G-12 The problems associated with short- and long-term of handling of storage of nuclear waste far outweigh the short-sighted continuation of this astronomically expensive and dangerous technology, when we should be committing money to renewable and sustainable alternative energy sources, such as photovoltaics and wind power. Which, when pared with conservation, is a much more logical solution to our energy needs.

MR. CAMERON: Thank you, Nancy.

And I would just like to thank all of you for your comments and bringing your concerns forward to us. I think you can see from some of the things that the NRC staff said about what we're doing here, the concerns are always important to us. Some of the concerns we can try to address because they're within our areas of responsibility, but I think all of the concerns are important to us as Americans in terms of larger policy choices.

Thank you for your comments tonight.

I'm just going to ask Andy Kugler to close the meeting for us. Andy.

If you can, please stay after the meeting because the staff and our experts are here. If there is anything else you want to talk about, if there's any other documents you want to take home, we can get those for you, too.

Andy.

MR. KUGLER: I just wanted to thank you again for coming out this evening.

One thing I did want to mention. In the packet of materials that Etoy gave you when you came in, one of the items was a Meeting Feedback Form. We look for ways to try to do things better, and if you have some suggestions on what we could do, we would certainly appreciate that feedback. You can either fill it out now and drop it off at the back, or its prepostage paid and you can fill it out later and mail it in. Either way, it will get to us and we can take a look at what comments you may have.

Beyond that, as Chip mentioned, we will be staying after the meeting. We would be happy to talk to you about any questions you may have.

Other than that, thank you for coming again, and drive safely going home.

Thank you.

(Whereupon at 8:44 p.m. the meeting was closed.)

RDB received
3/2/05

12/10/04
69FR71255

(1)

TVA

Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402-2801

February 25, 2005

10 CFR 54
10 CFR 51

Chief, Rules and Directives Branch
Division of Administrative Services
Office of Administration, Mailstop T-6D59
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos.	50-259
Tennessee Valley Authority	)		50-260
			50-296

TENNESSEE VALLEY AUTHORITY (TVA) COMMENTS ON DRAFT NUREG-1437 SUPPLEMENT 21 TO THE GENERIC ENVIRONMENTAL IMPACT STATEMENT FOR LICENSE RENEWAL OF THE BROWNS FERRY NUCLEAR PLANT (BFN), UNITS 1, 2, AND 3

Enclosed are TVA's comments on the subject document. TVA appreciates the opportunity to comment. This letter contains no new commitments.

If you have any questions about this information, please contact Chuck Wilson, Project Manager for BFN License Renewal Environmental Review, at (423) 751-6153 or cwilson@tva.gov.

Sincerely,

John C. Fornicola
Manager
Nuclear Assurance and Licensing

Enclosure

ENCLOSURE

TVA COMMENTS ON NRC'S SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT FOR BROWNS FERRY NUCLEAR PLANT (BFN) UNITS 1, 2, AND 3

Executive Summary

Page xx, Line 15: The statement is made that power generation alternatives are evaluated assuming that the replacement power generation plant is located at either the BFN site or some other unspecified alternative location. In contrast, Chapter 8 follows material supplied in TVA's Environmental Report which analyzes four different types of alternative power plants, all of which are analyzed at specified locations and none of which (for stated reasons) are at the BFN site. M-1

Section 1.2.2 License Renewal Evaluation Process

Page 1-5, paragraph beginning Line 39: This paragraph makes no mention of how TVA, being a federal agency, fulfilled its own NEPA obligations by preparing a Supplemental Environmental Impact Statement for Browns Ferry License Renewal. As explained in a letter dated June 4, 2004, to NRC from TVA's Mark Burzynski, Manager of Nuclear Licensing, each of the 92 license renewal environmental issues listed in NRC's GEIS and summarized in 10 CFR 51, Subpart A, Appendix B, Table B-1, were reviewed by TVA's various subject matter experts that were involved in preparing TVA's SEIS and the subsequent Environmental Report submitted by TVA as part of its application for BFN license renewal. M-2

Page 1-6, Line 6: The phrase "and its support organization" is not understood. To whom or what entity does this refer? M-3

Section 2.1.2 Reactor Systems

Page 2-4, Line 26: The sentence beginning on this line would be clarified if it was changed to read, "Each unit was originally licensed for an output..." M-4

Section 2.1.3 Cooling and Auxiliary Water Systems

Page 2-7, Line 7: Please check the number 8.75; this should possibly be 8.66. M-5

Page 2-7, Line 18: The number 7800 is correct but TVA2003a may not be the correct reference (source). M-6

Section 2.2.2 Water Use

Page 2-19, Line 22: The statement is made that "TVA has committed to rebuild the sixth cooling tower." To avoid any potential confusion with regulatory commitments, please replace the referenced statement with the following sentence: M-7

"As reflected in the Record of Decision for the TVA Final Environmental Impact Statement (Federal Register Vol. 67, No. 117, pp. 41565 – 41569, June 18, 2002), TVA's decision was to adopt the agency-preferred alternative to refurbish and restart BFN Unit 1, to proceed with NRC license extensions for all three units at BFN, and to construct a single 20-cell linear mechanical draft cooling tower in the currently vacant position (tower 4) where a tower that was destroyed by an accidental fire in 1986 was never replaced. With EPU of Units 2 and 3 at 120 percent of the originally licensed power level and the rebuilding of this tower, the consumptive use of cooling water would therefore increase."

Page 2-20, Line 6: Without any statement about the frequency of low flow at the plant, the assertion that the intake water flow encompasses a significant fraction of the daily average river flow can be somewhat misleading. Based on historical data, daily average river flows as low as the intake water flow occur less than 0.3 percent of the time, and daily average flows as low as three times the intake water flow occur only about 10 percent of the time. More specific values are stated in Section 4.1.1, Page 4-13, lines 28 – 30 (7Q10 of 8700 cfs in NPDES permit rationale). M-8

Page 2-20, Lines 9 through 12: The stated minimum daily average flows (if sufficient water is available) were implemented via TVA's Reservoir System Operation and Planning Review of 1990, and these target values were in place at the time of NRC's March 2004 site visit to gather environmental information. The target minimum river flows for BFN are now slightly different as a result of the ROD for the Reservoir Operations Study (May 19, 2004). The target minimum daily average flows now are 10,000 cfs July through September (same as before); 11,000 cfs December through March (higher than before); and 7,000 cfs otherwise (higher than before). M-9

Section 2.2.5, Aquatic Resources M-10

Page 2-41, Lines 19 through 22: The Alabama cave shrimp discussion should be moved to the federal endangered species section. M-11

Section 2.2.6 Terrestrial Resources

Page 2-44, Line 14: The *Cornus* spp. parenthetic should be changed to *Cornus florida*. M-12

Page 2-44, Paragraph beginning Line 37: To be more accurate, the second sentence should be revised to state, "There are numerous invasive plants in the area

(TVA2003a), of which TVA has identified 19 as high priority, including Chinese privet, Japanese honeysuckle, Japanese knotweed, and Nepal grass." Also, the scientific name is included parenthetically for some plants in this sentence but not for others, which is inconsistent.

M-13

Page 2-45, Line 5: The scientific name for black willow (*Salix nigra*) is not provided.

M-14

Page 2-46, Table 2-3, Line 10: The table caption would be more accurate as "Federally Listed Terrestrial Species Reported from Counties Associated with the Browns Ferry Nuclear Plant Site and its Transmission Line Corridors."

M-15

Page 2-47, Table 2-4, Line 5: The table caption would be more accurate as "Alabama State-Listed Terrestrial Species Reported from the Vicinity of the Browns Ferry Nuclear Plant and Associated Transmission Line Corridors."

M-16

Page 2-49, Table 2-4, Line 29: The specific epithet for dwarf filmy fern is *petersii*.

M-17

Page 2-50, Table 2-4, Line 3: The specific epithet for prairie trillium is *recurvatum*.

M-18

Page 2-50, Table 2-5, Line 10: The table caption would be accurate as "Mississippi State-Listed Terrestrial Species Reported from the Vicinity of the Browns Ferry Nuclear Plant and Associated Transmission Line Corridors."

M-19

Page 2-53, Table 2-5, Line 1: The specific epithet for white walnut is *cinerea*.

M-20

Page 2-54, Lines 20 and 29: The statements in these two paragraphs about species being listed in various counties are potentially misleading, because they are threatened or endangered throughout their ranges, not just in these counties.

M-21

Page 2-54, Lines 24 and 25: The statement that "there is no known nesting habitat within 5 km (3 mi) of the site" is misleading because there is nesting habitat along the shoreline. A more accurate description would be that "although there is nesting habitat along the shoreline in the area around BFN, there are no known nests."

M-22

Page 2-55, Lines 1, 2, 13, 14, 23, 37, 38: Similar to the above comment on Page 2-54, Lines 20 and 29, the species discussed are threatened or endangered throughout their ranges, not just in these counties.

M-23

Page 2-55, Lines 7 and 8: Delete the portion of the sentence after "drainage canals" which discusses "forested habitats." Gray bats don't normally use forested habitats unless along a stream.

M-24

Page 2-55, Line 32: It is not accurate to refer to the Morgan County station for Hart's-tongue fern as being in the southern portion of its range. This fern is highly disjunct,

and while it has been found as far south as Mexico, it occurs nowhere in between the few AL/TN stations and Michigan.

Section 2.2.7 Radiological Impacts

M-25

Page 2-57, paragraph at top of page: For aquatic monitoring TVA does not currently sample invertebrates, and terrestrial monitoring includes food crops, soil, and milk if applicable.

Section 2.2.8.2 Public Services

M-26

Page 2-61, beginning Line 33: The sentence beginning on this line should be clarified to state that the "approximately 1200 persons" is for the BFN non-outage operating staff, and does not include the Unit 1 recovery workers. For example, the sentence could be changed to read, "BFN, which is the primary traffic generator in the vicinity of the site, currently averages a daily site non-outage population of approximately 3600 persons; of this total, 1300 is for the total Unit 2/3 operating workforce, and 2300 is for Unit 1 recovery." The sentence beginning in Line 35 could also be changed to read, "The operating unit population currently peaks at approximately 2200 during outages, which occur every 24 months (per unit) for approximately 2 months."

M-27

Page 2-62, Line 20: Since DOE (eventually) takes responsibility for spent fuel at the nuclear plant site boundary, TVA will not be involved in spent fuel shipments past that point. As a suggestion, the words "TVA plans to" could be changed to "DOE may."

Section 2.2.8.4 Visual Aesthetics and Noise

M-28

Page 2-65, Paragraph beginning Line 27: The acreage for Mallard-Fox Creek State Wildlife Management Area (WMA) is 1483 (all land acres). The acreage for Swan Creek State WMA is 8870 (3045 acres land; 5825 acres water). Both WMAs are managed by the Alabama Department of Conservation and Natural Resources, Division of Wildlife & Freshwater Fisheries, and both WMAs are used for waterfowl and small game hunting. (information corrected from BFN License Renewal Environmental Report)

M-29

Page 2-66, Line 29: The referenced statement from TVA's SEIS for BFN License Renewal (TVA 2002a) states that "There are no Federal, State of Alabama, or local municipal noise standards, regulations or ordinances that apply to the action alternatives evaluated in this SEIS." Suggest re-wording the sentence beginning Line 29 to "Currently, there are no Federal, State, or local municipal noise standards or regulations that apply to BFN license renewal alternatives" or the equivalent.

M-30

Page 2-66, paragraph beginning Line 29: The sound level values used in this paragraph do not include the planned sixth cooling tower. A suggested improvement is to use the

6-tower calculated results from Section 4.3.19 of TVA's FSEIS for BFN License Renewal as bounding values.

Section 2.2.8.5 Demography

M-31

Page 2-67, Line 5: Delete the reference to 10-mile ring increments; TVA estimated the population only for 20 and 50-mile rings.

M-32

Page 2-67, sentence beginning Line 13: In contrast to this statement, the ER on Page E-34 states that the AL growth rate is projected to exceed that of Lauderdale and Morgan Counties from 2000 to 2015.

M-33

Page 2-67, Line 37: The 24.5 percent value for Limestone County population growth between 1990 and 2001 is not recognized. It might have been based on an earlier population estimate. The correct change is 23.6 percent based on the most recently released (2004) U.S. Census Bureau county population estimates.

M-34

Page 2-68, Line 1: The 2 percent growth per year value referenced from the BFN License Renewal Environmental Report (TVA 2003a) cannot be confirmed. The correct annual growth rate is 1.5 percent, not 2.

Section 4.1.1 Water Use Conflicts

M-35

Page 4-14, Lines 6 and 7: This section is focused on make-up water, but the volume of water "consumed" by BFN (82 cfs, as stated on Page 4-13, Line 34) is much too small to ever threaten other uses of the large volume of water in Wheeler Reservoir (as stated on Page 4-13, Lines 39 – 41). Consequently, TVA would never de-rate the plant to mitigate water-use conflicts. The concluding sentence of this Section should be changed to state, "The staff determined that water-use conflicts would be SMALL and further mitigation measures are not warranted."

Section 4.1.5 Microbiological Organisms

M-36

Page 4-25, Lines 5 – 8: What is stated is correct, but it begs for an explanation of why the diffuser discharge temperature could be 0.3°F warmer for two unit operation than for three unit operation (both at EPU), even though three units obviously generate 50 percent more heat than two units. Although this is true, the maximum temperatures in the analyses correspond to open mode conditions creating a temperature of 90°F at the downstream end of the mixing zone (i.e., the NPDES limit). Since the plant releases less heat with two units than it does with three units, it can operate at higher ambient river temperatures (and thus a higher diffuser discharge temperature) with two units and still stay within the downstream mixing zone limit of 90°F.

Section 4.2 Transmission Lines

Page 4-26, Sentence beginning Line 15: Change "will be required if the proposed action" to "will be required whether or not the proposed action." M-37

Page 4-26, Paragraph beginning Line 36: The restriction class definitions vary depending on the type of maintenance and resource area being considered and do not necessarily agree with the simplified statements made here (see table of Class Definitions, pages E-562 and E-563 of Attachment E-6, Transmission Line Corridor Environmental Analysis, of the BFN License Renewal Environmental Report). M-38

Page 4-27, Line 2: The statement that "There is no broadcast application of herbicides." is incorrect. TVA does use and expects to continue using broadcast and/or aerial herbicides in sections of transmission line corridors where appropriate. M-39

Section 4.4.2 Public Services: Public Utilities

Page 4-37, Sentence beginning Line 10: This sentence appears to contradict itself regarding the existence or absence of refurbishment activities. Also, the permanent plant staffing will increase for Unit 1 operations. M-40

Page 4-37, Sentence beginning Line 14: The assumed numbers are not understood. Permanent plant staffing will increase by approximately 150 for Unit 1 operations. M-41

Section 4.4.4 Public Services: Transportation

Page 4-39, Line 21: The license renewal staff is in Chattanooga and is temporary; currently only one license renewal person is at the site. M-42

Page 4-39, Line 25: The number 1810 assumes 210 more vehicles on each road. If the traffic divides equally as stated, there would be 70 more vehicles on each road. M-43

Section 4.4.5 Historic and Archaeological Resources

Page 4-40, Sentence beginning in Line 10: License Renewal by itself changes nothing with regard to historic properties. M-44

Section 4.6.1 Aquatic Species

Page 4-49, Line 16: To be more accurate, this sentence should be corrected as follows: "...candidate species) that occur or historically have occurred in either Wheeler Reservoir..." M-45

Page 4-49, Line 30: To use correct terminology, replace the phrase "Each sensitive area review project" with "Each proposed transmission line vegetation management project..." M-46

Section 4.6.2 Terrestrial Species

Page 4-50, Paragraph beginning Line 17: The following information updates that previously provided by TVA for Natural Areas crossed by transmission corridors or within 0.5 mile of the corridors. For clarity, it is recommended that the text specify the five transmission line corridors that were reviewed and note the ones with no Natural Areas. Note in particular that for Lines 23 and 24, the Duck River State Wildlife Management Area, the Duck River Unit 1 Proposed Designated Critical Habitat, and Elk River and Richland Creek are not appropriate to the scope of this document because these sites are not on the line segments shown on page 2-16 (i.e., only the first 23 miles of the 87-mile-long Browns Ferry to Maury line are included as applicable, and the sites are all on the last segments of the line). This exclusion also applies to the Duck River State Scenic River. M-47

Browns Ferry-Maury 500-kV (L6060), Alabama
- Philadelphia Glade (within 0.5 mile)
- Swan Creek State Wildlife Management Area (within 0.5 mile)

Browns Ferry – Trinity 500-kV (L6078), Alabama
- This TL corridor does not cross any Natural Areas.
- Mallard-Fox Creek State Wildlife Management Area (within 0.5 mile)

Browns Ferry – Trinity 161-kV (L5054), Alabama
- This TL corridor does not cross any Natural Areas.
- Mallard-Fox Creek State Wildlife Management Area (within 0.5 mile)

Browns Ferry – Athens 161-kV (L5055), Alabama
- This TL corridor does not cross any Natural Areas.

Browns Ferry – Union 500-kV (L6091), Mississippi
- Natchez Trace National Parkway
- Canal Section Wildlife Management Area
- TN-TOM Lock D Pool Reservoir Reservation
- East Fork Tombigbee Macro Site
- John Bell Williams State Wildlife Management Area
- TN-TOM Lock E Pool Reservoir Reservation
- TN-TOM Waterway
- Foxtrap Creek Ravine Potential National Natural Landmark
- Bear Creek Unit 2 Proposed Designated Critical Habitat
- Lake Lamar Bruce State Fishing Lake (within 0.5 mile)

Page 4-50, Sentence beginning Line 30: Clarification is needed. TVA does not work with its Right-of-Way (ROW) maintenance contractors to develop restrictions for the ROW contractors to follow; instead, TVA develops and establishes guidelines for the ROW contractors to follow. M-48

Section 4.7 Evaluation of Potential New and Significant Information

Page 4-53, Line 9: As written, this sentence may be misleading. With the new condensers and other changes the total intake flow when Unit 1 is restarted will be higher than for previous three-unit operation. M-49

Page 4-53, Lines 22 – 24: The cited reference (Hopping 2004) discussed discharge temperatures but not specifically thermal stratification. However, it can be concluded from the information given that thermal stratification will also increase. Actually, reservoir stratification locally will be disrupted by mixing from the diffusers. As the flow moves downstream, stratification will be reestablished as the heat accumulates at the surface. Due to the larger amount of heat, the stratification will be larger than that before EPU. Any excess heat will escape to the atmosphere, and the stratification will slowly approach natural conditions as the flow continues further downstream. Far-field modeling reported in the Environmental Report for the BFN License Renewal Application indicates that surface temperatures in the forebay of Wheeler Dam will be, on the average, about 0.3°F warmer for three units at EPU (compared with three units at the originally licensed thermal power). On average, the flow reaches Wheeler Dam before natural conditions are fully reestablished. M-50

Section 4.8.1 Cumulative Impacts Resulting from Operation of the Plant Cooling System M-51

Page 4-66, Line 12: The word "municipal" on this line appears to be an error; the intended word may be "industrial." M-52

Page 4-67, Bottom Paragraph beginning Line 30: This paragraph discusses the TVA Reservoir Operations Study (ROS). On Line 37 it is stated that "...for all alternatives the existing minimum flow past the plant could be maintained." The cited reference is a TVA fact sheet entitled "Wheeler Reservoir Operations under the ROS Preferred Alternative." Although it is true that existing minimum flow past the plant could be maintained, this was not explicitly stated in the cited reference; rather, it states that "...flow requirements also would be used to protect water quality and aquatic resources." Elsewhere in the ROS FEIS (Chapter 3), data are provided showing that target minimum flows will be maintained. As noted in the comments for Section 2.2.2 Water Use, the target minimum flows for BFN were slightly changed by the ROS, and in some months are now slightly higher compared to the pre-ROS values.

