Parts 72 and 73). Furthermore, the WBN ISFSI design and location would be in compliance with security-based limits and vehicle physical barrier requirements to protect against terrorist attack or sabotage, and other security-related events.

NRC's *Waste Confidence Draft GEIS* discusses potential acts of sabotage or terrorism on spent fuel pools and ISFSIs in Chapter 4.19. The NRC concluded that the environmental risk of an act of sabotage or terrorism is small based on the very low probability of a successful attack, and that the "continued storage of spent fuel will not constitute an unreasonable risk to the public health and safety from acts of radiological sabotage theft or diversion of special nuclear material" (*Waste Confidence Draft GEIS*, pp. 4-89 and 4-90). TVA has determined that these conclusions apply to TVA's plants, particularly because TVA has taken all required measures following the September 11, 2001 terrorist attacks.

After the attacks of September 11, 2001, a number of studies and security assessments were conducted to determine whether the existing security requirements would be effective in protecting nuclear facilities from terrorist attack. The NRC concluded after these studies that security measures in place for ISFSI facilities were adequate. Tests on the ruggedness of the Holtec dry cask storage designs have shown that the systems can withstand a large explosive blast (Kipp 2004) and the direct impact of an aircraft loaded with fuel (Smith 2004) without loss of containment integrity.

As noted above, TVA concluded in 2007 that "risk of and potential impacts from a terrorist attack on WBN are not expected to increase significantly due to completion of WBN Unit 2 (including on-site storage at an ISFSI). Because WBN is an existing, operating nuclear facility, the risks and potential consequences of a terrorist attack already exist, and safeguards have been taken to protect against such risks" (*TVA WBN Unit 2 SEIS*, p. S-4).

The NRC has developed a set of rules specifically aimed at protecting the public from harm that could result from sabotage of spent nuclear fuel casks. There are numerous physical protection and safeguards regulations (i.e., 10 CFR Parts 73.37 and 73.51) that must be implemented. The dry storage cask safety features that provide containment, shielding and thermal protection also provide protection against sabotage.

**Summary**

In summary, the results of numerous environmental reviews have shown that the potential environmental risks associated with postulated accidents relating to storage of spent nuclear fuel show that impacts would be small. In addition, TVA is not aware of any aspects of its plants that would place them outside the NRC's generic evaluation of the environmental impacts of continued at-reactor storage of spent fuel that is provided in the *Waste Confidence Draft GEIS*. TVA concludes that the potential impacts from extended storage at the WBN site are not expected to increase or substantially change from those identified in previous environmental documents, and no additional mitigation measures beyond those already being implemented, committed to, or added in the future would be required.

**Cumulative Effects**

In May 2013, the *NRC WBN Unit 2 FES* included a cumulative impacts analysis of the environmental risks of postulated accidents relating to operations at WBN Units 1 and 2 as well as units at TVA's nearby SQN. Storage of spent fuel in the WBN and SQN spent fuel pools and at the existing SQN ISFSI were included in this analysis. NRC determined that environmental impacts of severe accidents would be small when weighted by probabilities of such events occurring. "The severe accident risk for a nuclear power plant gets smaller as the distance increases. The combined risk at any location within 80 km (50 mi) of the WBN site would be bounded by the sum of risks for all of these operating and proposed nuclear power plants. Even though there would be several plants included in the combination, this combined risk would still be low. On this basis, the NRC staff concluded that the cumulative risks from severe accidents at any location within 80 km (50 mi) of the WBN Unit 2 likely would be small" (*NRC WBN Unit 2 FES*, pp. 4-99 and 4-100). The risks associated with constructing and operating the WBN ISFSI would be minimal compared to the cumulative risks analyzed by NRC. Therefore, when added to the risks associated with those activities analyzed by NRC, the cumulative environmental risks associated with constructing and operating an ISFSI at WBN would be small.

**Mitigation**

All components of the proposed ISFSI would be designed, built, and operated to eliminate or reduce any risks associated with postulated accidents. As stated above, the Holtec International HI-STORM system is licensed by NRC to meet stringent design standards. The WBN ISFSI would be designed and constructed to seismic Category I standards, which ensures structures, systems, and components are designed and built to withstand the maximum potential earthquake stresses for the region where a nuclear plant is sited. These standard requirements serve to mitigate the risk for failure of the ISFSI. TVA would also take appropriate measures to avoid adverse effects from a Probable Maximum Flood event. In addition, the WBN ISFSI design and location would be in compliance with physical protection and safeguards regulations.

**3.7 Greenhouse Gas Emissions and Climate Change****3.7.1 Affected Environment**

Greenhouse gases (GHGs) are any of the atmospheric gases that absorb infrared solar radiation, thereby contributing to the warming of the Earth's surface. Common GHGs include carbon dioxide, methane, nitrous oxide, and water vapor. Combustion of carbon-based fuels such as coal, natural gas, and petroleum products is a major source of GHGs.