Page 4-68, Lines 32 – 33: As noted in the comments for Section 2.2.2 Water Use, the statement about what is a "significant fraction" lacks a definition, and should be accompanied by a statement regarding the frequency of occurrence. M-53

Section 4.8.5 Cumulative Impacts on Groundwater Use and Quality

Page 4-71, Line 32: All BFN potable water comes from Athens Water Services, which has the Elk River (not the Tennessee River) as its principal source. M-54

Section 8-1 No-Action Alternative

Page 8-2, Paragraph beginning Line 7: Suggest re-ordering these options, from the most likely to the least likely, which would be (3), (2), (1), or (4). Spelled out, this would be as follows: "Under the no-action alternative, replacement of BFN electricity generation capacity would be met by (1) TVA generating alternatives other than BFN, (2) power purchased from other electricity providers, (3) demand-side management (DSM), or (4) some combination of these options. M-55

Section 8.1.7 Socioeconomics

Page 8-5, Line 22: The total TVA payment to Limestone County was $4,544,825 in FY 2002 and $4,566,727 in FY 2003. Not all of this, however, is attributable to BFN. The BFN portion of this payment was $2,008,723 in FY 2002 and $2,015,210 in FY 2003. Total county revenues are variable, causing the share to vary considerably from year to year. However, in FY 2002, the BFN portion of TVA's payment was 6.5 percent of the total county revenues of $30,758,933; in FY 2003, they were 10.03 percent of county revenues of $20,082,621. The 5.88 percent value quoted at the bottom of page E-209 of the Environmental Report is not correct. M-56

Page 8-5, Paragraph beginning Line 36: Per the above comment, the property tax revenue equivalent from BFN is approximately 10 percent or less of total Limestone County revenues. M-57

Section 8.1.10 Environmental Justice

Page 8-6, bottom paragraph: These potential negative and disproportionate impacts could apply to secondary job losses such as retail, services, etc., but not to direct BFN job losses. M-58

Section 8.2.1.1 Closed-Cycle Cooling System

Page 8-17, Line 31: TVA projects that the total number of workers would exceed 500 for approximately 2 ½ years (see TVA's Environmental Report for BFN License Renewal, Page E-289, paragraph under Socioeconomics). M-60

Section 8.2.3 Natural Gas Combined-Cycle Generation

Page 8-32, Table 8-6, Impact Category for Air Quality: The stated quantities of air emissions are the values reported in Section E.7.2.2.1 of TVA's Environmental Report for BFN License Renewal, but they are based on seven NGCC plants. In Section 8.2.3 on Page 8-31 of NRC's SEIS, the statement is made that eight NGCC plants would be needed. M-61

Page 8-36, Sentence beginning on Line 2: This sentence appears to contradict itself; it may have too many negatives. M-62

Page 8-36, Sentence beginning on Line 32: This sentence is not clear; words may have been omitted, or it might contain grammatical errors. M-63

Section 8.2.4.1 Closed-Cycle Cooling System

Page 8-40, Table 8-8, Impact Category of Land Use: The "Impact" is listed as MEDIUM to LARGE and the "Comment" statement is made that "Additional land-use impacts would occur for uranium mining." Currently, BFN has fuel contracts to use blended-down surplus highly-enriched uranium; these do not involve any uranium mining, and it is likely that an ABWR at Bellefonte could use the same fuel, especially if BFN was discontinued. M-64

Section 8.2.6.10 Delayed Retirement

The paragraph on Delayed Retirement is not consistent with the following statements made by TVA in a May 27, 2004 letter to NRC transmitting "Addition Information for License Renewal Environmental Review" from Mark Burzynski, Manager of Nuclear Licensing: "TVA has no schedule for retiring current generating units. TVA is adding environmental controls and maintaining the existing units as necessary to keep them running. TVA has no retired fossil units that would be considered for restarting." Please delete all references to TVA fossil plants being slated for retirement. M-65

Section 8.2.6.11 Utility-Sponsored Conservation

Page 8-53, Line 29: Suggest spelling out DSM (Demand-Side Management). M-66

Section 8.2.7 Combination of Alternatives

Page 8-54, Table 8-10, Impact Category on Air Quality: The air emissions values listed are approximately 80 percent of the values listed in Table 8-6, which were the values stated by TVA for seven 510 MW units. M-67

Appendix E, BFN Units 1, 2, and 3 Compliance Status and Consultation Correspondence

Page E-25, Line 36: As noted earlier, the use of the word "committed" could invite confusion with regulatory commitments. A more accurate characterization would be as follows: M-72

"As reflected in the Record of Decision for the TVA Final Environmental Impact Statement for BFN License Renewal (Federal Register Vol. 67, No. 117, pp. 41565 – 41569, June 18, 2002), TVA's decision was to adopt the agency-preferred alternative to refurbish and restart BFN Unit 1, to proceed with NRC license extensions for all three units at BFN, and to construct a single 20-cell linear mechanical draft cooling tower in the currently vacant position (tower 4) where a tower that was destroyed by an accidental fire in 1986 was never replaced. Regardless of the schedule for power uprates on any unit, the 6th tower is scheduled for completion prior to the first summer following Unit 1 restart."

Page E-29, Paragraph beginning Line 23: The restriction class definitions vary depending on the type of maintenance and resource area being considered and do not necessarily agree with the simplified statements made here (see table of Class Definitions, pages E-562 and E-563 of Attachment E-6, Transmission Line Corridor Environmental Analysis, of the BFN License Renewal Environmental Report). M-68

Page E-29, Line 30: The statement that "There is no broadcast application of herbicides." is not correct. TVA does use and expects to continue using broadcast and/or aerial herbicides in sections of transmission line corridors where appropriate. M-69

Appendix F, GEIS Environmental Issues Not Applicable to BFN Units 1, 2, 3

Page F-2, Table F-1, first item: The statement that BFN uses <100 gpm of groundwater is potentially misleading because BFN does not use any groundwater. M-71

RDB received 3/3/05

United States Department of the Interior

OFFICE OF THE SECRETARY
OFFICE OF ENVIRONMENTAL POLICY AND COMPLIANCE
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

ER 04/918

12/10/04
69 FR 71855
(3)

February 25, 2005

Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

RE: Draft Generic Environmental Impact Statement (GEIS), Supplement 21, for License Renewal of Tennessee Valley Authority's (TVA), Browns Ferry Nuclear Plant. Units 1, 2, and 3, Alabama (NUREG – 1437, Supplement 21)

Dear Sir/Madame:

The Department of the Interior (Department) has completed review of the U.S. Nuclear Regulatory Commission's (NRC) Draft GEIS for License Renewal of the Tennessee Valley Authority) (TVA) Browns Ferry Nuclear Plant, Units 1, 2, and 3. We submit the following comments for your consideration.

Project Description

In December 2003, the TVA submitted an application to the NRC to renew the operating licenses for Browns Ferry Nuclear Plant, Units 1, 2, and 3 for an additional 20-year period. TVA's license renewal at Browns Ferry Nuclear plant (BFN) also proposes to increase the power production at each of the three units to 120% of their originally licensed power production capacity. It should be noted that Unit 1 at BFN has not operated since 1985, and the applicant is currently engaged in activities necessary to return this unit to service. In TVA's application to NRC to renew current operating licenses, TVA stated that almost all of the activities associated with this effort are confined to existing on-site structures, and little new construction is necessary. Therefore, any impacts associated with the construction of new facilities on-site would be bounded by those impacts discussed in the 1972 EIS prepared by TVA. Subsequently, NRC reviewed TVA's request and produced the Draft GEIS.

The NRC's Draft GEIS defined the purpose and need of re-licensing BFN in the following way: "...the proposed action (renewal of the operating licenses) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and where authorized, Federal (other than NRC) decision makers." Secondly, the goal of NRC's environmental review was to meet requirements in 10 CFR 51.95(c)(4) and the Draft GEIS, to determine whether or not the adverse environmental impacts of license renewal are so great that

SISP Review Complete
Template = ADM-013

E-RIDS = ADM-03
Add = M. Hasnik (MTH2)

preserving the option of license renewal would be unreasonable for energy planning decision makers. Collectively, the statement of purpose and need and evaluation criterion mentioned above have guided NRC in determining whether or not an existing nuclear power plant could continue to operate beyond the period of the current operating license.

Environmental Concerns

Effects of plant operation on health of fish and other aquatic organisms in the Tennessee River

Based on TVA's Vital Signs Monitoring Reservoir Fish Assemblage Index, the fisheries resources in Wheeler Reservoir in the vicinity of BFN have maintained a "fair" or "good" rating since the early 1990's. Coupled with the monitoring of fish assemblages, TVA has also monitored overall ecological health via use of their Vital Signs Monitoring Program. The Vital Signs Monitoring Program divides TVA reservoirs into three zones: the inflow area (riverine-like segment), transition zone (mid-reservoir segment), and the fore bay (lake-like segment). This program has systematically monitored key physical, chemical, and biological indicators (i.e. dissolved oxygen, chlorophyll, sediments, benthic macro invertebrates, and fish) to evaluate ecological conditions of TVA reservoirs. When needed, TVA targets detailed assessments to identify significant problems and address those conditions as appropriate. TVA has sample/monitoring sites located upstream and downstream of BFN. The transition zone sampling site for Wheeler Reservoir is located at Tennessee River Mile (TRM) 295.9, approximately 1 mile upstream of BFN. The fore bay zone sampling site is located at TRM 277, near the confluence of the Elk River with Wheeler Reservoir. Based on the period of record for these two monitoring sites, they appear to maintain a "fair" to "good" rating from year to year for ecological health.

In 2000, TVA initiated macro invertebrate monitoring in support of BFN's thermal variance monitoring program. Since a number of federally-listed mussels are known to occur in Wheeler Reservoir and the Tennessee River, we were especially interested in reviewing TVA data on benthic macro invertebrate sampling and water quality chemistry at various monitoring sites in Wheeler Reservoir. The monitoring resulted in ratings of "excellent" for community density at TRM 295.9 monitoring site (approximately 1 mile upstream of BFN) in 2000 and "good" condition in 2001 and 2002. At TRM 291.7 (approximately 2 miles downstream of BFN diffusers) the rating was "excellent" for community density in 2001 and "good" in 2002. N-1

These ratings can be deceptive, however, giving the impression that the mussels and other invertebrates found at these locations are the desirable, native fauna. As mentioned in the Draft GEIS, Asiatic clams, an introduced exotic species, can dominate benthic environments, competing for food, nutrients, and space with native benthic organisms and may feed directly on native, unionid sperm, glochidia, and newly metamorphosed juvenile mussels. Since its first detection in the Tennessee River system in the early 1960's, the Asiatic clam has increased in number and spread throughout the entire Tennessee River system. These data should be reanalyzed to determine if TVA's assessment is an accurate measure of conditions for the native aquatic biota, or native federally or state listed species in or adjacent to these sampling sites. N-2

These and similar monitoring/sampling efforts by TVA are critical to ensuring that BFN's National Pollutant Discharge Elimination System (NPDES) permit limits, state water quality standards, and other environmental permit requirements are followed. Taken separately, the data

suggest that there are relatively low or insignificant impacts occurring further downstream of the BFN site; however, a more detailed assessment is clearly necessary to evaluate conditions immediately downstream of the BFN site.

In addition to an examination of general conditions at individual sample sites, the detailed assessment should include an analysis of any episodically poor water quality conditions and specific conditions in bottom waters. For instance, if dissolved oxygen levels drop for extended periods of time at, or near the stream bottom in the reservoir within, adjacent to, or within the mixing zone downstream of the effluent/diffuser site; benthic-dwelling species, such as mussels, could be severely impacted or killed. If a toxic substance was released through the diffusers into the reservoir, benthic species near, downstream, or within the mixing zone of BFN would likely be adversely affected. These are the conditions, although sometimes short-lived, which may, nonetheless, exert profound effects on aquatic organism health and viability, particularly of non-mobile species such as mussels and other invertebrate fauna. N-3

The proposed license renewal at BFN seeks to increase the power production at each of the three units to 120% of their originally licensed power production capacity. Unit 1 has been off-line and not in service since 1985. By bringing Unit 1 back on-line, TVA's short term goal (within the next 5 years), there will be a need to increase the amount of water withdrawn from Wheeler Reservoir. The proposed operation of all three units at the new operating license levels will also require BFN to increase the amount of cooling water withdrawn from Wheeler Reservoir. These increases in water withdrawn from the reservoir will have a two-fold effect: first, an increase in entrainment of aquatic organisms into the intake structures from the reservoir and, secondly, significant increases in the volume of thermal heated water released back to the reservoir.

Entrainment and subsequent mortality of aquatic organisms in intake cooling water, and biocides N-4

We are concerned about uptake of aquatic organisms into the boiler reactor water by entrainment, including larvae and early life stages of federally-protected mussels (if present), as well as other mussels, fish), phytoplankton, and zooplankton. Opportunities to divert fish from entrainment (e.g. strobe lights) and use of angled trash racks with sluiceways, and appropriate screens may mitigate for increased entrainment of larger fish and invertebrates, if incorporated into design plans. There may also be methods to minimize entrainment depending on depth of water withdrawal and location of water withdrawal structures. N-5

Boiler reactor water is subjected to intense pressure, heat, and biocide treatment. The raw water intake for BFN is treated biannually with a molluscicide to control bio-fouling by zebra mussels and Asiatic clams. Raw water samples are taken biweekly during the months of April to September and analyzed for zebra mussel larvae as an early detection system aimed at reducing the potential of bio-fouling of BFN's raw water intake structure. Without adequate screening and fish rack sluiceways, aquatic organisms taken up by entrainment into the intake pipe and subjected to such environment will be killed by these treatments.

Water withdrawal, temperature, chlorine, copper, and hydrazine effects in the Tennessee River N-6

We are not sure what biocides are utilized at BFN; however, chlorine is often used in biocides. Chlorine is extremely toxic to a wide variety of freshwater organisms (Hunn and Schnick 1990). Safe concentrations (i.e. those that do not produce any lethal or sub lethal effects) are likely

much lower, especially considering the relatively sessile nature and long life span of mussels relative to these short-term test exposures. Under longer-term exposures (>96 hours), lethality to fish and aquatic invertebrates has been documented at chlorine concentrations between 3.4 and 26 ug/L (EPA 1985). Because chlorine" extreme toxicity, the EPA established a Federal ambient water quality criterion maximum concentration of 0.019 mg/L and a continuous concentration (CCC) of 0.011 mg/L for chlorine, respectively, to protect aquatic life (EPA 2002). Studies have shown that mussels are very similar in sensitivity to other sensitive aquatic organisms and that 0.019 mg/L is likely protective (Ingersoll 2003). To meet these limits, a dechlorination unit or use of alternatives such as UV or ozonation could be utilized. Alternatively, high flow rate velocity flushes, ultrasound, or robotic mechanical cleaning devices could occur on influent and effluent pipes.

N-7

The toxicity of chlorine to aquatic life is a function of total residual chlorine (TRC), which includes both free chlorine and chloramines (Flora et al. 1984). Monitoring of free chlorine does not serve as an adequate indicator of the potential toxicity of facility effluents nor does it provide adequate data to avoid toxic effects to listed mussels. Therefore, TRC should be measured rather than free chlorine.

N-8

Hydrazine has been used to scavenge oxygen during blow downs of cooling towers in an effort to help reduce oxidization from occurring in the towers. Discharges of this potential toxicant into the Tennessee River may cause more than detrimental effects to federally listed mussels, if present, as well as many other aquatic organisms. The rate of degradation of hydrazine in water is highly dependent on factors such as pH, temperature, oxygen content, alkalinity, hardness, and the presence of organic material and metal ions. The toxicity of hydrazine increased for guppies in soft water (at pH <7.0) compared with the toxicity in hard water at pH ~ 8.0 (Slonim 1977), indicating increased persistence of hydrazine in soft, non-alkaline water such as that of Wheeler Reservoir (TVA 1971). Increased water temperature also enhances the toxicity of the compound for bluegills (Hunt el al., 1981) (http://www.inchem.org/documents/ehc/ehc/ehc68.htm#SectionNumber:5.1). Because the Tennessee River at BFN's point of discharge is expected to have low alkalinity and elevated in-stream water temperatures due to BFN's thermal discharge, these conditions raise our concerns for the toxicity of hydrazine in the discharge, and its potential adverse effects on aquatic biota.

To operate units 2 and 3 at their current operating license level, BFN withdraws 1,635 cfs per unit. With the addition of Unit 1, the projected total withdrawal from Wheeler Reservoir through all three units would be approximately 4,907 cfs. TVA is seeking extended power up-rates (EPUs), which would increase the total combined power level produced at BFN. TVA claims an increase in power production would not require further increases in intake flows. When Units 1, 2, and 3 are generating at the proposed 120% capacity level. TVA believes BFN can continue to meet current ADEM regulatory limits of the NPDES permit by employing various mitigating strategies like de-rating and the use of the cooling tower helper mode of operation. TVA has committed to the construction of a sixth cooling tower to enable BFN to meet current NPDES permit limits.

Due to various system limitations, BFN cannot pull the entire condenser circulating water through the cooling towers when it operates in the helper mode. TVA estimates that during helper mode operation approximately 3,725 cfs is directed through the six cooling towers. Therefore, the remaining 1,000 cfs of thermal heated water bypasses the towers and will need to

be directly routed to the river. TVA operates the cooling towers only when necessary to meet NPDES permit requirements, typically a few weeks during the hottest part of the summer (usually during July and August). Since July and August are the critical months for approaching maximum river water temperature limits specified in BFN's NPDES permit, BFN would be required to utilize the cooling towers or be forced to de-rate the plant.

The TVA modeled the daily average flow for Wheeler Reservoir at BFN. The TVA used an unsteady flow model of Wheeler Reservoir, utilizing data from Guntersville Dam and Wheeler Dam to assess a time series of the daily average flow for the period of 1976 to 2002. The average river flow past BFN was estimated as 46,606 cfs, ranging from a high of 378,742 cfs to a low of 2,638 cfs. Therefore, the water intake flow for Units 1, 2, and 3 of 4,907 cfs encompasses a significant fraction of the daily average and low river flow past BFN. The 7Q10 flow at BFN (as defined in the NPDES permit) is 8,700 cfs. Target minimum flows for Wheeler Reservoir were established by TVA's river operations environmental impact statement completed in 1990. The minimum daily average flows at BFN are 10,000 cfs for July through September, 8,000 cfs for December through February, and 5,000 cfs in other months.

N-9

These average flows are targets determined by a computer model that has been given certain data sets or variables based on historic flow data. If these variables are inaccurate or erroneous, the model would produce an artificial reading of forecasted water quality conditions and aquatic organisms would bear the consequences. Our concern is for the welfare of the aquatic species located in, near, and downstream of BFN's effluent plume.

We understand TVA has committed to complying with NPDES permit requirements at BFN. However, we find it difficult to understand how BFN can manage bringing Unit 1 back into service and up-rate the three units, when under current operations and during hot weather events, BFN has difficulty meeting NPDES water temperature limits on a consistent basis with units 2 and 3. Although a sixth cooling tower would aid in reducing condenser circulating water temperatures, we fail to see how BFN could operate all three units at 120% power production capacity during these hot weather/high water temperature periods of the year without de-rating or without creating additional cooling systems to cool heated water. It is unclear how these units could be up-rated if cooling capacity at BFN is insufficient. De-rating seems to be the only valid option in this case. Again, we have difficulty understanding the reasoning behind up-rating when, generally, the highest power consumption by the public occurs during the hottest weather periods of the year (i.e. as air conditioning use increases).

During hot weather, high-demand periods in July or August, TVA would be forced to request waivers from ADEM to exceed water quality standards and limitations for temperature designed to protect aquatic life. Such episodic violations are highly likely to occur in the future, especially during low flow, drought years in the Tennessee River. As mentioned earlier, these critical periods of the year create difficult environmental conditions on the aquatic biota in the Tennessee River. Mussels may be especially vulnerable since the July to August period is when mussel metabolism increases and when dissolved oxygen availability decreases. Careful consideration of environmental impacts would need to be made by TVA as these events occur. We believe TVA should closely re-examine opportunities for thermal water storage and/or for storage of excess uptake water during high-temperature, low-flow conditions to prevent episodic lethal conditions for fish (including potential fish host of listed mussels) and invertebrates during such periods of high water use, even if water must be pumped from off-site locations. During

such periods, there could be significant population-level effects on aquatic invertebrates and fish both near the discharge and downstream.

Higher water temperatures, in concert with nutrient loading into the Tennessee River from point and non-point sources, generally promote the growth of aquatic plants, particularly nuisance and invasive species, and may trigger algal blooms. Federal and state environmental agencies must then employ eradication programs that typically result in herbicidal treatments. These programs are extremely expensive and are difficult to effectively implement.

Maintenance Practices for Transmission Line Rights-of-Way

We are concerned about the maintenance practices employed along BFN's transmission line rights-of-way. Our understanding of TVA's maintenance practices follow the strict guidance and protocols developed in the Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities manual. We have reviewed this manual and are comfortable with the protocols developed. We understand TVA's Heritage staff (which consists of biologist, ecologists, and cultural resources staff) reviews all maintenance activities associated with transmission line rights-of-way. We support and strongly recommend that the TVA Heritage staff remain involved in the process of all maintenance proposals associated with BFN's power distribution facilities. We also encourage continued surveys of sites along or adjacent to maintained rights-of-way for rare, threatened, or endangered plants and animals, particularly in any previously un-surveyed portions of the system with unusual habitat conditions.

N-10

We remain concerned about BFN's practice of controlling vegetation in the transmission line rights-of-way at stream crossings, using mowing and herbicide applications to reduce the cover to herbaceous species. This modification to the natural vegetative cover may lead to erosion and sedimentation of streams. We are particularly concerned about this practice at stream crossings where federally-listed mussels may occur, specifically Bear Creek, the designated critical habitat for the federally-listed mussel, Cumberlandian combshell, *Epioblasma brevidens*.

We have provided TVA Heritage staff a table listing acute toxicity of various nonionic surfactants/spreaders used with glyphosate products and toxicity of formulated glyphosate products. We encourage the TVA Heritage staff to work with TVA maintenance staff to ensure that appropriate herbicides and surfactants, with low toxicity to aquatic invertebrates and fish, are utilized and applied by spot methods only near streams, and that EPA label rates are not exceeded.

Recommendations

Effects of plant operation on health of fish and other aquatic organisms in the Tennessee River

N-11

- Reinitiate the ichthyoplankton characterization study done between the years of 1974 and 1979, prior to startup of BFN and continue a similar type study during the initial years of operations of the proposed up-rate of BFN's Units 1, 2, and 3.

Entrainment and subsequent mortality of aquatic organisms in intake cooling water, and biocides

- Quantify the diversity and abundance of organisms entrained by water withdrawal at all intake pipes and evaluate screening mesh size, low velocity intake, and other techniques to minimize entrainment. Quantification should occur at least monthly for the year of the study and for the year following screen changes. N-12

Water withdrawal, temperature, chlorine, copper, and hydrazine effects in the Tennessee River

- Monitor temperature, dissolved oxygen, alkalinity, pH, TRC, copper, and hydrazine at the downstream end of the mixing zone on a monthly basis to determine if modeling has accurately predicted concentrations. Target bottom waters at those times of the year that have historically produced the lowest river flow and warmest river water temperatures. Conduct a formal risk assessment using EPA methods to assess whether concentrations are protective of sensitive fish and invertebrates, particularly federally-listed mussels, if present. Include low-flow, high-temperature conditions in the risk assessment. N-13 N-15

- If hydrazine is determined to pose a risk to aquatic species (particularly mussels), eliminate discharge of hydrazine by designing a system for separating and containing hydrazine from all discharges to the Tennessee River/Wheeler Reservoir. If copper in bottom sediments appears to occur at concentrations above ecological risk levels, implement a plan to replace copper components at the plant with brass, titanium, or other typical replacement parts used by other nuclear power facilities to reduce copper. N-16 N-17

- Reduce or eliminate discharge of chlorine to the Tennessee River through use of a dechlorination unit for removal of chlorine before discharge. If there is a discharge of chlorine, then at least monitor TRC daily. To provide adequate protection of aquatic life, the permit should establish EPA criterion chronic concentration of 0.011 mg of TRC per liter as a permit limitation for continuous discharges and monitor it daily. If chlorine treatments are intermittent, the criterion for protection of aquatic life from acute toxicity can be substituted. Mechanical cleaning (e.g. robotic) and flushing controls should be considered as an alternative to chlorine. N-18

Maintenance Practices for Transmission Line Rights-of-Way

- Use mowing or prescribed burns as an alternative to herbicide use for controlling vegetation along transmission line rights-of-way, particularly near stream crossings and riparian habitats. Mowing should be timed to avoid periods of nesting ground birds. If herbicides are used, use Roundup Custom or Accord or similar low toxicity, low-solubility herbicides, together with a low-toxicity surfactant such as LI 700 or Agri-Dex in strict adherence to the label. Near streams and other water bodies, evaluate toxicity based on toxicity to aquatic species. Periodically survey to determine if federally-listed plant species have become established in rights-of-way. N-14 N-19 N-20 N-21

- At all stream crossings, especially where federally-listed mussels are known to occur, maintain or plant stream riparian areas with native shrub species and insure that BMPs are installed to control erosion.

Currently, NRC is informally consulting with the Service's Daphne Ecological Services Field Office on the proposed BFN re-license project. NRC has provided to the Daphne FO a biological assessment on the federally-listed species located in the vicinity of BFN's facilities. We are currently reviewing NRC's biological assessment for the proposed BFN re-license proposal and will more fully address impacts of this project on listed species in a separate review. We are not able, at this time, to conclude informal consultation on this project. We continue to cooperatively work with NRC and TVA to gather information on listed species potentially affected by the proposed re-licensing of BFN.

We welcome the opportunity to assist in the design of monitoring plans. Upon our review of all the pertinent water quality data and threatened and endangered species information, we will provide our final comments and consultation under section 7 of the Endangered Species Act. Initiation of formal consultation with the NRC may be necessary after our review of this information.

If you have any questions or need additional information, please contact Mr. Rob Hurt at the Fish and Wildlife Service, in Decatur, Alabama, (256) 353-7243 ext. 29.

Sincerely,

Gregory Hogue
Regional Environmental Officer

cc:
FWS, R4
OEPC, WASO
TVA

References:

Flora, M.D., T.E. Ricketts, J. Wilson, and S. Kunkle. 1984. Water quality criteria: an overview for park natural resource specialists. Water Resources Field Support Laboratory, National Park Service, Colorado State University, Fort Collins, CO. 46pp. WRFSL Report No. 84-4.

Hunn, J.B. and R.A. Schnick 1990. Toxic substances. pp 19 to 40 In F.P. Meyer and L.E. Barclay (eds.), Field manual for the investigation of fish kills. U.S. Fish and Wildlife Service Resource Publication 177. Washington D.C.

Ingersoll C.G. 2003. Developing water quality standards for recovery of imperilled freshwater mussels (Family Unionidae). U.S. Geological Survey, Columbia, MO. 11pp.

TVA. 1971. Quality of water in Wheeler Reservoir. Division of Environmental Research and Development-Water Quality Branch, Tennessee Valley Authority. Chattanooga, TN. 74pp.

U.S. EPA 1985. Ambient water quality criteria for chlorine. Office of Water Criteria and Standards Division, Washington, D.C. U.S. EPA 440/5-84-030.

U.S. EPA 2002. National recommended water quality criteria: 2002. U.S. Environmental Protection Agency, Office of Water and Office of Science and Technology. EPA-822-R-02-047. 33pp.

FEB-14-2005 10:25 P.02

5/5/05

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

February 28, 2005

12/10/04
69FR 71855

(4)

Rules Review and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, D.C. 20555-0001

ML050700107

RE: **EPA Review and Comments on Draft Generic Supplemental Environmental Impact Statement (DGSEIS) License Renewal of Nuclear Plants, Supplement 21 Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3 CEQ No. 040563**

Dear Sir:

EPA Region 4 reviewed the Draft Generic Supplemental EIS (DGSEIS) pursuant to Section 309 of the Clean Air Act and Section 102 (2)(C) of the National Environmental Policy Act (NEPA). The purpose of this letter is to provide the Nuclear Regulatory Commission (NRC) with EPA's comments regarding potential impacts of the proposed renewal of the Browns Ferry Nuclear Plant Operating Licenses (OLs).

The Tennessee Valley Authority (TVA) submitted an application to renew the Operating License (OLs) for the Browns Ferry Nuclear Plant Units 1, 2, and 3 for an additional 20 years. The proposed action, (license renewal), would provide for continued operation and maintenance of existing facilities and transmission lines.

Based on the review of the DGSEIS, the document received a rating of EC-1, meaning that environmental concerns exist regarding some aspects of the proposed project. Specifically, protecting the environment involves the continuing need for appropriate storage and ultimate disposition of radioactive wastes generated on-site. In addition, the DGSEIS does not include complete information regarding the facility's CWA/NPDES compliance status. P-1 P-2

According to EPA's records, Browns Ferry Nuclear Plant has reported non-compliance regarding total suspended solids and coliform during the last two years. EPA's records also show that the facility was issued a letter of violation/warning by the State with regard to the Clean Water Act on February 17, 2004. However, page 2-8, line 22 mentions that "operations will continue to meet regulatory limits established in the existing NPDES Permit." Page 2-21 discusses the Plant's relationship with ADEM and the NPDES Permit, but does not mention the compliance status nor the letter of violation. The Final GSEIS needs to include information regarding how the facility has been addressing the non-compliance issues.

E-RIDS=ADM-03
Add= M. Masnik
(MTM2)

SISP Review Complete

Internet Address (URL) • http://www.epa.gov
Recycled/Recyclable • Printed with Vegetable Oil Based Inks on Recycled Paper (Minimum 30% Postconsumer)

The DGSEIS acknowledges that OL renewal of the Browns Ferry Nuclear Plant will require continuing radiological monitoring of all plant effluents. Appropriate storage of spent fuel assemblies and radioactive wastes on-site is required, in order to prevent impacts. Page A-11 discusses the Waste Confidence Rule (10 CFR 51.23), in which the Commission generically determined that the spent fuel generated by any reactor can be safely stored onsite for at least 30 years beyond the licensed operating life of the reactor. Ultimately, long-term radioactive waste disposition will require transportation of wastes to a permitted repository site. We note the information on pages 6-4 through 6-6 of the document, regarding the expected availability of Yucca Mountain as a geological repository for spent nuclear fuel and high-level waste.

P-3

In conclusion, the document states that the OL renewal would result in fewer environmental impacts than the feasible alternatives for generating power, and the NRC considers impacts of OL renewal to be small. Overall, the impacts as defined in the DGSEIS appear to be within acceptable limits.

Thank you for the opportunity to comment on this document. If we can be of further assistance, please contact Ramona McConney of my staff at (404) 562-9615.

Sincerely,

Heinz Mueller

Heinz J. Mueller, Chief
Office of Environmental Assessment

RDB Received 3/8/05

From: "Michele Boyd" <mboyd@citizen.org>
To: <BrownsFerryEIS@nrc.gov>
Date: 3/2/05 5:36PM
Subject: Comments from Public Citizen and SACE

12/10/04
69FR 71855
(2)

Please find attached comments from Public Citizen and Southern Alliance for Clean Energy on the NRC's Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 21 Draft Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3. Also attached are two supplements to these comments: the Nuclear Security Coalition's Petition and Petition Annex to the NRC requesting actions to provide stronger defenses of BWR-Mark I & II containments and spent fuel.

Michele Boyd

Michele Boyd
Legislative Director
Energy Program
Public Citizen
215 Pennsylvania Ave, SE
Washington, DC 20003
(202) 454-5134
mboyd@citizen.org

CC: <sara@cleanenergy.org>

SISP Review Complete
Template = ADM-013

E-RIDS = ADM-03
Add = M. Hasnik (MTH2)

March 2, 2005

Chief, Rules Review and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, DC 20555-0001

Re: Comments on the Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 21 Draft Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3 (NUREG-1437)

To Whom It May Concern:

The following are the comments of Public Citizen and the Southern Alliance for Clean Energy (SACE) on the NRC's Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 21 Draft Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3.

Public Citizen is a national non-profit organization that works to protect citizens and the environment from the dangers posed by nuclear power and seeks policies that will lead to safe, affordable and environmentally sustainable energy. Public Citizen accepts no corporate or government funding.

Southern Alliance for Clean Energy (SACE) is a regional not-for-profit, nonpartisan conservation and energy consumer organization focused on energy policy, including nuclear concerns, for well over twenty years with members throughout the Southeast.

O-1

Reactor Design Vulnerabilities

The three Browns Ferry nuclear reactors are all BWR-Mark I GE-4 design, which has numerous inherent security flaws: the spent-fuel pool is elevated above ground level, making it vulnerable from above, below, and from the side; the reactor itself is located above ground level; and the reactor lacks a traditional "containment dome" and instead has a thin steel shell. Of the 104 nuclear reactors in the United States, 34 have these particular vulnerabilities to acts of terrorism. The Nuclear Security Coalition, of which Public Citizen and SACE are members, have submitted a petition to the NRC that requests the NRC to provide stronger defenses of boiling-water reactors with Mark I and II containments and their spent fuel. We have attached the Coalition's NRC petition and petition annex to these comments. Given the serious vulnerabilities of these types of reactors to attack, this petition should be fully considered and acted upon by the Commission before decisions are made about relicensing any of the Mark I and II BWRs, including the three reactors at Browns Ferry.

O-2

Relicensing of Browns Ferry Unit 1

Browns Ferry Unit 1 has been in the non-defined regulatory status of "administrative hold" for nearly 20 years, which is a longer time period than it actually operated. The operating license for Unit 1 should have been revoked after it was shut down in 1985 for failing "to

consistently maintain a documented design basis and to control the plant's configuration in accordance with that basis."[1] To ensure optimal safety at the plant, TVA should now be required to go through NRC's license application process for Unit 1 as required for any new plant. Only after an extended period of operation without any incident or accident following a restart should TVA be allowed to apply for a license extension. To give a license extension to a plant that has not operated in 20 years is utterly absurd. We are further concerned over safety allegations brought forward by former contractors that performed work for the Browns Ferry Unit 1 Restart process—citing that poor practices have occurred and work has been done outside of design specifications. Until the safety allegations can be thoroughly reviewed by the NRC, the restart should not go forward, and consequently, the relicensing of Unit 1 in particular should not be allowed.

High-level radioactive waste

In all likelihood, license renewal at Browns Ferry reactors would exacerbate existing space issues regarding onsite spent fuel, and create 20 years' worth of additional, dangerous high-level waste, with no practicable or thorough means of securing it. The Draft SEIS fails to evaluate the environmental impacts and security threat of indefinitely storing the additional irradiated fuel that will be generated over the 20-year license extension. Each reactor will create annually between 100 and 150 metric tons additional irradiated fuel to the site. Despite the NRC's Waste Confidence Decision, the only site under consideration, Yucca Mountain in Nevada, is far from a done deal. Numerous scientific questions remain about whether the site can safely store waste. Moreover, the Department of Energy (DOE) has not yet submitted its license application to the NRC, although the statutory deadline was more than two years ago. DOE was supposed to begin accepting waste in 1998 and is highly unlikely to meet its revised goal of accepting waste by 2012. O-8

Even if Yucca Mountain is opened, the site cannot hold the high-level radioactive waste that will be generated by existing reactors after 2010. Therefore, in addition to the waste generated by existing reactors, waste created by the reactors over the 20-year extension would also have to remain onsite for an indefinite period of time. The environmental impacts of indefinite storage must be thoroughly evaluated in the Final SEIS. O-3

We would also like to raise concerns over a serious accident that occurred at Browns Ferry on October 24, 2004—32 tons of equipment were dropped onto the refueling floor by a faulty overhead crane. When Browns Ferry exceeds its spent fuel capacity, which certainly will occur if it continues to operate, the overhead crane will likely be used to move and load 100 ton dry storage casks used for storing nuclear waste from the spent fuel pool. The possible devastation that could occur if such a load were dropped is serious, and needs to be addressed well before the reactors are relicensed or Unit 1 is brought back online.

[1] Letter from O. J. Zeringue, Senior Vice President – Nuclear Operations, Tennessee Valley Authority, to United States Nuclear Regulatory Commission, "Response to Request for Information Regarding Adequacy, Availability, and Control of Design Bases Information," February 12, 1997.

Decommissioning
The NRC should evaluate the decommissioning trust fund balances for TVA's Browns Ferry units and how decommissioning will be impacted by extending the operating licenses of all three units. The NRC should also ensure that sufficient decommissioning funds would be in place in order to protect utility ratepayers and taxpayers. According to a General Accounting Office (GAO) report in 2003, all of TVA's nuclear power plants were found to be below the benchmark of sufficiency for decommissioning trust fund balances—with the Browns Ferry units being among nuclear plants with the poorest decommissioning fund status. This is extremely problematic. O-4

Water Use
Nuclear power plants have a wide impact on water quantity and quality. Nuclear power plants release radioactive contaminants and hazardous chemicals into surrounding water resources, contribute greatly to thermal pollution, negatively impact aquatic life, and require enormous volumes of water in order to operate—more water use than any other traditional form of energy production and significantly more water than renewable energy technologies. Browns Ferry itself uses a tremendous amount of water. The SEIS mentions that with Unit 1 back online, the total water withdrawal for all three reactors at Browns Ferry would be 3171 million gallons per day. That is staggering. We disagree with the assumption that only a small amount of water is lost due to evaporation. Though the reactors have limited use of cooling towers, water consumption does occur and should be quantified. Further, in order to reduce the negative impacts to water supplies, year-round use of cooling towers or the technology to install permanent-use cooling towers should be investigated and implemented. The NRC needs to further study this issue to help reduce Browns Ferry's negative impacts to surrounding water resources and provide a more thorough analysis of the benefits to water use and quality from renewable energy supplies than is currently addressed in the SEIS. O-5

Economics
As we pointed out in our scoping comments, TVA is very close to exceeding its congressionally mandated debt ceiling of $30 billion. Currently, TVA has about $25 billion in debt, in addition to $3 billion to $5 billion worth of other obligations that could be considered debt (e.g. leaseback contracts, pre-purchase of electricity, etc.). The restart of Browns Ferry Unit 1 is estimated to cost a total of $1.8 billion. According to NRC regulations related to Supplemental EIS for license renewals [10 CFR 51.95(c)(2)], the SEIS "is not required to include discussion of...the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation." The solvency of TVA certainly appears to be "essential" to making any meaningful comparison of alternative and should be included in the Final SEIS. O-6

Analysis of Alternatives
The SEIS does not provide a thorough review of energy alternatives or technologies. Some data appears out-of-date and should be revisited using the most current information from independent sources, not just directly from TVA. Further, it is hard to understand how renewable energy technologies, like biomass, solar, and wind, which are not likely to be O-7

targeted by terrorists nor have the capacity, in terms of accidents, to kill thousands of people or permanently contaminate large land areas, can be assessed by the NRC to have a 'large' environmental impact while relicensing all the reactors at Browns Ferry is considered to have a 'small' impact. This assessment flies in the face of common sense.