The climate of WBN is described in the *NRC WBN Unit 2 FES*. In summary, the WBN is located in an area of the humid subtropical climate zone that is influenced by the eastward and northerly storm systems that move across the southern United States. The area's climate is moderate while its winters are cool. Average temperatures in the area range from average highs of 50 degrees (F) in January to average highs of near 90 degrees (F) in July, with approximately 50 inches of average annual precipitation.

The NRC's *WBN Unit 2 SES* analysis states that projected changes at WBN during the life of WBN Unit 2 may include an increase in average temperatures (2 to 3 degrees F) and a small change in precipitation averages (p. 2-88). However, NRC's review of WBN meteorological data for periods between 1972 and 2008 did not identify any significant local changes in climate (*NRC WBN Unit 2 SES*, p. 2-89). More recent climate modeling data (downscaled to United States counties) indicate the potential for temperature increases in Rhea County of 4 to 6 degrees over the life of WBN Unit 2 and 5 to 10 degrees by 2100. The data also indicate the potential for small precipitation changes relative to natural variations (National Aeronautics and Space Administration 2014).

Though there are uncertainties about the potential effects of climate change (as it is occurring in the context of global warming), any changes in local climate are not anticipated to affect TVA's WBN operations or indefinite management of an ISFSI. The current trends do not suggest that temperature, wind, or precipitation would change during the operating life of WBN to the extent that modifications to WBN operations would be necessary. For instance, while precipitation change may affect the availability of water for cooling spent fuel, the change would not substantially affect the availability of water from Tennessee River for water use (*NRC WBN Unit 2 SES*, p. 4-83). Changes to the local climate may be more substantial over an indefinite period of on-site spent fuel storage at an ISFSI. However, even substantial changes in the climate are not anticipated to affect TVA's management of the ISFSI, given that the ISFSI operations and infrastructure are not affected by temperature changes, are designed to withstand extreme weather events, and only require small amounts of water.

### **3.7.2 Environmental Consequences**

#### **3.7.2.1 Alternative A (No Action)**

Under Alternative A, TVA would not construct an ISFSI pad and associated facilities. With no construction activities, there would be no emissions of greenhouse gases associated with the construction worker vehicles and fossil-fueled construction equipment. Current levels of greenhouse gas emissions would occur from plant operations. Plant operations would cease once capacity is reached in the spent fuel pool, drastically reducing total emissions quantities. Decommissioning of WBN would result in GHG emissions, associated with worker transportation and equipment use, but those would be in small quantities (*NRC WBN Unit 2 FES*, p. 7-71). Compared to Alternative B, taking no action would result in fewer greenhouse gas emissions.

#### **3.7.2.2 Alternative B (Proposed ISFSI)**

The construction and operation of an ISFSI at WBN would result in emissions of heat and some greenhouse gases. TVA and DOE have previously analyzed the potential GHG and climate impacts of continued storage of spent fuel at WBN and determined that these impacts would be small (*TVA WBN Unit 2 SEIS; CLWR EIS*). In 2013, NRC came to the same conclusion (*Waste Confidence Draft GEIS*).



Some heat emissions would result from operations of the ISFSI. In 2007, TVA estimated that the effects of operations of a heat dissipation system at WBN ISFSI would be small: the equivalent to the heat emitted into the atmosphere by 15 to 20 average-size cars (*TVA WBN Unit 2 SEIS*, p. 99).

In considering the Proposed ISFSI Alternative, TVA assumes that a Holtec HI-STORM FW dry cask storage system would be utilized and that, at the maximum design-licensed decay heat level for each cask of 47.05 kW, the heat emitted by 180 casks would be approximately 8500 kW (i.e., 180 casks × 47.05 kW = 8469 kW). In comparison, this amount of heat is less than 0.5 percent of the heat released to the environment for each operating WBN nuclear reactor, on the order of 2,400,000 kW (*TVA WBN Unit 2 SEIS*, p. 98). Over time, the maximum decay heat level for the Holtec cask may increase based on design improvements approved by NRC. However, it is unlikely that such an increase would be substantial enough to result in more than small heat emissions.

Increased heat emitted from the operation of the ISFSI would not create impacts on the climate or meteorology in the region. In addition, because the loading of the WBN ISFSI would take place over a 40-year period, the full ISFSI heat amount would not be generated until the end of the period (*CLWR EIS*, p. 5-100).

Greenhouse gas emissions would also be small. During the approximately two-year period of construction of the WBN ISFSI and facilities, emissions of CO<sub>2</sub> and other greenhouse gases are expected primarily from combustion engines in heavy construction equipment, generators and vehicles for the estimated 10 to 25 ISFSI construction workers. During normal operations of the ISFSI, very small amounts of GHGs would be generated by the few onsite workers commuting and conducting maintenance and by the equipment used to infrequently transport spent fuel from the WBN Auxiliary Building to the ISFSI pad.