According to a recent study by the Renewable Energy Policy Project, called *Powering the South: A clean and affordable energy plan for the Southern United States*, Alabama has the ability to significantly reduce electricity consumption through existing, affordable energy efficiency measures.[2] If these measures were adopted, by 2020 Alabama could: save 29 MWh of electricity; reduce electricity demand by 23%; and reduce net electricity costs by $651 million. Reducing energy demand and use saves not only money but also precious water resources. Further, less nuclear waste would be generated. More recent energy efficiency and conservation measures should be studied and implemented before permitting the relicensing of Browns Ferry's three reactors or the restart of Unit 1. O-9

TVA has excellent wind resources within its service area. In fact, they have approximately 29MW of wind currently installed. TVA should be encouraged to invest more in developing this clean, safe energy resource instead of spending billions of dollars on the costs of restarting Unit 1 and extended operation of all three nuclear reactors. There is also potential for biomass energy production in Alabama and TVA's service territory. Clean forms of biomass represent a 'homegrown' energy source that can provide local jobs to rural areas that would also support farmers and the region's economy, while helping expand renewable energy technologies. The use of solar technologies, such as photovoltaics and solar thermal systems, are not as cumbersome or difficult as reflected in the SEIS. The Rancho Seco nuclear plant, which is now closed, provides an example of the land availability at existing nuclear plants. There was minimal information in the SEIS on these options.

We appreciate this opportunity to comment during this scoping process, and trust that our comments will be taken seriously.

Sincerely,

Michele Boyd
Legislative Director
Public Citizen
215 Pennsylvania Ave., SE
Washington, DC 20003

Sara Barczak
Safe Energy Director
Southern Alliance for Clean Energy
3025 Bull Street, Suite 101
Savannah, GA 31405

[2] The report is available at http://www.poweringthesouth.org/figure/pts_repp_book.pdf.

The petition attached to the Public Citizen comment letter was submitted to the NRC by the Nuclear Security Coalition c/o Citizens Awareness Network on August 10, 2004, under a separate cover and is being evaluated by the NRC staff under 10 CFR 2.206 independently of the BFN license renewal. The petition is available from ADAMS at the NRC website http://www.nrc.gov/reading-rm/adams.html under accession number ML050630419.

Appendix B

Contributors to the Supplement

Appendix B

Contributors to the Supplement

The overall responsibility for the preparation of this supplement was assigned to the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission (NRC). The statement was prepared by members of the Office of Nuclear Reactor Regulation with assistance from other NRC organizations, Pacific Northwest National Laboratory, Argonne National Laboratory, and Los Alamos National Laboratory.

Name	Affiliation	Function or Expertise
	NUCLEAR REGULATORY COMMISSION	
Michael T. Masnik	Nuclear Reactor Regulation	Sr. Project Manager, Ecology
Andrew J. Kugler	Nuclear Reactor Regulation	Section Chief
Robert G. Schaaf	Nuclear Reactor Regulation	Project Manager
Tomeka Terry	Nuclear Reactor Regulation	Civil Engineer
Barry Zalcman	Nuclear Reactor Regulation	Technical Monitor
Jennifer A. Davis	Nuclear Reactor Regulation	Historic and Archaeological Resources
Robert Palla	Nuclear Reactor Regulation	Severe Accident Mitigation Alternatives
James Wilson	Nuclear Reactor Regulation	Ecology, Water Use
Richard L. Emch	Nuclear Reactor Regulation	Radiation Protection
Alicia R. Williamson	Nuclear Reactor Regulation	Environmental Scientist
Samuel Hernandez	Nuclear Reactor Regulation	General Engineer
	PACIFIC NORTHWEST NATIONAL LABORATORY[a]	
Michael R. Sackschewsky		Task Leader
J. Amanda Stegen		Deputy Task Leader
William F. Sandusky		Air Quality, Noise, Electromagnetic Fields
Katherine A. Cort		Socioeconomics, Environmental Justice
Kathleen Rhoads		Decommissioning, Radiation Protection
Stuart B. Saslow		Water Use and Hydrology
Tara O. Eschbach		Historic and Archaeological Resources
Paul L. Hendrickson		Land Use, Alternatives
Kimberly D. Leigh		Scientist
Cary A. Counts		Technical Editor
Debora A. Schulz		Document Design Lead
Jean M. Cheyney		Document Design
Trina I. Russell		Document Design
Susan M. Tackett		Document Design
Rose M. Urbina		Document Design
Barbara Wilson		Publications Assistant
	ARGONNE NATIONAL LABORATORY[b]	
William Vinikour		Aquatic Ecology
	LOS ALAMOS NATIONAL LABORATORY[c]	
Sam Loftin		Terrestrial Ecology
	INFORMATION SYSTEMS LABORATORY	
Bob Schmidt		Severe Accident Mitigation Alternatives
Kimberly Green		Severe Accident Mitigation Alternatives

(a) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute.
(b) Argonne National Laboratory is operated for the U.S. Department of Energy by the University of Chicago.
(c) Los Alamos National Laboratory is operated for the U.S. Department of Energy by the University of California.

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to the Tennessee Valley Authority Application for License Renewal of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Appendix C

Chronology of NRC Staff Environmental Review Correspondence Related to the Tennessee Valley Authority Application for License Renewal of Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and the Tennessee Valley Authority (TVA) and other correspondence related to the NRC staff's environmental review, under Title 10 of the Code of Federal Regulations (CFR) Part 51, of TVA's application for renewal of the operating licenses for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (BFN). All documents, with the exception of those containing proprietary information, are available electronically from the NRC's Agencywide Document Access and Management System (ADAMS) found on the Internet at the following web address: http://www.nrc.gov/reading-rm/adams.html. The website provides text and image files of NRC's public documents. The ADAMS accession number for each document is included below.

December 31, 2003	Letter from TVA to NRC, BFN, Docket No. 50-259, 50-260, and 50-296, Application for Renewed Operating Licenses (Accession No. ML040060355).
January 7, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Receipt and Availability of the License Renewal Application for BFN (Accession No. ML040090370).
January 8, 2004	NRC press release announcing the availability of license renewal application for BFN (Accession No. ML040080693).
February 27, 2004	Letter from NRC to Mr. R. Crabtree, National Marine Fisheries Service (NOAA Fisheries), Request for List of Protected Species Within the Area Under Evaluation for the BFN License Renewal (Accession No. ML040610754).
March 4, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, transmitting Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding the Application from Tennessee Valley Authority for Renewal of the Operating Licenses for BFN (Accession No. ML040650206).

March 4, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for License Renewal for the BFN (Accession No. ML040640755).
March 5, 2004	Letter from NRC to Mr. L. Goldman, U.S. Fish and Wildlife Service (FWS), Request for List of Protected Species Within the Area Under Evaluation for the BFN License Renewal (Accession No. ML040680881).
March 8, 2004	Letter from NRC to Dr. L. Warner, State Historic Preservation Office, BFN Operating License Renewal (Accession No. ML040700557).
March 10, 2004	NRC press release announcing for hearing on application for license renewal of BFN (Accession No. ML040700395).
March 11, 2004	Letter from D. Bernhart, NOAA Fisheries, to NRC Protected Species List Request, Proposed Renewal of Operating Licenses for BFN, Limestone County, Alabama (Accession No. ML041330242).
March 17, 2004	Notice of Public Meeting to Discuss Environmental Scoping Process for the BFN License Renewal Application (Accession No. ML040770966).
March 23, 2004	Letter from NRC to the Honorable C. Smith, Principal Chief, Cherokee Nation of Oklahoma, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890750).
March 23, 2004	Letter from NRC to the Honorable K. Chambers, Principal Chief, Seminole Nation of Oklahoma, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890884).
March 23, 2004	Letter from NRC to the Honorable B. Anoatubby, Governor, Chickasaw Nation, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890969).
March 23, 2004	Letter from NRC to the Honorable R.P. Beaver, Principal Chief, Muscogee (Creek) Nation, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890973).

March 23, 2004	Letter from NRC to the Honorable M. Hicks, Principal Chief, Eastern Band of Cherokee Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890980).
March 23, 2004	Letter from NRC to the Honorable L. Poncho, Chairman, Coushatta Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860795).
March 23, 2004	Letter from NRC to the Honorable C. Enyart, Chief, Eastern Shawnee Tribe of Oklahoma, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860780).
March 23, 2004	Letter from NRC to the Honorable C. Norris, Chief, Jena Band of Choctaw Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860586).
March 23, 2004	Letter from NRC to the Honorable P. Martin, Chief, Mississippi Band of Choctaw Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890862).
March 23, 2004	Letter from NRC to the Honorable B.K. McGertt, Town King, Thlopthlocco Tribal Town, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860319).
March 23, 2004	Letter from NRC to the Honorable T. Yargee, Chief, Alabama-Quassarte Tribal Town, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890959).
March 23, 2004	Letter from NRC to the Honorable L. Wesley, Towns King, Kialagee Tribal Towns, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860311).
March 23, 2004	Letter from NRC to the Honorable G.E. Pyle, Chief, Choctow Nation of Oklahoma, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860339).
March 23, 2004	Letter from NRC to the Honorable D. Proctor, Chief, United Keetoowah band of Cherokee Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890841).

March 23, 2004	Letter from NRC to the Honorable M. Cypress, Chairman, Seminole Indian Tribe, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890689).
March 23, 2004	Letter from NRC to the Honorable K. Battiste, Chairman, Alabama-Coushatta Tribe of Texas, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040890931).
March 23, 2004	Letter from NRC to Mr. E. Barbry Jr., Director, Tunica-Biloxi Tribe, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860762).
March 23, 2004	Letter from NRC to Ms. J. Makaseah, Cultural/Historic Preservation Department, Absentee-Shawnee Executive Committee, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860705).
March 23, 2004	Letter from NRC to Mr. R. Thrower, Tribal Historic Preservation Office, Poarch Creek Indians, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860251).
March 23, 2004	Letter from NRC to the Honorable B. Cypress, Chairman, Miccosukee Indians Tribe, Request for Comments Concerning BFN Operating License Renewal (Accession No. ML040860239).
March 31, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Review Schedule for Application for Renewal of the Operating Licenses for the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (TAC Nos. MC1704, MC1705, and MC1706). (Accession No. ML040910016).
April 28, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Request for Additional Information Regarding Severe Accident Mitigation Alternatives (SAMAs) for the BFN, License Renewal Application (Accession No. ML041200517).
May 14, 2004	Summary of Scoping Meetings to Support Review of the BFN, License Renewal Application (Accession No. ML041390581).

May 19, 2004	Letter from Mr. L. Goldman, FWS, Daphne, Alabama, to NRC, providing an updated list of protected species within the area under evaluation for the BFN License Renewal (Accession No. ML041550148).
May 20, 2004	Letter from NRC to Mr. J.A. Scalice, TVA, Notice of Extension of the Comment period on the Environmental Scope of the Plant-Specific Supplement to the Generic Environmental Impact Statement (GEIS) Regarding License Renewal for BFN (Accession No. ML041450255).
May 27, 2004	Letter from Mr. M.J. Burzynski, TVA to NRC, Browns Ferry Nuclear Plant (BFN) - Units 1,2, and 3 - March 30-31, 2004 Meeting Follow-Up - Additional Information for License Renewal Environmental Review (Accession No. ML041530161).
June 25, 2004	Letter from TVA to NRC, Browns Ferry Nuclear Plant (BFN), Units 2 and 3, Change Technical Specifications (TS) for TS-418, Request for License Amendment, Extended Power Uprate (EPU) Operation (Accession No. ML041840301).
June 28, 2004	Letter from TVA to NRC, Browns Ferry Nuclear Plant (BFN), Unit 1, Proposed Change for TS-431, Request for License Amendment, EPU Operation (Accession No. ML042800186).
July 7, 2004	Letter from TVA to NRC, Response to Request for Additional Information Regarding SAMAs to support the Review of the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3, License Renewal Application (Accession No. ML041910423).
July 15, 2004	Letter from NRC to Karl W. Singer, TVA, Issuance of Environmental Scoping Summary Report Associated with the Staff's Review of the Application by Tennessee Valley Authority for Renewal of the Operating Licenses for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (TAC Nos. MC1768, MC1769, and MC1770) (Accession No. ML041970726).
August 20, 2004	Letter from NRC to TVA, Request for Additional Clarification Regarding Severe Accident Mitigation Alternatives for the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (TAC Nos. MC1768, MC1769, and MC1770) (Accession No. ML042330233).

September 15, 2004	Letter from NRC to TVA, Summary of Telecommunication with TVA to discuss follow-on Severe Accident Mitigation Analysis (SAMA) Requests for Additional Information, (RAI) (Accession No. ML042590186).
September 30, 2004	Letter from TVA to NRC, Response to Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 (Accession No. ML043860076).
October 20, 2004	E-mail from C. A. McCullough, TVA to R. Palla, NRC, Response to Request for Additional Information Concerning BFN, LR, SAMA, RAI-II, Number of Plant Damage States (Accession No. ML043010285).
October 25, 2004	Letter from NRC to L. Goldman, FWS, Biological Assessment for License Renewal of the Browns Ferry Nuclear Power Plant, and a Request for Informal Consultation (Accession No. ML042990342).
December 1, 2004	Letter from L. Goldman, FWS, to NRC, Acknowledging receipt of the Biological Assessment for License Renewal of the Browns Ferry Nuclear Power Plant (Accession No. ML050690019).
January 25, 2005	Summary of Public Draft Supplemental Environmental Impact Statement Meeting to Support Review of the Browns Ferry Nuclear Plant, Units 1, 2 and 3, License Renewal Application (TAC Nos. MC1768, MC1769, and MC1770) (Accession No. ML0506020210).
February 25, 2005	Letter from John Fornicola, TVA, to NRC, Tennessee Valley Authority Comments on Draft NUREG-1437 Supplement 21 to the Generic Environmental Impact Statement for License Renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (Accession No. ML050630390).
February 25, 2005	Letter from Gregory Hogue, FWS, to NRC, Comments on Draft SEIS, Supplement 21, for License Renewal of Tennessee Valley Authority's Browns Ferry Nuclear Plant (Accession No. ML050630415).
February 28, 2005	Letter from H.J. Mueller, EPA, to NRC, EPA Review and Comments on Draft Generic Supplemental EIS for License Renewal of Nuclear Plants, Supplement 21 Regarding BFN (Accession No. ML050700107).

March 1, 2005	Email correspondence between Michael Masnik, NRC, and Charles Wilson, TVA, Questions for TVA (Accession No. ML050700296).
March 2, 2005	Email from Michelle Boyd, Public Citizen, to NRC, Comments from Public Citizen and SACE (Accession No. ML050630419).
March 15, 2005	Email correspondence between Michael Sackschewsky, Pacific Northwest National Laboratory, and Charles Wilson, TVA, Environmental noncompliance (Accession No. ML050800336).
March 15, 2005	Fax from Charles Wilson, TVA, to Michael Sackschewsky, Pacific Northwest National Laboratory, ADEM Review of Discharge Monitoring Reports (Accession No. ML050810353).
March 24, 2005	Letter from Michael Masnik, NRC, to Nancy Muse, Comment Response Letter Regarding License Renewal of Browns Ferry Nuclear Plant, Units 1, 2, and 3 (Accession No. ML050800545).
April 29, 2005	Email correspondence between Alicia Williamson, NRC, and Charles Wilson, TVA, Requesting reference material (Accession No. ML051520190).
May 11, 2005	Email correspondence between Brenda Adams, TVA, and Alicia Williamson, NRC, Providing probabilistic risk assessments, individual plant examinations, for BFN Unit 2 (Accession No. ML051520190).

Appendix D

Organizations Contacted

Appendix D

Organizations Contacted

During the course of the staff's independent review of environmental impacts from operations during the renewal term, the following Federal, State, regional, local, and Native American tribal agencies were contacted:

Absentee-Shawnee Executive Committee, Shawnee, Oklahoma

Advisory Council on Historic Preservation, Washington D.C.

Alabama-Coushatta Tribe of Texas, Livingston, Texas

Alabama Department of Conservation, Montgomery, Alabama

Alabama Department of Environmental Quality, Decatur, Alabama

Alabama Department of Environmental Quality, Water Division, Montgomery, Alabama

Alabama Department of Transportation, Montgomery, Alabama

Alabama Economic and Community Development, Office of Water Resources, Montgomery, Alabama

Alabama Historical Commission, Montgomery, Alabama

Alabama-Quassarte Tribal Town, Wetumka, Oklahoma

Century 21 Realtors, Athens, Alabama

Cherokee Nation of Oklahoma, Tahlequah, Oklahoma

Chickasaw Nation, Ada, Oklahoma

Choctaw Nation of Oklahoma, Durant, Oklahoma

City of Athens Chamber of Commerce, Athens, Alabama

City Clerk, Athens, Alabama

Community Development Department, Decatur, Alabama

Coushatta Indian Tribe, Elton, Louisiana

Eastern Band of Cherokee Indians, Cherokee, North Carolina

Eastern Shawnee Tribe of Oklahoma, Seneca, Missouri

Jena Band of Choctaw Indians, Jena, Louisiana

Kialegee Tribal Town, Wetumka, Oklahoma

Limestone County Administrators, Athens, Alabama

Miccosukee Indian Tribe, Miami, Florida

Mississippi Band of Choctaw Indians, Philadelphia, Mississippi

Morgan County Commissioners Office, Decatur, Alabama

Muscogee (Creek) Nation, Okmulgee, Oklahoma

National Oceanic and Atmospheric Administration, St. Petersburg, Florida

Poarch Creek Indians, Atmore, Alabama

Seminole Indian Tribe, Hollywood, Florida

Seminole Nation of Oklahoma, Wewoka, Oklahoma

Thlopthlocco Tribal Town, Okemah, Oklahoma

Tribal Historic Preservation Office, Atmore, Alabama

Tunica-Biloxi Tribe, Office of Cultural and Historic Preservation Department, Marksville, Louisiana

USDA Forest Service, Bankhead National Forest, Double Springs, Alabama

USDA Forest Service, Southern Region, Pineville, Louisiana

U.S. Bureau of Indian Affairs, Washington, D.C.

U.S. Fish and Wildlife Service, Daphne, Alabama

U.S. Fish and Wildlife Service, Decatur, Alabama

United Keetoowah Band of Cherokee Indians, Tahlequah, Oklahoma

Appendix E

Browns Ferry Nuclear Power Plant, Units 1, 2, and 3
Compliance Status and Consultation Correspondence

Appendix E

Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Compliance Status and Consultation Correspondence

Licenses, permits, consultations, and other approvals obtained from Federal, State, regional, and local authorities for Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) are identified in this appendix.

Correspondence received during the evaluation process of the application for renewal of the operating license for BFN is identified in Table E-1. Copies of the correspondence are included at the end of this appendix.

The licenses, permits, consultations, and other approvals obtained from Federal, State, regional, and local authorities for BFN are listed in Table E-2.

Table E-1. Consultation Correspondence Regarding License Renewal for Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Source	Recipient	Date of Letter
U.S. Nuclear Regulatory Commission (P.T. Kuo)	National Oceanic and Atmospheric Administration Fisheries (R. Crabtree)	February 27, 2004 (Accession No. ML04610754)
U.S. Nuclear Regulatory Commission (P.T. Kuo)	U.S. Fish and Wildlife Service (L. Goldman)	March 5, 2004 (Accession No. ML040680881)
U.S. Nuclear Regulatory Commission (P.T. Kuo)	Alabama Historical Commission (L. Warner)	March 8, 2004 (Accession No. ML0040700557)
National Oceanic Atmospheric Administration Fisheries (D. Bernhart)	U.S. Nuclear Regulatory Commission	March 11, 2004 (Accession No. ML0411330242)
U.S. Nuclear Regulatory Commission (P.T. Kuo)	Cherokee Nation of Oklahoma (The Honorable C. Smith)	March 23, 2004 (Accession No. ML040890750)
U.S. Fish and Wildlife Service (L. Goldman)	U.S. Nuclear Regulatory Commission (M. Masnik)	May 19, 2004 (Accession No. ML041550148)
U.S. Nuclear Regulatory Commission (P.T. Kuo)	U.S. Fish and Wildlife Service (L. Goldman)	October 25, 2004 (Accession No. ML042990342
U.S. Fish and Wildlife Service (L. Goldman)	U.S. Nuclear Regulatory Commission (P.T. Kuo)	December 1, 2004 (Accession No. ML050690019

Table E-2. Federal, State, and Local Licenses, Permits, Consultations, and Other Approvals for the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
NRC	Atomic Energy Act, 10 CFR Part 50	Operating License for Unit 1	Docket Number: 05000259	12/20/1973	12/20/2013	License authorizes operation of Unit 1.
NRC	Atomic Energy Act, 10 CFR Part 50	Operating License for Unit 2	Docket Number: 05000260	08/02/1974	06/28/2014	License authorizes operation of Unit 2.
NRC	Atomic Energy Act, 10 CFR Part 50	Operating License for Unit 3	Docket Number: 05000296	08/18/1976	07/02/2016	License authorizes operation of Unit 3.
ADEM	Clean Water Act, Alabama Water Pollution Control Act	NPDES Permit	AL0022080	12/29/2000	01/31/2006	Permit authorizes effluent discharges to the Tennessee River.
ADEM	Clean Air Act, Alabama Air Pollution Control Act	Air emission permits	708-0003-Z002; 708-0003-Z003	10/5/1978; 08/28/1995	None	Permits cover operation of auxiliary boilers, emergency diesel generators, and gasoline dispensing facility.
ADEM	Alabama Solid Wastes Disposal Act	Construction/ Demolition landfill permit	42-02	05/17/2000	05/16/2005	Permit allows disposition of nonhazardous, nonradioactive wastes in the onsite landfill.
FWS	Section 7 of the Endangered Species Act (16 USC 1536)	Consultation	N/A			Section 7 of the Endangered Species Act requires that Federal agencies, in cooperation with the license applicant, consult with the FWS and/or the NOAA fisheries concerning the potential impacts of a proposed licensing action on threatened or endangered species. Correspondence with FWS related to Section 7 is included in Appendix E.

Table E-2. (contd)

Agency	Authority	Description	Number	Issue Date	Expiration Date	Remarks
Alabama Department of Economic and Community Affairs, Office of Water Resources		Water withdrawal permit	Certificate of Use No. OWR - 1058	01/1/2001	01/1/2006	Permit specifies the maximum capacity of water withdrawn, diverted, or consumed and average daily use.
Alabama Historical Commission	Section 106 of the National Historic Preservation Act (16 USC 470f)	Consultation	Letters from E.A. Brown, Deputy State Historic Preservation Officer, to TVA, dated 01/8/2001 and 05/24/2001			The National Historic Preservation Act requires Federal agencies to take into account the effect of any undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. The Alabama Historical Commission determined that activities related to license renewal will have no effect on significant cultural resources provided that archaeological site 1Li535 and the Cox cemetery are avoided. Correspondence is included in Appendix E.

ADEM	=	Alabama Department of Environmental Management
CFR	=	Code of Federal Regulations
FWS	=	Fish and Wildlife Service
NOAA	=	National Oceanic and Atmospheric Administration
NPDES	=	National Pollutant Discharge Elimination System
NRC	=	Nuclear Regulatory Commission
USC	=	United States Code

February 27, 2004

Dr. Roy Crabtree
Regional Administrator
NOAA Fisheries
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702

SUBJECT: REQUEST FOR A LIST OF PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR THE BROWNS FERRY NUCLEAR PLANT LICENSE RENEWAL

Dear Dr. Crabtree:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by the Tennessee Valley Authority (TVA) for the renewal of the operating licenses for Browns Ferry Nuclear Plant Units 1, 2, and 3 (BFN). BFN is located in Limestone County, Alabama, 16 km (10 mi) southwest of Athens, Alabama. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provision of the National Environmental Policy Act (NEPA) of 1969, as amended, which includes an analysis of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is being submitted under the provisions of the Endangered Species Act of 1973, as amended, and the Fish and Wildlife Coordination Act of 1934, as amended.

The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines and would not result in significant new construction or disturbance. Any maintenance activities would be limited to previously disturbed areas. For the specific purpose of connecting BFN to the regional transmission system, there are seven 500-kilovolt (kV) lines and two 161-kV lines. These transmission line corridors are being evaluated as part of the SEIS process. The transmission line corridors traverse Limestone, Morgan, Lawrence, Franklin, and Colbert counties in Alabama; and Union, Lee, Tishomingo, and Itawamba counties in Mississippi. The site boundary and transmission lines are identified in Enclosures 1 and 2. The site boundary and transmission line corridors can also be viewed at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/browns-ferry/env-bfn-2.pdf the NRC's web site on pages E-70 and E-388, respectively.

The plant uses an open-cycle cooling system to dissipate waste heat to the environment. Cooling water is drawn from Wheeler Reservoir on the Tennessee River into the turbine-generator condensers and discharging it back to the reservoir via large submerged diffuser pipes that are perforated to maximize uniform mixing into the flowstream. Mechanical draft helper cooling towers are also used in the summer to reduce the heat load to the reservoir.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of species and information on protected, proposed, and candidate species and critical habitat that may be in

the vicinity of BFN and its associated transmission lines. The NRC has requested the same information and list of species from the U.S. Fish and Wildlife Service.

On March 30-31, 2004, the NRC plans to conduct a site audit at the BFN site. In addition, we plan to hold two public NEPA scoping meetings on April 1, 2004, at the Athens State University Student Center Cafeteria Ballroom, 300 Beaty Street, Athens, Alabama 35611-1999. Your staff is invited to attend both the site audit and the public meetings. Additional information on these activities will be forwarded to Mr. David Bernhart of your staff. The NRC staff will also forward to your office a copy of the draft SEIS along with a request for comments.

If you have any questions concerning BFN, the license renewal application, or other aspects of this project, please contact Dr. Michael Masnik, Senior Environmental Project Manager, at (301) 415-1191 or by e-mail at mtm2@nrc.gov.

Sincerely,

/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

March 5, 2004

Mr. Larry Goldman
Field Supervisor
U.S. Fish and Wildlife Service
Daphne Field Office
P.O. Drawer 1190
Daphne, AL 36526

SUBJECT: REQUESTS FOR A LIST OF PROTECTED SPECIES WITHIN THE AREA UNDER EVALUATION FOR THE BROWNS FERRY NUCLEAR PLANT LICENSE RENEWAL

Dear Mr. Goldman:

The U.S. Nuclear Regulatory Commission (NRC) is reviewing an application submitted by the Tennessee Valley Authority (TVA) for the renewal of the operating licenses for Browns Ferry Nuclear Plant Units 1, 2, and 3 (BFN). BFN is located in Limestone County, Alabama, 16 km (10 mi) southwest of Athens, Alabama. As part of the review of the license renewal application, the NRC is preparing a Supplemental Environmental Impact Statement (SEIS) under the provision of the National Environmental Policy Act (NEPA) of 1969, as amended, which includes an analysis of pertinent environmental issues, including endangered or threatened species and impacts to fish and wildlife. This letter is being submitted under the provisions of the Endangered Species Act of 1973, as amended, and the Fish and Wildlife Coordination Act of 1934, as amended.

The proposed action would include the use and continued maintenance of existing plant facilities and transmission lines and would not result in significant new construction or disturbance. For the specific purpose of connecting BFN to the regional transmission system, there are seven 500-kilovolt (kV) lines and two 161-kV lines. These transmission line corridors are being evaluated as part of the SEIS process. The transmission line corridors traverse Limestone, Morgan, Lawrence, Franklin, and Colbert counties in Alabama; and Union, Lee, Tishomingo, and Itawamba counties in Mississippi. The site boundary and transmission lines are identified in Enclosures 1 and 2. The site boundary and transmission line corridors can also be viewed at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/browns-ferry/env-bfn-2.pdf the NRC's website at on pages E-70 and E-388, respectively.

The plant uses an open-cycle cooling system to dissipate waste heat to the environment. Cooling water is drawn from Wheeler Reservoir on the Tennessee River into the turbine-generator condensers and discharging it back to the reservoir via large submerged diffuser pipes that are perforated to maximize uniform mixing into the flow-stream. Mechanical draft helper cooling towers are also used in the summer to reduce the heat load to the reservoir.

To support the environmental impact statement preparation process and to ensure compliance with Section 7 of the Endangered Species Act, the NRC requests a list of species and information on protected, proposed, and candidate species and critical habitat that may be in

the vicinity of BFN and its associated transmission lines. The NRC has requested the same information and list of species from NOAA Fisheries. In addition, please provide any information you consider appropriate under the provisions of the Fish and Wildlife Coordination Act.

On March 30-31, 2004, we plan to conduct a site audit at the BFN site. We plan to hold two public NEPA scoping meetings on April 1, 2004, at the Athens State University Student Center Cafeteria Ballroom, 300 North Beaty Street, Athens, Alabama 35611-1999. You and your staff are invited to attend both the site audit and the public meetings. Your office will receive a copy of the draft SEIS along with a request for comments. The anticipated publication date for the draft SEIS is November 2004.

If you have any questions concerning BFN, the license renewal application, or other aspects of this project, please contact Dr. Michael Masnik, Senior Environmental Project Manager, at (301) 415-1191 or by e-mail at mtm2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

March 8, 2004

Dr. Lee Warner
State Historic Preservation Officer
Alabama Historical Commission
468 South Perry Street
Montgomery, AL 36130-0900

SUBJECT: BROWNS FERRY NUCLEAR PLANT LICENSE RENEWAL REVIEW

Dear Dr. Warner:

The U.S. Nuclear Regulatory Commission (NRC) staff is reviewing an application to renew the operating licenses for Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN), which is located in Limestone County, Alabama, 16 km (10 mi) southwest of Athens, Alabama. BFN is operated by the Tennessee Valley Authority (TVA). The site boundary is shown on the NRC's web site at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/browns-ferry/env-bfn-2.pdf on page E-70. The application for renewal was submitted by TVA on January 6, 2004, pursuant to NRC requirements at Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54). The NRC has established that, as part of the staff review of any nuclear power plant license renewal action, a site-specific Supplemental Environmental Impact Statement (SEIS) to its "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS), NUREG-1437, will be prepared under the provisions of 10 CFR Part 51, which implements the National Environmental Policy Act of 1969 (NEPA). In accordance with 36 CFR 800.8, the SEIS will include analyses of potential impacts to historic and cultural resources. A draft SEIS is scheduled for publication in November of 2004, and will be provided to you for review and comment.

In the context of the National Historic Preservation Act of 1966, as amended, the NRC staff has determined that the area of potential effect (APE) for a license renewal action is the area at the power plant site and its immediate environs which may be impacted by post-license renewal land disturbing operation or projected refurbishment activities associated with the proposed action. The APE may extend beyond the immediate environs in those instances where post-license renewal land disturbing operations or projected refurbishment activities, specifically related to license renewal, may potentially have an effect on known or proposed historic sites located beyond the immediate environs of the proposed site. This determination is made irrespective of ownership or control of the lands of interest.

We understand that in a letter dated January 8, 2001, after reviewing the TVA issued Draft Environmental Impact Statement for Operating License Renewal of the Browns Ferry Nuclear Plant, you concluded that license renewal activities will have no effect on significant cultural resources, provided that site 1Li535 and the Cox Cemetery are avoided. The Alabama Historical Commission tracking number for this action is 2001-1439.

Dr. L. Warner -2-

On April 1, 2004, the NRC will conduct two public NEPA scoping meetings at the Athens State University Student Center Cafeteria Ballroom, 300 North Beaty Street, Athens, Alabama 35611-1999. You and your staff are invited to attend. Your office will receive a copy of the draft SEIS for review and comment. If you have any questions or require additional information, please contact the Senior Environmental Project Manager for the BFN project, Dr. Michael Masnik, at 301-415-1191 or mtm2@nrc.gov.

Sincerely,
/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312, FAX 570-5517
http://caldera.sero.nmfs.gov

Dear Colleague: MAR 11 '04

The National Marine Fisheries Service (NOAA Fisheries) Protected Resources Division has reviewed your letter pursuant to section 7(a)(2) of the Endangered Species Act (ESA) concerning letter dated 2/27/04; The NRC is reviewing an application submitted by the Tennessee Valley Authority (TVA) for renewal of the operating licenses for Browns Ferry Nuclear Plants units 1, 2, 3 (BFN).

___ We cannot determine impacts to threatened or endangered species, or designated critical habitat, under NOAA Fisheries' purview because the letter lacks sufficient information to evaluate the project. Enclosed are guidelines to conduct a proper biological evaluation.

✓ As requested, enclosed is a list of federally-protected species under the jurisdiction of NOAA Fisheries for the state of Alabama. Biological information on federally-protected sea turtles, shortnose and gulf sturgeon, smalltooth sawfish, and other listed species and candidate species can be found at the following website addresses: NOAA Fisheries Southeast Regional Office (http://caldera.sero.nmfs.gov/protect/protect.htm); NOAA Fisheries Office of Protected Resources (http://www.nmfs.noaa.gov/prot_res/prot_res.html); U.S. Fish and Wildlife Service (http://noflorida.fws.gov/SeaTurtles/seaturtle-info.htm), http://www.turtles.org; http://www/seaturtle.org; http://alabama.fws.gov/gs/; http://endangered.fws.gov/wildlife.html#Species; the Ocean Conservancy (http://www.cmc-ocean.org/main.php3); the Caribbean Conservation Corporation (http://www.cccturtle.org/); Florida Fish and Wildlife Conservation Commission (http://floridaconservation.org/psm/turtles/turtle.htm); http://obis.env.duke.edu/data/sp_profiles.php; www.mote.org/~colins/SawfishSawfishHomePage.html; www.floridasawfish.com; www.flmnh.ufl.edu/fish/sharks/InNews/sawprop.htm.

___ It is NOAA Fisheries' opinion that the project will have no effect on listed species or critical habitat protected by the ESA under NOAA Fisheries' purview. No further consultation with NOAA Fisheries pursuant to section 7(a)(2) of the ESA is required. Consultation with NOAA Fisheries, Habitat Conservation Division, pursuant to the Magnuson-Stevens Fishery Conservation and Management Act's requirements for essential fish habitat consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K), may be required. Please contact our Habitat Conservation Division at (727) 570-5317.

If you have any questions, please contact the ESA section 7 coordinator, Eric Hawk, at (727) 570-5312, or by e-mail at eric.hawk@noaa.gov.

Sincerely,

Katherine Y. for

David Bernhart
Acting Assistant Regional Administrator
for Protected Resources

✓ Enclosure
File:1514-22.
O:\forms\no-effect letter.wpd
I/SER/2004/
AL Species List

Endangered and Threatened Species and Critical Habitats

under the Jurisdiction of the National Marine Fisheries Service

Alabama

Listed Species	Scientific Name	Status	Date Listed
Marine Mammals			
blue whale	*Balaenoptera musculus*	Endangered	12/02/70
finback whale	*Balaenoptera physalus*	Endangered	12/02/70
humpback whale	*Megaptera novaeangliae*	Endangered	12/02/70
sei whale	*Balaenoptera borealis*	Endangered	12/02/70
sperm whale	*Physeter macrocephalus*	Endangered	12/02/70
Turtles			
green sea turtle	*Chelonia mydas*	Threatened[1]	07/28/78
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	06/02/70
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	12/02/70
leatherback sea turtle	*Dermochelys coriacea*	Endangered	06/02/70
loggerhead sea turtle	*Caretta caretta*	Threatened	07/28/78
Fish			
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened	09/30/91

Species Proposed for Listing

None

Designated Critical Habitat

Gulf Sturgeon: Gulf Sturgeon: A final rule designating Gulf sturgeon critical habitat was published on March 19, 2003 (68 FR 13370) and 14 geographic areas (units) among the Gulf of Mexico rivers and tributaries were identified. Maps and details regarding the final rule can be found at alabama.fws.gov/gs

Proposed Critical Habitat

None

3/10/04 11:20 AM

Candidate Species[2]	Scientific Name
Fish	
Alabama shad	*Alosa alabamae*
dusky shark	*Carcharhinus obscurus*
Goliath grouper	*Epinephelus itajara*
night shark	*Carcharinus signatus*
saltmarsh topminnow	*Fundulus jenkinsi*
sand tiger shark	*Odontaspis taurus*
speckled hind	*Epinephelus drummondhayi*
Warsaw grouper	*Epinephelus nigritus*

1. Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

2. Candidate species are not protected under the Endangered Species Act, but concerns about their status indicate that they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.

March 23, 2004

The Honorable Chadwick Smith, Principal Chief
Cherokee Nation of Oklahoma
PO Box 948
Tahlequah, OK 74465

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION REVIEW OF THE BROWNS FERRY NUCLEAR PLANT LICENSE RENEWAL APPLICATION

Dear Chief Smith:

The U.S. Nuclear Regulatory Commission (NRC) is seeking input for its environmental review of an application from Tennessee Valley Authority (TVA) to renew its operating licenses for the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN), located in Limestone County, Alabama, 16 km (10 mi) southwest of Athens, Alabama. BFN is in close proximity to lands that may be of interest to the Cherokee Nation Tribe. As described below, the NRC process includes an opportunity for public participation in the environmental review. We want to ensure that you are aware of our efforts and, pursuant to 10 CFR 51.28(b), the NRC invites the Cherokee Nation Tribal Community to provide input to the scoping process relating to the NRC's environmental review of the application.

The NRC will hold public scoping meetings for the BFN license renewal supplement to the NRC's "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (GEIS) (NUREG-1437). These scoping meetings will be held at the Athens State University, Student Center Cafeteria Ballroom, 300 North Beaty Street, Athens, Alabama, on Thursday, April 1, 2004. There will be two sessions to accommodate interested parties. The first session will convene at 1:30 p.m. and will continue until 4:30 p.m., as necessary. The second session will convene at 7:00 p.m., with a repeat of the overview portions of the meeting, and will continue until 10:00 p.m., as necessary. Additionally, the NRC staff will host informal discussions one hour before the start of each session. No formal comments on the proposed scope of the supplement to the GEIS will be accepted during the informal discussions. To be considered, comments must be provided either at the transcribed public meetings or in writing. The application and the environmental review process are described below.

Under NRC regulations, the original operating license for a nuclear power plant is issued for up to 40 years. The license may be renewed for up to an additional 20 years if NRC requirements are met. The current operating licenses for BFN will expire in 2013, 2014, and 2016 respectively. TVA submitted an environmental report as part of its application for renewal of the BFN operating license on January 6, 2004. The application is electronically available for inspection from the Publicly Available Records (PARs) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html, which provides access through the NRC's Public Electronic Reading Room (PERR) link. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's Public Document Room (PDR) Reference staff at 1 (800) 397-4209, (301) 415-4737, or by e-mail to pdr@nrc.gov. In addition, the application can be viewed on the Internet at

http://www.nrc.gov/reactors/operating/licensing/renewal/applications.html.

A paper copy of the document can be viewed at the NRC's PDR, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, 20852-2738 and at the Athens-Limestone Public Library, 405 East South Street, Athens, Alabama, 35611-1999. Also, the GEIS assesses the scope and impact of environmental effects that would be associated with license renewal at any nuclear power plant site. A copy of this document can also be found on the NRC's website or at the NRC's PDR.

The NRC is gathering information for the document that will be a BFN-specific supplement to the GEIS. The supplement will contain the results of the review of the environmental impacts on the area surrounding the BFN site that are related to terrestrial ecology, aquatic ecology, hydrology, cultural resources, and socioeconomic issues (among others) and will contain a recommendation regarding the environmental acceptability of the license renewal action.

Please submit any written comments the Cherokee Nation Tribal Community may have to offer on the scope of the environmental review by April 26, 2004. Comments should be submitted either by mail to the Chief, Rules and Directives Branch, Division of Administrative Services, *Mail Stop T-6D59, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001*, or by e-mail to BrownsFerryEIS@nrc.gov.

At the conclusion of the scoping process, the NRC staff will prepare a summary of the significant issues identified, the conclusions reached, and will mail a copy to you.