In previous analyses, NRC has included short-term storage of spent fuel as part of its estimation of CO<sub>2</sub> emissions from decommissioning activities for nuclear power plants. According to NRC, the primary sources of GHG emissions it identified during the decommissioning activities are fossil-fuel powered demolition equipment and worker transportation vehicles for the estimated 300 decommissioning workers (*Decommissioning GEIS*, p. 4-18). According to a study in 2012 by the EPA, these decommissioning activities may contribute about 1,000 metric tons of annual CO<sub>2</sub> equivalents; all U.S. emissions annually are approximately 6.7 billion metric tons (EPA 2012). As noted above, NRC concluded that the GHG emissions from activities to decommission WBN units would be small (*NRC WBN Unit 2 FES*, p.4-71)

Continued storage activities at the spent fuel pool and ISFSI would have similar emission sources. With a smaller work force, and fewer actions than the decommissioning work as a whole, fewer CO<sub>2</sub> emissions are expected from continued storage than from the decommissioning activities as a whole (*Waste Confidence Draft GEIS*, pp. 4-18 and 4-19). When comparing these emissions to total U.S. emission rates, NRC has concluded that “short-term continued storage would not be noticeable and would therefore be small.” (*Waste Confidence Draft GEIS*, p. 4-19). The short-term storage scenario assumes that spent fuel will be moved to a repository by the end of this period. Impacts of transporting spent fuel and storing fuel at a repository were addressed in 2008 by DOE in its *Supplement to the Yucca Mountain EIS*.

Emissions sources from indefinite storage, after decommissioning activities, would also include worker transportation vehicles and equipment used for the maintenance of the ISFSI facility and the spent fuel pool. Equipment would also be needed for those periods when canisters are transferred and replaced. The demolition of the ISFSI pad and construction of a replacement pad every 100 years would increase emissions temporarily. In their 2012 inventory, EPA estimated that the annual CO<sub>2</sub> footprint for every 100-year time frame (including canister transfer and ISFSI pad replacement) would be about 855 metric tons of CO<sub>2</sub> equivalents. Based on the comparison with total annual U.S. emissions (approximately 6.7 billion metric tons), NRC found that the annual GHG emissions of the spent fuel over an indefinite period would be small and unnoticeable.

### **3.7.3 Cumulative Impacts**

The scope of the climate change phenomenon is global and is cumulative by nature. In the *NRC WBN Unit 2 FES*, NRC reviewed the cumulative impacts of the greenhouse gas emissions from WBN Unit 2 operations and those of other past, present, and reasonably foreseeable activities and concluded that “local atmospheric impacts of GHG emissions related to operating and decommissioning WBN Unit 2 would be small” and that “local impacts of the combined emissions for the full plant life cycle would be small” (pp. 4-82 and 83). The anticipated greenhouse gas emissions from construction and operation of the ISFSI are anticipated to be much smaller than those of Unit 2 operations. Any incremental impacts from continued, indefinite ISFSI operations would be very small.

### **3.8 Unavoidable Adverse Environmental Impacts**

The Proposed ISFSI Alternative would create some unavoidable adverse environmental effects. Due to the constraints and requirements of storage of spent fuel for the short-term and indefinite storage periods, impacts described in this chapter are unavoidable. As described above, TVA proposes to incorporate numerous design features that would minimize or eliminate potential adverse effects.

### **3.9 Irreversible and Irretrievable Commitment of Resources**

Irreversible commitments of resources include the use or consumption of non-renewable resources as a result of constructing and operating an ISFSI at WBN. Irretrievable commitments involve the use or commitment of resources for a period of time.

Certain activities associated with the Proposed ISFSI Alternative, especially those involving construction of ISFSI facilities and the operation of heavy equipment, would result in the irreversible commitment of certain fuels, energy, building materials, capacity for waste disposal, and process materials. These commitments would result under both storage scenarios. Because an ISFSI would be in operation in perpetuity under the indefinite storage scenario, land commitments for the ISFSI would be irreversible. Under the indefinite storage scenario, the commitment of resources required to replace the ISFSI every 100 years and to continue operating the facility in perpetuity would also be irreversible.

TVA’s use of portions of the WBN site for the ISFSI facilities and equipment would constitute a cumulative irretrievable commitment of land resources and land use for the life of the ISFSI under the short-term storage scenario, continuing for up to 100 years. At the end of the short-term storage scenario, transporting the spent fuel to an off-site location would result in additional irreversible and irretrievable commitments of resources.

These conclusions are supported by those made by the NRC in their study of waste confidence of continued onsite storage of spent fuel (*Waste Confidence Draft GEIS*, p. 8-8).

### **3.10 Relationship of Short-Term Uses and Long-Term Productivity**

In the *Waste Confidence Draft GEIS*, NRC also examined the relationship of short-term uses and long-term productivity and concluded that the maximum impact on long-term productivity of the land occupied by the WBN ISFSI would result if the ISFSI is not dismantled after the short-term storage period ends. Under the indefinite storage scenario, therefore, the loss of productivity in the location would be indefinite and other productive uses of the site would be foregone. Long-term productivity of those lands needed for waste disposal would also be impacted. Though GHG emissions of the ISFSI proposal would be very small, those emissions could contribute to long-term impacts associated with climate change (*Waste Confidence Draft GEIS*, pp. 8-9 and 8-10). Impacts to long-term productivity can be eliminated under the short-term storage scenario, once the ISFSI operations cease and the associated facilities are decommissioned.



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## ATTACHMENT A

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