The NRC will prepare a draft supplemental environmental impact statement (SEIS) for public comment, and will hold another set of public meetings in the site vicinity to solicit comments on the draft. A copy of the draft SEIS will be sent to you for your review and comment. After consideration of public comments received on the draft, the NRC will prepare a final SEIS. If you need additional information regarding the environmental review process, please contact Dr. Michael Masnik, Senior Environmental Project Manager, at (301) 415-1191.

Sincerely,

/RA/
Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. Drawer 1190
Daphne, Alabama 36526

IN REPLY REFER TO:

04-0760

May 19, 2004

U.S. Nuclear Regulatory Commission
Division of Regulatory Improvement Programs
Attn: Dr. Michael Masnik
Washington, D.C. 20555-0001

Dear Dr. Masnik:

This letter is in response to your letter, dated March 4, 2004, notifying our agency of the Nuclear Regulatory Commission's (NRC) plan to prepare a Supplemental Environmental Impact Statement (SEIS) for the Browns Ferry Nuclear Plant Operations License Renewal, Limestone County, Alabama. The following comments are provided in accordance with the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661-667e), the Migratory Bird Treaty Act (16 U.S.C. 703, *et seq.*) and section 7 of the Endangered Species Act, as amended (16 U.S.C. 1531-1543).

According to your letter, the proposed action would include the use and continued maintenance of the existing plant facilities and transmission lines. However, you indicated that very little new construction or ground disturbance would occur as a result of the proposed action. The entire Tennessee River system and the 5-county area traversed by the transmission lines provides habitat to a number of terrestrial and aquatic federally listed species. A county list of these species may be found on our website at the following address, http://daphne.fws.gov/es/specieslst.htm. The SEIS should address the type of ground disturbance and maintenance needed for the transmission lines. If the maintenance involves the use of chemicals or mowing to maintain the rights-of-way in a herbaceous environment, further consultation with the Service will be required to determine the extent, if any, these applications will have on listed species.

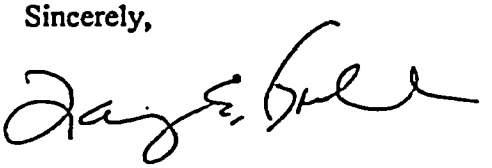
The U.S. Fish and Wildlife Service, Daphne, Alabama Field Office has concerns with the thermal plume that will be created if the maximum operating power level is increased for the facility. Thermal plume could impact aquatic organisms, particularly the rough pigtoe (*Pleurobema plenum*), an endangered mussel found in the vicinity of the discharge. The Service requests that surveys for threatened and endangered mussels be conducted and thermal plume models be produced pursuant to the preparation of the SEIS, and provided to this office for review.

The Service appreciates the early coordination on this project and we look forward to working with you during the preparation of the SEIS. If you have questions or comments, please direct them to

PHONE: 251-441-5181 www.fws.gov FAX: 251-441-6222
SHIPPING ADDRESS: 1208-B Main Street, Daphne, AL 36526

Mr. Bruce Porter, at (251)441-5864 or via email bruce_porter@fws.gov.

Sincerely,



Larry E. Goldman
Field Supervisor

cc: Mr. Jon M. Loney,
Environmental Policy and Planning
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1499

October 25, 2004

Mr. Larry Goldman
Field Supervisor
U.S. Fish and Wildlife Service
P.O. Drawer 1190
Daphne, AL 36526

SUBJECT: BIOLOGICAL ASSESSMENT FOR LICENSE RENEWAL OF THE BROWNS FERRY NUCLEAR POWER PLANT, AND A REQUEST FOR INFORMAL CONSULTATION

Dear Mr. Goldman:

The U.S. Nuclear Regulatory Commission (NRC) staff has prepared the enclosed biological assessment (Enclosure 1) to evaluate whether the proposed renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) operating licenses for a period of an additional 20 years would have adverse effects on listed species. The proposed action (license renewal) is not a major construction activity. BFN is located on the north shore of Wheeler Reservoir in Limestone County, Alabama, at Tennessee River Mile (TRM) 294.

By letter dated March 5, 2004, the NRC requested a list of Federally threatened or endangered species that may be in the vicinity of BFN and its associated transmission lines. In a letter dated May 19, 2004, the U.S. Fish and Wildlife Service (FWS) directed the NRC to the following Website, http://daphne.fws.gov/es/specieslst.htm, for a list of Federally listed threatened or endangered species to evaluate in a biological assessment (BA). The FWS Website listed 11 terrestrial and 38 aquatic Federally protected species as potentially occurring in counties containing the BFN site, transmission line and rights-of-way, and Wheeler Reservoir. Your letter dated May 19, 2004, also expressed concerns related to the operation of BFN and the potential impact on the rough pigtoe; specifically, potential impacts resulting from the plant operating at maximum power levels.

For documentation purposes, the NRC has included all terrestrial and aquatic species found on the aforementioned FWS Website in the enclosed BA. This BA provides an evaluation of the potential impact of renewing the BFN operating licenses for an additional 20 years of operation on the forty-five listed species and four candidate species identified in Tables 1, 2, and 3 of the BA.

The NRC has determined that the proposed action has no effect on the red-cockaded woodpecker (*Picoides borealis*), the American hart's tongue fern (*Asplenium scolopendrium* var. *americanum*), and 29 of the aquatic species (Table 3). In addition, the staff has determined that the proposed action may affect, but is not likely to adversely affect, the bald eagle (*Haliaeetus*

L. Goldman

leucocephalus), gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalis*), Price's potato bean (*Apios priceana*), leafy prairie clover (*Dalea foliosa*), Eggert's sunflower (*Helianthus eggertii*), fleshy-fruited gladecress (*Leavenworthia crassa*), lyrate bladder-pod (*Lesquerella lyrata*), Tennessee yellow-eyed grass (*Xyris tennesseensis*), Anthony's riversnail (*Athearnia anthonyi*), slender campeloma (*Campeloma decampi*), armored snail (*Pyrgulopsis pachyta*), spectaclecase (*Cumberlandia monodonta*), Cumberlandian combshell (*Epioblasma brevidens*), pink mucket (*Lampsilis abrupta*), slabside pearlymussel (*Lexingtonia dolabelloides*), rough pigtoe (*Pleurobema plenum*), and the slackerwater darter (*Etheostoma boschungi*). The site contains no critical habitat for any protected species. However, some areas within the transmission line rights-of-way have recently been designated critical habitat for the Cumberlandian combshell. TVA has designed and implemented maintenance procedures for its transmission line rights-of-way that protect all listed species and their habitats.

We are placing this BA in our project files and are requesting your concurrence with our determination. In reaching its conclusion, the NRC staff relied on information provided by the licensee, on research performed by NRC staff, and information from the FWS (i.e., including current listings of species provided by FWS, Daphne, Alabama Field Office).

If you have any questions regarding this BA or the staff's request, please contact Dr. Michael Masnik, Senior Project Manager, at 301-415-1191 or by email at mtm2@nrc.gov.

Sincerely,

/RA/

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket Nos.: 50-259, 50-260, and 50-296

Enclosure: As stated

cc w/encl.: See next page

Biological Assessment

Browns Ferry Nuclear Power Plant
License Renewal Review

Limestone County, Alabama

October 2004

Docket Numbers 50-259, 50-260, and 50-296

U.S. Nuclear Regulatory Commission
Rockville, Maryland

Appendix E

Biological Assessment of the Potential Effects on Endangered or Threatened Species from the Proposed License Renewal for the Browns Ferry Nuclear Plant

1.0 Introduction

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. The Tennessee Valley Authority (TVA) operates Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 (BFN) pursuant to NRC operating license (OL) numbers DPR-33, DPR-52, DPR-68, which expire on December 20, 2013, June 28, 2014, and July 2, 2016, respectively.

TVA has prepared an Environmental Report (ER) (TVA 2003) in conjunction with its application for renewal of the BFN OLs, as provided for by the following NRC regulations:

- Title 10 of the Code of *Federal Regulations*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," Section 54.23, Contents of application - environmental information (10 CFR 54.23).

- Title 10 of the Code of Federal Regulations, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," Section 51.53, Postconstruction environmental reports, Subsection 51.53(c), Operating license renewal stage (10 CFR 51.53(c)).

The renewed OLs would allow up to 20 additional years of plant operation beyond the current licensed operating term.

No major refurbishment or replacement of important systems, structures, or components are expected during the 20-year BFN license renewal term. In addition, no construction activities are expected to be associated with license renewal.

In a letter dated March 5, 2004, the staff requested comments from the U.S. Fish and Wildlife Service (FWS) on the OL renewal application for BFN (NRC 2004). Specifically, the staff requested a list of species and information on protected, proposed, and candidate species and critical habitat that may be in the vicinity of BFN and its associated transmission line rights-of-way. In a letter from the FWS dated May 19, 2004 (FWS 2004e), the staff was directed to an FWS website (http://daphne.fws.gov/es/specieslst.htm) for a list of species to include in this biological assessment (BA). A total of 11 terrestrial and 38 aquatic species were listed for the counties within which the BFN site and its transmission line rights-of-way are located,

and for Wheeler Reservoir, which serves as the source of cooling water for BFN. The FWS expressed specific concern (FWS 2004) over the potential impact of all three BFN units operating at maximum power levels on the rough pigtoe (*Pleurobema plenum*).

2.0 Proposed Action

The proposed Federal action is the renewal of the OLs for BFN. In response to the increasing demands for bulk power, TVA seeks to use existing facilities to the greatest extent possible to meet requirements for electric power. TVA is pursuing this approach because: (1) it ensures that future power needs can be met; (2) it avoids the large capital expenditures associated with construction of new generating facilities; and (3) it avoids the environmental impacts resulting from siting and constructing new power generating facilities. Consistent with this approach, TVA proposes to continue operation of BFN after expiration of the current OL for each unit. Implementing the proposed action is dependent on the staff determining that renewal of the OLs for BFN is the best course of action. Renewal of the current OLs would permit operation of the units for an additional 20 years beyond their current (original) 40-year operating license period.

In July 2004, the TVA submitted extended power uprate (EPU) applications to increase the licensed power levels of each of the three units to 3952 megawatts thermal (MW(t)) (i.e., to 120 percent of the originally licensed power levels), thereby bringing the combined total power level for the three units to 11,856 MW(t). In a separate environmental assessment, NRC is currently evaluating the potential environmental impacts of the proposed EPUs at BFN. If approved, the EPUs would take effect during the existing license term and would continue during the 20-year term of the renewed OLs. This BA was prepared to evaluate the potential environmental impacts of operating Units 1, 2, and 3 at 120 percent of their originally licensed power levels for an additional 20 years beyond the current license term for each unit.

Continued maintenance activities on the transmission line rights-of-way that are used to connect BFN to the electric power grid would be required if the proposed action is adopted. The TVA Transmission and Power Supply-Transmission Operations and Maintenance organization conducts maintenance activities on transmission lines and rights-of-way in the TVA system. These activities include, but are not restricted to, maintenance of vegetation in each right-of-way, replacement of poles or towers, installation of lightning arresters and counterpoise, and upgrading existing equipment. Regular maintenance activities are conducted on a 3-to-5-year cycle (Muncy et al. 1999).

3.0 The Plant

3.1 Plant Description

The three-unit BFN plant, including the intake and discharge canals, is enclosed by a security fence. Primary access to the plant area is by way of an access road through a security gate. The plant has the following principal physical structures in the central site area: reactor containment building, turbine building, radioactive waste building, service building, intake pumping station, transformer yard, 161-kV and 500-kV switchyards, off-gas stack, sewage treatment facilities, and administration and maintenance buildings. The hot and cold water discharge channels and mechanical draft cooling towers are located northwest of the central site area, while the training center, employee physical fitness center, materials storage and procurement complex, and structures from a former aquatic research laboratory are located to the east of the central site area (see Figure 1).

3.2 Reactor Systems

BFN has two active nuclear reactor units (Units 2 and 3) and one inactive unit (Unit 1). Each unit includes a boiling water reactor (BWR) and a steam-driven turbine generator manufactured by General Electric Company. Work began in 2002 to bring Unit 1 up to current standards, and operation of the reactor is currently scheduled to resume in 2007.

The nuclear steam supply system at BFN is typical of General Electric BWRs. Each nuclear system includes a single-cycle, forced-circulation, General Electric BWR that produces steam for direct use in a steam turbine. The design employs a pressure suppression primary containment that houses the reactor vessel, the reactor coolant recirculating loops, and other branch connections of the reactor primary system. The pressure suppression system consists of a dry well, a pressure suppression chamber that stores a large volume of water, connecting vents between the dry well and the pressure suppression chamber, isolation valves, containment cooling systems, and other service equipment. Cooling systems are provided to remove heat from the reactor core, the dry well, and the water in the pressure suppression chamber, thus providing continuous cooling of the primary containment under accident conditions. Appropriate isolation valves are actuated during this period to ensure confinement of radioactive material, which might otherwise be released from the reactor containment during the course of an accident.

The secondary containment substructure consists of poured-in-place, reinforced concrete exterior walls that extend up to the refueling floor. The refueling room floor is also constructed of reinforced, poured-in-place concrete. The secondary containment structure completely encloses the primary containment dry wells, fuel storage and handling facilities, and essentially all of the core standby cooling systems for the three units. During normal operation and when

isolated, the secondary containment is maintained at a negative pressure relative to the building exterior.

3.3 Cooling and Auxiliary Water Systems

Wheeler Reservoir on the Tennessee River is the source for cooling water and most of the auxiliary water systems for BFN (see Figure 2). Potable water is supplied by the City of Athens Utilities Water Department in Athens, Alabama. Groundwater is not used at the site. Figure 1 shows the general layout of the buildings and structures at the site.

The intake forebay is separated from Wheeler Reservoir by a gate structure with three bays that are each 12 m (40 ft) wide by about 7.3 m (24 ft) high (TVA 1972). Each bay includes a 6-m (20-ft)-high gate that can be raised or lowered depending on the operational requirements of the plant. The flow velocity through the openings varies depending on the gate position. When the gates are in their full-open position and the plant is operated in either the open mode (once-through) or cooling tower helper mode, the average flow velocity through the openings is about 0.2 m/s (0.6 fps) for the operation of one unit, 0.34 m/s (1.1 fps) for the operation of two units, and 0.52 m/s (1.7 fps) for the operation of all three units (TVA 2003). These flow velocities are based on an intake flow per unit of about 46,300 L/s (734,000 gpm), which is 46.3 m^3/s (1635 cfs).

The intake pumping station includes 18 bays (i.e., six bays per reactor unit), each with a traveling screen. Each bay has a net opening size of about 2.6 m by 6 m (8.75 ft by 20 ft). The maximum average flow velocity through each bay is about 0.49 m/s (1.6 fps) and is independent of the reservoir surface elevation. The maximum average velocity through a clean screen with net openings of 0.95 cm by 0.95 cm (3/8 in. by 3/8 in.) is about 0.64 m/s (2.1 fps) (TVA 2003). Flow velocities through the intake pump station bays and traveling screens are independent of the number of units in operation and the reservoir elevation.

The BFN units are normally cooled by pumping water from Wheeler Reservoir into the turbine generator condensers and discharging it back to the reservoir via three large submerged diffuser pipes that are perforated to maximize uniform mixing into the flow stream. These pipes range in diameter from 5.2 m to 6.2 m (17 ft to 20.5 ft). The flow exits each discharge pipe through 7800 5-cm (2-in.) ports (TVA 2003). This straight-through flow path is known as "open cycle" or "open mode" operation. As originally designed, the maximum thermal discharge from the once-through cooling water system is directed into the Wheeler Reservoir, with a temperature increase across the intake and discharge of 13.9°C (25°F) (TVA 1972). The flow exits the diffusers and mixes with the reservoir flow. At the edge of the discharge mixing zone, the water temperature is required to be less than 5.6°C (10°F) above ambient (ADEM 2003).

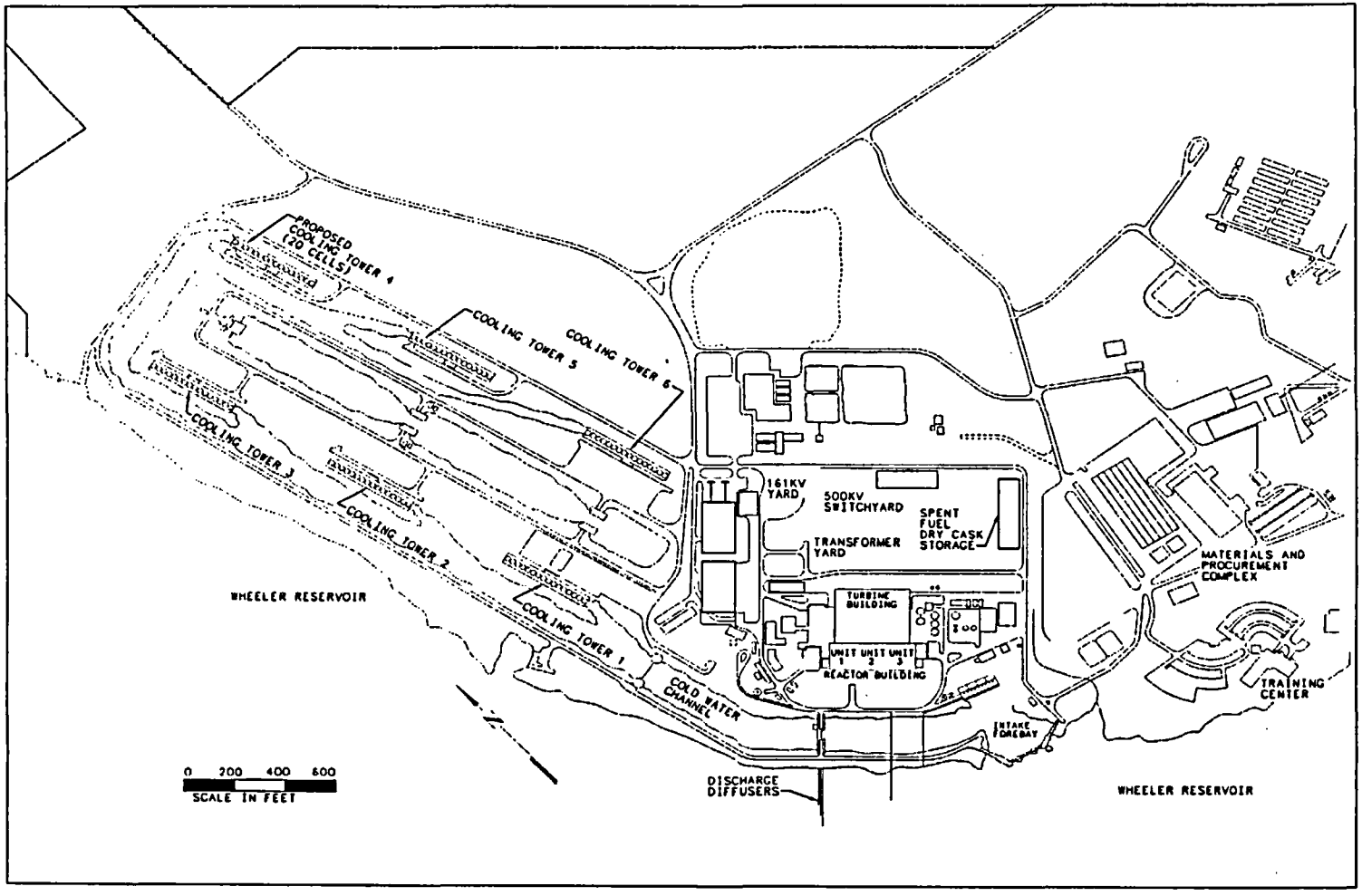


Figure 1. Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Site Features

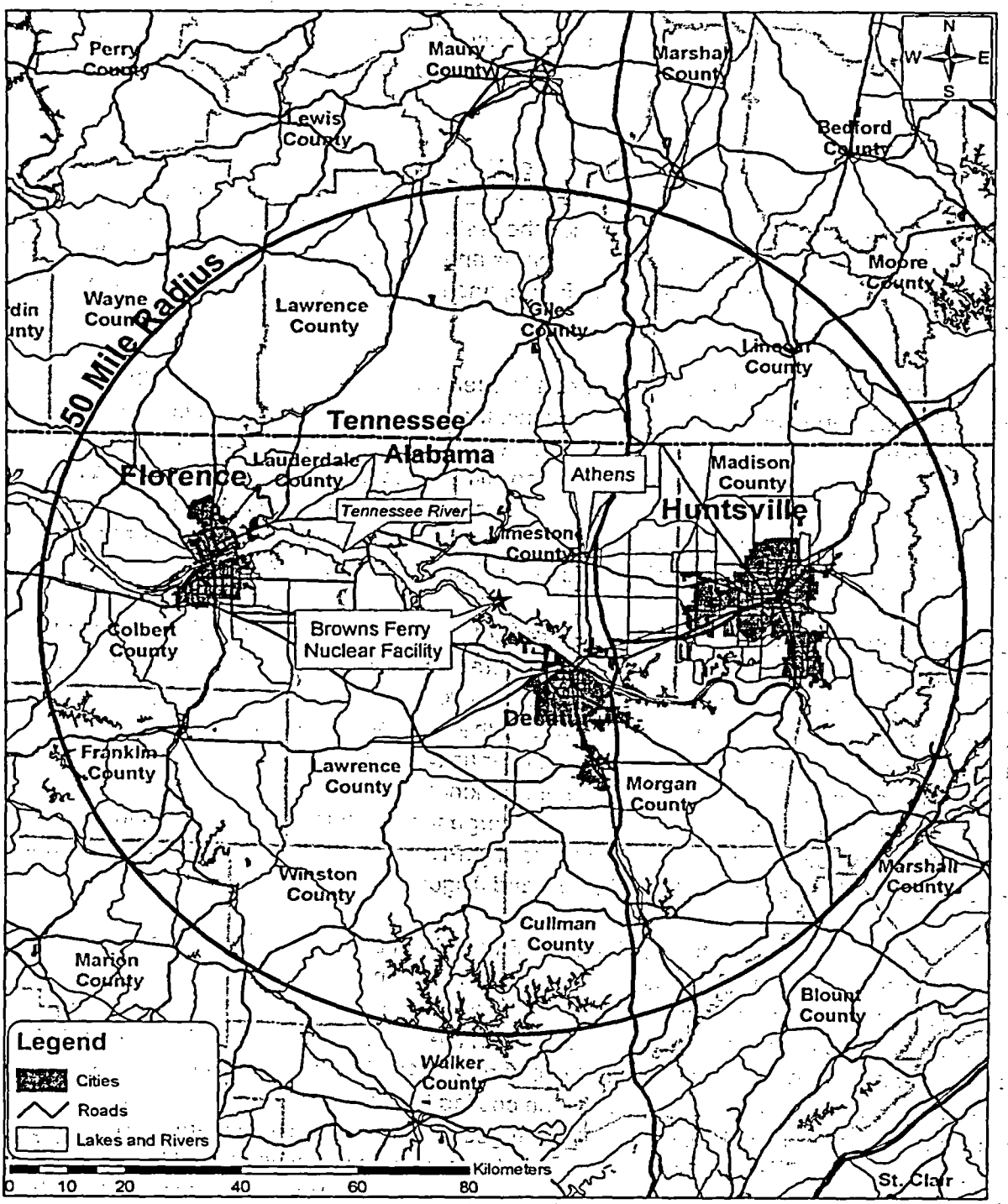


Figure 2. Brown's Ferry Nuclear Power Plant, Units 1, 2, and 3 Site and Surrounding Area

Through various gates, some of this cooling water can also be directed through mechanical draft cooling towers to reduce its temperature as necessary to comply with environmental regulations. This flow path is known as the "helper mode," and the cooling towers are referred to as "helper towers."

The capacity also exists to recycle cooling water from the cooling towers directly back to the intake structure without being discharged to the reservoir. This flow path, known as the "closed mode" of operation, has not been used since the restart of Units 2 and 3 because of difficulties in achieving temperature limits in summer months and problems with equipment reliability. TVA does not anticipate using this mode in the future, and no procedures for operating in this mode currently exist.

In recent years, only Units 2 and 3 have been in operation, but because of a combination of system upgrades and improved flow calibrations, the measured total per-unit condenser circulating water (CCW) flow rate in open mode (with three CCW water pumps per unit) has increased. The condenser tubes were replaced with stainless steel tubing that have a larger internal diameter and lower flow resistance. This modification increased flow through the condenser by approximately 6 percent. TVA estimates total intake for three-unit operation in open mode to be 139 m^3/s (4907 cfs) or 12,000 m^3/d (3171 MGD) (TVA 2003).

Because of various system limitations, BFN cannot pass all the CCW through the cooling towers when operating in the helper mode. The fraction of cooling water that cannot be passed through the cooling towers is routed directly to the river. Almost all of the cooling water that passes through the cooling towers is returned to the river, but a small amount is lost to the atmosphere during operation. If cooling tower capacity is increased during the license renewal term, this consumptive use could increase proportionately. The cooling towers are only operated when necessary to meet thermal discharge temperature limits specified in the National Pollutant Discharge Elimination System (NPDES) permit, typically a few weeks during the hottest part of the summer (typically July and August).

For the last 6 years, during which Units 2 and 3 have both been in service, the greatest amount of time cooling tower operation has been required has been about 8 percent of a year (TVA 2003). Increased thermal power limits proposed for Units 2 and 3 will result in an additional increase of approximately 2.2°C (4°F) in the circulating water temperature leaving the main condenser (for each operating unit) (Hopping 2004). This increase in water discharge temperature will result in increased use of the cooling tower during summer periods to maintain compliance with discharge limitations. No changes to the plant intake system or to the individual unit intake flow rates are expected to be required as a result of the Units 2 and 3 EPU project, and operations will continue to meet regulatory limits established in the existing NPDES permit.

Simulations with the near-field hydrothermal model were conduced for the period 1985 through 2002, excluding 2 years (1989 and 1990) for which no river ambient temperature data are available (TVA 2003). TVA varied both the use of the helper towers and unit power levels to maintain discharge temperatures to within NPDES permit limits. Model results showed that, with Units 2 and 3 operating at 120 percent power, the cooling towers will be used on average approximately 5.3 percent of the time, and derating will be required approximately 0.10 percent of the time (i.e., 6.2 days over the 16-year simulation period). On average, with all three units at 120 percent power, use of the cooling towers will increase to approximately 7.2 percent of the time and derating will increase to approximately 0.29 percent of the time (i.e., 17 days over the 16-year simulation). The simulation of three unit operation at 120 percent power assumed the construction and operation of an additional sixth 20 cell cooling tower. The licensee has committed placing the new tower in operation prior to the first summer following the return of Unit 1 to service (TVA 2004c).

The residual heat removal service water (RHRSW) system consists of four pairs of pumps located on the intake structure for pumping raw river water to the heat exchangers in the RHRSW system and four additional pumps for supplying water to the emergency equipment cooling water (EECU) system. The EECU system distributes cooling water supplied by the RHRSW system to essential equipment during normal and accident conditions.

The impacts evaluated in this BA include those from operation of all three of the BFN reactor units, each at 120 percent of the original licensed thermal power level. TVA has stated (TVA 2002a) that "no changes are expected to be required to the plant intake system or to the individual unit intake flow rates as a result of the EPU project." TVA also indicated that existing thermal discharge limits would be met by increased use of the helper towers, and if necessary, derating one or more units.

4.0 Environmental Setting

The proposed license renewal will apply to all three units at BFN, which is located on the north shore of Wheeler Reservoir in Limestone County, Alabama, at Tennessee River Mile (TRM) 294. The BFN site is approximately 48 km (30 mi) west of Huntsville, Alabama; 16 km (10 mi) northwest of Decatur, Alabama; and 16 km (10 mi) southwest of Athens, Alabama (Figure 2). The power plant is located on a 340-ha (840-ac) tract owned by the Federal government and held in custody by TVA, a corporate agency and instrumentality of the United States.

4.1 Terrestrial Resources

BFN is located within the Highland Rim section of the Interior Low Plateau Physiographic Province. Botanically, the site is within the Mississippian Plateau section of the Western Mesophytic Forest Region (EPA 2004). In this region of northern Alabama, native forest

communities generally consist of mixed oak forests that vary in composition in relation to topography and soils. Historically, upland forests in the vicinity of the site were characterized by mixtures of southern red oak (*Quercus falcata*), black oak (*Q. velutina*), post oak (*Q. stellata*), and white oak (*Q. alba*), with dogwood (*Cornus* spp.) commonly present in the understory. The clearing of forested lands for agriculture has converted many of these forest communities to early successional habitats, allowing introduced plant species to replace representative native plant communities.

The site is situated in an area where the land is used primarily for agriculture (TVA 2003). The countryside includes open pasture lands, scattered farmsteads, few residents, and little industry within several miles. The south and west side of the BFN site abuts Wheeler Reservoir, and has a shoreline of approximately 3772 m (12,375 ft), with 58 percent of the shoreline stabilized with riprap. The remaining 42 percent of the shoreline of the site is partially eroded and is composed of mixed upland forest vegetation. The stabilized shoreline adjacent to the BFN facilities is primarily vegetated by young (approximately 4-to-5-year-old) black willow (*Salix nigra*), common hackberry (*Celtis occidentalis*), sumac (*Rhus* spp.), and exotic species such as Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), and trumpet creeper (*Campsis radicans*). The remainder of the shoreline just west of the facility is vegetated with a young mixed upland forest scattered with a few large, old specimens (approximately 80-plus years) of oaks and loblolly pine (*Pinus taeda*). Young plants associated with the upland forest include black locust (*Robinia pseudoacacia*), sweetgum (*Liquidambar styraciflua*), sassafras (*Sassafras albidum*), cottonwood (*Populus* spp.), elm (*Ulmus* spp.), common hackberry, and black cherry (*Prunus serotina*). Common understory vegetation in the forested area includes Chinese privet, spleenwort (*Asplenium* spp.), Virginia creeper (*Parthenocissus quinquefolia*), and poison ivy (*Toxicodendron radicans*).

Invasive exotic plant species are a concern in the area. TVA reports approximately 19 invasive species in the area with a special emphasis on Chinese privet, Japanese honeysuckle, Japanese knotweed (*Polygonum cuspidatum*), and Nepal grass (*Microstegium vimineum*) (TVA 2003).

There are approximately 10 ha (25 ac) and 5 ha (12 ac) of National Wetlands Inventory and U.S. Army Corps of Engineers-classified wetlands, respectively, occurring at the BFN site (TVA 2003). These areas include forested wetlands, emergent (marsh) wetlands, and scrub-shrub/emergent wetlands (based on 1980s aerial photography). The wetland ecological communities identified at the site are dominated by plant species that are common in the region, including black willow, buttonbush (*Cephalanthus occidentalis*), sedges (*Carex lupulina, C. vulpinoidea, Rhyncospora corniculata*), rushes (*Juncus* spp., *J. brachycarpus*), water hemlock (*Conium maculatum*), and smartweeds (*Polygonum* spp.). These wetlands occur in areas that have been previously disturbed by clearing and agriculture, and areas that are

mowed periodically. These types of wetlands commonly occur on previously disturbed former or presently used agricultural land, and the dominant vegetation species occurring within them are common in the region.

The vegetation communities described above are not unusual for the area and provide no sensitive or rare forms of wildlife habitat. Wildlife habitat on the site can be broadly classified as upland and riparian/wetland. Animal species commonly associated with upland communities include white-tailed deer (*Odocoileus virginianus*), cottontail rabbit (*Sylvilagus floridanus*), Virginia opossum (*Didelphis virginiana*), hispid cotton rat (*Sigmodon hispidus*), song sparrow (*Melospiza melodia*), eastern bluebird (*Sialia sialis*), northern mockingbird (*Mimus polyglottus*), turkey vulture (*Cathartes aura*), tufted titmouse (*Baeolophus bicolor*), American toad (*Bufo americanus*), spring peeper (*Pseudacris crucifer*), black racer (*Coluber constrictor constrictor*), and eastern box turtle (*Terrapene carolina*) (TVA 2003). Riparian communities can support a unique assemblage of wildlife including muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), raccoon (*Procyon lotor*), wood duck (*Aix sponsa*), belted kingfisher (*Ceryle alcyon*), barred owl (*Strix varia*), American woodcock (*Scolopax minor*), Carolina wren (*Thryothorus ludovicianus*), prothonotary warbler (*Protonotaria citrea*), eastern phoebe (*Sayornis phoebe*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans*), eastern newt (*Notophthalmus viridescens*), southern two-lined salamander (*Eurycea cirrigera*), common snapping turtle (*Chelydra serpentina serpentina*), and northern water snake (*Nerodia sipedon*) (TVA 2003). Some water holes along Wheeler Reservoir are used by American alligators (*Alligator mississippiensis*) in the winter. Invasive terrestrial animals that are expected to occur in the project vicinity include European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), and rock dove (*Columba livia*).

BFN is connected to the TVA system network by seven 500-kilovolt (kV) transmission lines via the 500-kV switchyard (TVA 2003). One line is to the Madison substation; two are to the Trinity substation; one line each are to the West Point, Maury, and Union substations; and one line is to the Limestone 500-kV substation. There are two additional 161-kV lines, one to the Athens substation and one to the Trinity substation. All lines occupy portions of four rights-of-way; three that terminate at the Maury, Trinity, and Athens substations, Alabama, and one that terminates at the Union substation in Union County, Mississippi (Figure 3). In all, there are approximately 257 km (160 mi) of transmission line rights-of-way associated with BFN. The rights-of-way pass through Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama, and Itawamba, Lee, Tishomingo, and Union Counties, Mississippi.[a] The Maury, Trinity, and Athens transmission line rights-of-way are found in the Eastern Highland Plain ecoregion, while the 175-km (109-mi)-long Union right-of-way traverses the Eastern Highland Plain and Transition Hills, crosses into Mississippi and passes through the Fall Line Hills, Flatwoods/Blackland Prairie Margins, and Blackland Prairie ecoregions (EPA 2004).

[a] Prentis County, Mississippi is not included. Species accounted for in adjacent counties.

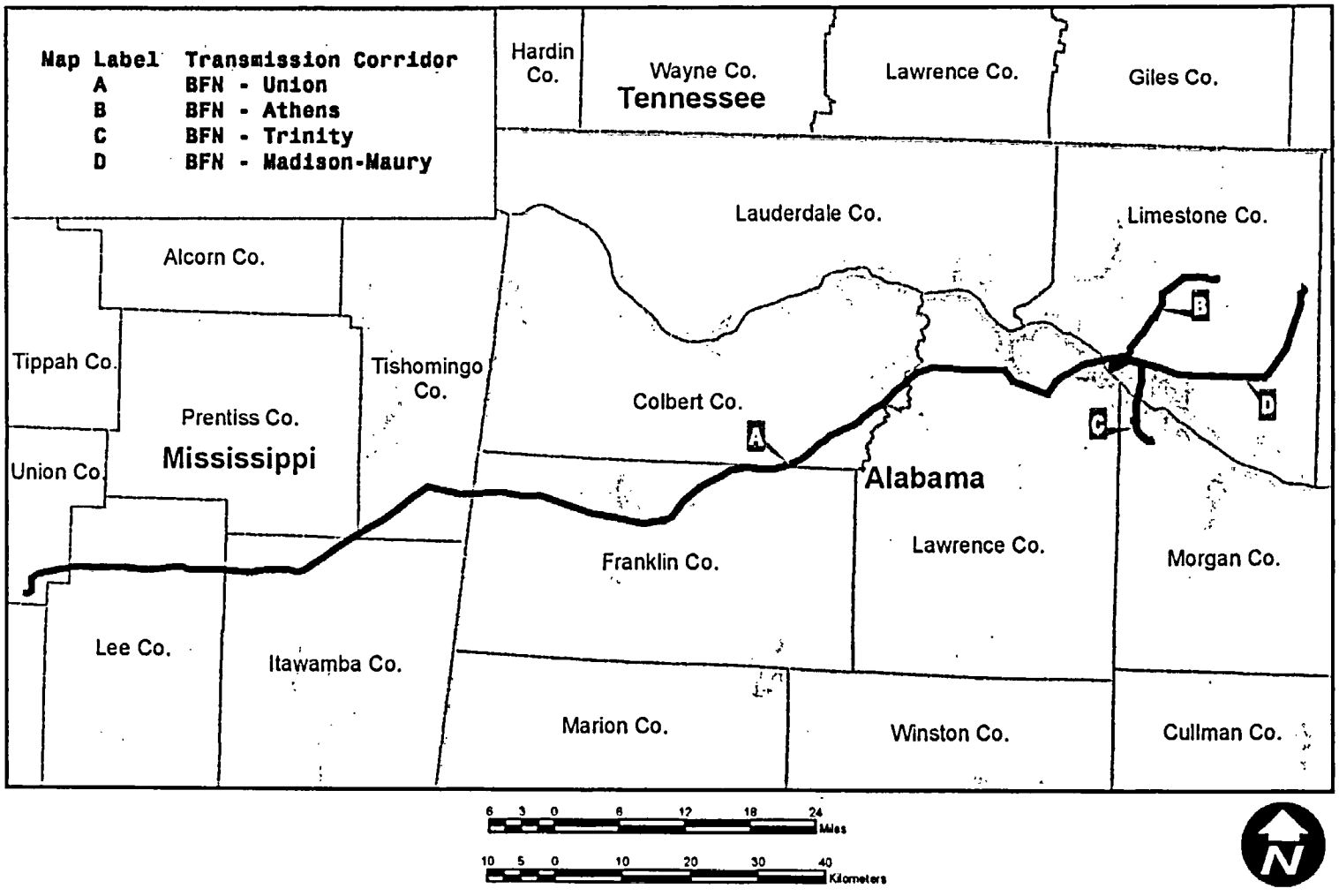


Figure 3. Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 and Its Associated Transmission Lines and Rights-of-Way

Transmission line maintenance activities are reviewed for potential resource issues by technical specialists in the TVA Regional Natural Heritage and Cultural Resources programs (Muncy et al. 1999). A 1.6-km (1.0-mi) buffer area on either side of each transmission line right-of-way is reviewed for the presence of terrestrial species, while a 16.1-km (10-mi) buffer area is used for aquatic species (TVA 2003). The TVA Regional Natural Heritage program maintains a database of more than 27,000 occurrence records for protected plants, animals, caves, National Wetland Inventory wetlands, cultural resources, and areas of management concern for the entire TVA Power Service Area. TVA also conducts fieldwork to inventory and protect threatened and endangered species and environmentally sensitive areas on public lands it administers. Activities conducted by project staff members include monitoring species populations, educating the public, and managing and maintaining habitats (including caves) at TVA-managed sites.

Transmission line rights-of-way are regularly surveyed and video taped from a helicopter. Video tapes can then be used to search for sensitive habitat types before field crews are dispatched. Access routes and restrictions for maintenance activities are determined based on knowledge of the species or resources to be protected. Vehicles and equipment are restricted from a site when habitat-sensitive resources are present (Class 2 restrictions). Within Class 2 restricted areas, all vegetation clearing and herbicide applications are done by hand. Class 1 restrictions allow hand or mechanical clearing and herbicide use for vegetation control on transmission line rights-of-way. There is no broadcast application of herbicides. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, U.S. Environmental Protection Agency (EPA) guidelines, and State regulations. The streamside management zone is maintained to (1) slow and spread surface-water flow so particulate matter will be trapped and filtered before reaching the stream channel, (2) protect stream bank integrity, and (3) protect water temperature in the stream.

4.2 Aquatic Resources

The aquatic resources in the vicinity of BFN are primarily associated with the Wheeler Reservoir portion of the Tennessee River. Wheeler Reservoir is the source and receiving body for the BFN cooling system (TVA 2003). Other aquatic habitats include several tributaries to Wheeler Reservoir: Paint Rock and Flint Rivers in the upper reach; Indian, Cotaco, and Flint Creeks in the middle reach; and Limestone, Piney, Swan, Fox, Mallard, Spring, First, and Second Creeks and the Elk River in the lower section. Elk River, the largest of these tributaries, flows into Wheeler Reservoir about 16 km (10 mi) downstream of BFN. Guntersville Reservoir is upstream of Wheeler Reservoir, while Wilson Reservoir is downstream. All three reservoirs are run-of-the-river impoundments on the Tennessee River.

The seven transmission lines located in four rights-of-way associated with BFN cross a number of streams ranging in size from small intermittent streams to the Tennessee River. Rivers and

larger streams crossed by or near the transmission lines include Limestone, Piney, Swan, Round Island, Big Nance, Town, Spring, Cedar, Little Bear, and Bear Creeks in Alabama; and Bear, Little Brown, Donivan, Twentymile, Mantachie, Mud, and Bridge Creeks and the Tennessee-Tombigbee Waterway in Mississippi. Transmission line right-of-way maintenance activities in the vicinity of stream and river crossings employ best management practices to minimize erosion and shoreline disturbance while encouraging vegetative cover (TVA 2003).

A total of 63 fish species plus hybrid sunfish, hybrid striped bass x white bass (*Morone saxatilis* x *M. chrysops*), and hybrid walleye x sauger (*Stizostedion vitreum* x *S. canadense*) were collected from 1995 through 2002 in the vicinity of BFN (TVA 2002b, 2003). A total of 72 fish species were identified in impingement samples collected between 1974 and 1977 (TVA 1978). Important commercial fish species that occur in Wheeler Reservoir include blue catfish (*Ictalurus furcatus*), channel catfish (*I. punctatus*), flathead catfish (*Pylodictis olivaris*), bigmouth buffalo (*Ictiobus cyprinellus*), smallmouth buffalo (*I. bubalus*), and common carp (*Cyprinus carpio*). Gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*D. petenense*) are the dominant forage species in Wheeler Reservoir (TVA 2003). Threadfin shad has been the dominant species numerically in Wheeler Reservoir since 1990 (Baxter and Buchanan 1998). Game fish species include largemouth bass (*Micropterus salmoides)*, smallmouth bass (*M. dolomieui*), spotted bass *(M. punctulatus*), black crappie (*Pomoxis nigromaculatus*), white crappie *(P. annularis*), bluegill (*Lepomis macrochirus*), longear sunfish (*L. megalotis*), redear sunfish (*L. microlophus*), sauger, striped bass, hybrid striped bass, yellow bass (*Morone mississippiensis*), and yellow perch (*Perca flavescens*).

Historically, 39 mussel species occurred in Wheeler Reservoir. Thirty-one of these species were considered riverine (i.e., those that evolved in free-flowing reaches), with 19 of these species now considered non-reproducing riverine species within Wheeler Reservoir (Ahlstedt and McDonough 1992). In 1982, 12 mussel species were collected during a survey for the proposed barge facility at BFN (Pryor 1982), and 11 species were collected across the river during a survey for a proposed barge terminal for the Mallard-Fox Creek Development Project (Carroll 1982). The washboard (*Megalonaias nervosa*) was the most common species collected during both surveys. It is currently the predominant species that is commercially harvested (TVA 2003). The Ohio pigtoe (*Pleurobema cordatum*) was previously the most valuable commercial species, but its numbers have decreased because of habitat alterations due to impoundment (Ahlstedt and McDonough 1992). None of the species collected were Federally or State protected.

In 1991, 24 species of mussels were collected from Wheeler Reservoir, with six species represented by weathered, empty shells (Ahlstedt and McDonough 1992). The 24 species included all species previously collected near BFN in the two 1982 collections by Pryor and Carroll. It was estimated that 460 million mussels or 2.33 mussels/m^2 (0.22 mussels/ft^2)

occurred in the reservoir in 1991 (Ahlstedt and McDonough 1992). The most common species (and estimated number within Wheeler Reservoir) collected in 1991 were the elephant-ear (*Elliptio crassidens,* 116 million), washboard (88 million), pink heelsplitter (*Potamilus alatus,* 56 million), and threehorn wartyback (*Obliquaria reflexa,* 44 million) (Ahlstedt and McDonough 1992). In addition to the habitat alteration resulting from reservoir creation, over-harvesting and periods of drought (e.g., from 1983 to 1988) may have affected reproduction and/or survival of most thick-shelled mussel species in Wheeler Reservoir (Ahlstedt and McDonough 1992). Water-quality impairments and loss of necessary fish hosts have also contributed to the decline of mussel populations. The biodiversity of mussel communities in the mainstem Tennessee River reservoirs is anticipated to continue the long-term downward trend in terms of abundance and diversity (TVA 2004a).

In 1998, 17 mussel species were collected on the east channel of Wheeler Reservoir near Hobbs Island, over 64 river kilometers (40 river miles) upstream of BFN, between TRMs 336.4 and 335.5. The two most common mussel species were the elephant-ear and the Ohio pigtoe. Two Federally endangered species were also collected: one specimen of the rough pigtoe (*Pleurobema plenum*) and 16 specimens of the pink mucket (*Lampsilis abrupta*) (Yokely 1998). In 1999, 16 native mussel species were collected in the vicinity of BFN: 14 species at TRM 298 upstream of BFN and 12 species at TRM 292 downstream of BFN. None of these were Federally listed species (TVA 2003). Eleven commercial mussel species have been reported near BFN from TRM 305 to TRM 275 (Ahlstedt and McDonough 1992).

Two areas of Wheeler Reservoir are designated as State-protected mussel sanctuaries where commercial mussel fishing is not permitted. One sanctuary extends from Guntersville Dam (TRM 349) downstream to the mouth of Shoal Creek (TRM 347); the second extends from the upstream end of Hobbs Island (TRM 337) downstream to Whitesburg Bridge (TRM 333) (TVA 2003). In the reservoir overbanks, mussels are generally spread over large areas and are not concentrated in mussel beds (TVA 2003).

5.0 Evaluation of Threatened and Endangered Species

A review of the TVA Regional Natural Heritage database indicates that no Federally listed species of animals or plants have been reported from areas within 4.8 km (3.0 mi) of the BFN site (TVA 2003). However, there are 49 species (11 terrestrial and 38 aquatic species) that are listed as threatened, endangered, or candidate species by FWS that occur, at least historically, within the portion of the Tennessee River that encompasses Wheeler Reservoir or within one or more of the counties of Alabama and Mississippi within which the BFN transmission lines are located.

5.1 Terrestrial Species

There are 11 terrestrial species that are listed as threatened or endangered by the FWS and that potentially occur in the vicinity of BFN or along the transmission line rights-of-way (Table 1). All 11 Federally listed species have been reported from counties that contain BFN transmission line rights-of-way (Table 1).

Table 1. Federally Listed and Candidate Terrestrial Species for Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama, and Itawamba, Lee, Tishomingo, and Union Counties, Mississippi, Occurring Near Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 and Along the Transmission Line Rights-of-Way.

Scientific Name	Common Name	Status[a]	County Listings		Habitat
			AL[b]	MS[c]	
Birds					
Haliaeetus leucocephalus	bald eagle	T	Fr	It Ti	Coastlines, lakes, rivers and other water bodies
Picoides borealis	red-cockaded woodpecker	E	La	--	Open pine forests, generally at least 80 to 120 years old
Mammals					
Myotis grisescens	gray bat	E	Co Fr La Li Mo	Ti	Restricted to cave or cave-like habitats. Gray bats roost and form maternity colonies in caves located along rivers and reservoirs
Myotis sodalis	Indiana bat	E	Co La Li Mo	Ti	Hibernate in caves during winter months but can be found in hollow trees and under loose tree bark during the summer
Plants					
Apios priceana	Price's potato bean	T	--	Le	Open mixed hardwood forests often on floodplains, in or near riparian areas
Asplenium scolopendrium var. *americanum*	American hart's-tongue fern	T	Mo	--	Around the openings to limestone caves and sinkholes
Dalea foliosa	leafy prairie-clover	E	Fr La Mo	--	Cedar glades in northern Alabama and central Tennessee

Table 1. (contd)

Scientific Name	Common Name	Status[a]	County Listings AL[b]	County Listings MS[c]	Habitat
Helianthus eggertii	Eggert's sunflower	T	Co Fr La Li Mo	--	Barrens habitats within the Interior Plateau Ecoregion of Kentucky, Tennessee, and Alabama
Lesquerella lyrata	lyrate bladder-pod	T	Co Fr La	--	Disturbed glade habitats
Xyris tennesseensis	Tennessee yellow-eyed grass	E	Fr	--	Moist to wet, limestone-derived soils in open or lightly wooded sites
Leavenworthia crassa	Fleshy-fruited gladecress	C	La Mo	--	Endemic to limestone glades in Lawrence and Morgan Counties

(a) Status: C = candidate, E = endangered, T = threatened;.
(b) AL counties: Co = Colbert; Fr = Franklin; La = Lawrence; Li = Limestone; Mo = Morgan;.
(c) MS counties: It = Itawamba; Le = Lee; Ti = Tishomingo; – = not listed.

Sources: FWS 2000b, 2004a; NatureServe 2004.

Bald Eagle (*Haliaeetus leucocephalus*)

The bald eagle is reported to occur in Franklin County, Alabama, and Itawamba and Tishomingo Counties, Mississippi. Bald eagles prefer habitat along coastlines, lakes, rivers and other water bodies that provide their primary food source – fish and waterfowl (NatureServe 2004). Eagles generally nest in tall trees or on cliff faces near water and away from human disturbance. Bald eagles are known in the area around BFN, but there is no known nesting habitat within 4.8 km (3.0 mi) of the site. Nesting sites on other TVA property are managed using FWS guidelines (FWS 1987a). Transmission line rights-of-way are likely to be within foraging areas for this species, particularly those that cross Wheeler Reservoir and the Tennessee-Tombigbee Waterway. The TVA reports incidents of eagle mortality associated with transmission lines but no mortality has been observed on BFN-associated lines.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts, and transmission line right-of-way maintenance activities are reviewed for potential resource issues by TVA (Muncy et al. 1999). Access routes and activity

restrictions are determined based on knowledge of the eagles in the area. Mechanical clearing and herbicide use may be used for vegetation control in transmission line rights-of-way. Access routes and activity restrictions are determined based on knowledge of the eagles in the area. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations. The staff reviewed TVA maintenance activities and determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, bald eagles.

Red-Cockaded Woodpecker (*Picoides borealis*)

The red-cockaded woodpeckers is reported to occur in Lawrence County, Alabama, but not within at least 4.8 km (3.0 mi) of the transmission line rights-of-way. Red-cockaded woodpeckers inhabit open pine forests that are at least 80 to 120 years old (NatureServe 2004). Hardwood forests, or pine forests with a hardwood understory are usually avoided. There is no woodpecker habitat within 4.8 km (3.0 mi) of BFN, and it is unlikely that there is any suitable habitat along the BFN transmission line rights-of-way.

Because there is no habitat on the BFN site or transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term will have no effect on the red-cockaded woodpecker.

Gray Bat (*Myotis grisescens*)

The gray bat is reported to occur in Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama, and in Tishomingo County, Mississippi. Gray bats are colonial and are restricted to cave or cave-like habitats (NatureServe 2004). They roost, and the females form maternity colonies in caves located along rivers and reservoirs over which they feed. During the winter, gray bats congregate and hibernate in a limited number of caves across the southeast. Although no suitable habitat for this species occurs within 4.8 km (3.0 mi) of BFN, gray bats likely forage along the Tennessee River, adjacent to the plant site. Some of the BFN transmission line rights-of-way are likely to be within foraging areas for this species.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts and transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of gray bats in the area. Mechanical clearing and herbicides may be used for vegetation control in transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

The staff reviewed TVA maintenance activities and determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the gray bat.

Indiana Bat (*Myotis sodalis*)

The Indiana bat is reported to occur in Colbert, Lawrence, Limestone, and Morgan Counties, Alabama, and in Tishomingo County, Mississippi. Indiana bats are colonial and hibernate in caves during winter months, but they can be found in hollow trees and under loose tree bark during the summer, where they form small maternity colonies (NatureServe 2004). Indiana bats forage for insects primarily in riparian and upland forests. Roosting and foraging habitat for Indiana bats is very limited on the BFN site. Water sources are composed of water lagoons, sedimentation ponds, and drainage canals, and forested habitats are primarily small woodlots of poor quality. No suitable Indiana bat habitat is known to occur within 4.8 km (3.0 mi) of the BFN site. Some of the BFN transmission line rights-of-way are likely to be within foraging areas for this species.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts, and may improve foraging habitat for Indiana bats. Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of Indiana bats in the area. Mechanical clearing and herbicides may be used for vegetation control in transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat for Indiana bats on the BFN site, and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the Indiana bat.

Price's Potato Bean (*Apios priceana*)

Price's potato bean is reported to occur in Lee County, Mississippi. This species is found in open mixed hardwood forests, often on flood plains in or near riparian areas (NatureServe 2004). Although thought to be somewhat dependent on disturbances that maintain an early successional environment, it is also reported to be sensitive to some management activities such as logging, cattle grazing, and highway rights-of-way maintenance. No populations of Price's potato bean are known to exist within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the BFN transmission line rights-of-way.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species. Transmission line rights-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of Price's potato bean in the area. Mechanical clearing and herbicide use may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat for Price's potato bean on the BFN site, and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, Price's potato bean.

American Hart's-Tongue Fern (*Asplenium scolopendrium* var. *americanum*)

American hart's-tongue fern is reported to occur in Morgan County, Alabama. In the southern portions of its range, this fern is found only around the openings to limestone caves and sinkholes (NatureServe 2004). No populations have been recorded within 4.8 km (3.0 mi) of BFN, and no suitable cave habitat has been identified along the BFN transmission line rights-of-way.

Because it does not occur at the BFN site or along BFN-associated transmission line rights-of-way, the staff has determined that continued operation of BFN over the 20-year license renewal term will have no effect on the American hart's tongue fern.

Leafy Prairie Clover (*Dalea foliosa*)

Leafy prairie clover is reported to occur in Franklin, Lawrence, and Morgan Counties, Alabama. This species is found in association with cedar glades in northern Alabama and central Tennessee. No populations of leafy prairie clover are known from within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the transmission line rights-of-way. The leafy prairie clover has been found within 4.8 km (3.0 mi) of the Union transmission line in Colbert County, Alabama (TVA 2004b).

Construction and maintenance of the transmission line rights-of-way are designed to minimize environmental impacts, and transmission line rights-of-way maintenance activities are reviewed for potential resource issues by TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of leafy prairie clover in the area. Mechanical clearing and herbicides may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

There is no habitat on the BFN site but suitable habitat could exist along a portion of the Union transmission line in Colbert County, Alabama. After reviewing the TVA maintenance activities, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the leafy prairie clover.

Eggert's Sunflower (*Helianthus eggertii*)

Eggert's sunflower is reported to occur in Colbert, Franklin, Lawrence, Limestone, and Morgan Counties, Alabama. This species is found in barrens habitat within the Interior Plateau Ecoregion of Kentucky, Tennessee, and Alabama (NatureServe 2004). No populations have been recorded within 4.8 km (3.0 mi) of BFN. Populations may occur along the BFN transmission line rights-of-way because the species is reported to respond favorably to management activities such as burning and mowing (NatureServe 2004).

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species. Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of the Eggert's sunflower in the area. Mechanical clearing and herbicides may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat on the BFN site and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the Eggert's sunflower.

Fleshy-Fruited Gladecress (*Leavenworthia crassa*)

The fleshy-fruited gladecress is listed as a candidate species by FWS and is reported to occur in Lawrence and Morgan Counties, Alabama. Reportedly endemic to Lawrence and Morgan Counties, this species inhabits limestone glades and has been identified from only six sites (NatureServe 2004). No populations have been recorded within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the BFN transmission line rights-of-way.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species. Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of fleshy-fruited gladecress in the area. Mechanical clearing and herbicide use

may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations..

Because there is no habitat on the BFN site and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the fleshy-fruited gladecress.

Lyrate Bladder-Pod (*Lesquerella lyrata*)

Lyrate bladder-pod is reported to occur in Colbert, Franklin, and Lawrence Counties, Alabama. The species in known from only two populations in Franklin and Colbert Counties (FWS 2004b). The plant is an annual in the mustard family and is found in disturbed glade habitats. No populations have been recorded within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the BFN transmission line rights-of-way.

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species. Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of lyrate bladder-pod in the area. Mechanical clearing and herbicide use may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat on the BFN site and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the lyrate bladder-pod.

Tennessee Yellow-Eyed Grass (*Xyris tennesseensis)*

Tennessee yellow-eyed grass is reported to occur in Franklin County, Alabama. This species is found in moist-to-wet, limestone-derived soils in open or lightly wooded sites (NatureServe 2004). No populations are known to exist within 4.8 km (3.0 mi) of BFN, but suitable habitat could be found along the BFN transmission line rights-of-way. It has been found within 4.8 km (3.0 mi) of the Union transmission line in Franklin County, Alabama (TVA 2004b).

Construction and maintenance of transmission line rights-of-way are designed to minimize environmental impacts (Muncy et al. 1999), and may improve habitat for this species.

Transmission line right-of-way maintenance activities are reviewed for potential resource issues by the TVA (Muncy et al. 1999). Access routes and activity restrictions are determined based on knowledge of Tennessee yellow-eyed grass in the area. Mechanical clearing and herbicides may be used for vegetation control on transmission line rights-of-way. Herbicide application is carefully controlled and personnel who apply the herbicides are trained, licensed, and follow manufacturer's guidelines, EPA guidelines, and State regulations.

Because there is no habitat on the BFN site and after reviewing the TVA maintenance activities, which may improve habitat along transmission line rights-of-way, the staff determined that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the Tennessee yellow-eyed grass.

5.2 Aquatic Species

A total of 38 Federally listed aquatic species on the FWS website are identified as potentially occurring in the project area (i.e., Wheeler Reservoir or in streams crossed by transmission line rights-of-way associated with the BFN site). Nine of these species have a reasonable potential of occurring in the project area and are discussed in Section 5.2.1 below. The remaining 29 species are only briefly discussed in Section 5.2.2 because of presumed extinction or extripation from the project area, no recent records of collection, or because the habitat of the project area is clearly unsuitable for the species.

5.2.1 Species Potentially Occurring in the Project Area

Nine aquatic species are listed as threatened, endangered, or candidate species by FWS and have a reasonable potential to occur in the project area (i.e., Wheeler Reservoir or within streams crossed by the transmission lines associated with BFN) (Table 2).

Anthony's Riversnail (*Athearnia anthonyi*)

Anthony's riversnail is Federally listed as endangered throughout its entire range (FWS 1994), except where proposed for establishment as a nonessential experimental population in the free-flowing reach of the Tennessee River from the base of Wilson Dam downstream to the back-waters of Pickwick Reservoir (about 19 km [12 mi]) and the lower 8 km (5 mi) of all tributaries to this reach in Colbert and Lauderdale Counties, Alabama (FWS 2001). It was known to occur in Alabama, Georgia, and Tennessee. It has been extirpated from most of its historic range due to pollution, siltation, and habitat modification or destruction. Many populations were lost when the Tennessee River and the lower reaches of its tributaries were impounded (FWS 1994). Only two populations of Anthony's riversnail are known to survive. The largest of these occurs in the Tennessee River, Jackson County, Alabama, and Marion County, Tennessee, a short distance downstream of Nickajack Dam. This population also extends a short distance into the

Table 2. Federally Listed and Candidate Aquatic Species Potentially Occurring in Wheeler Reservoir or Streams Crossed by the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Transmission Line Rights-of-Way.

Scientific Name	Common Name	Status[a]	County Listings[b] AL	County Listings[b] MS	Habitat
Snails					
Athearnia anthonyi	Anthony's riversnail	E	Co Li	--	Large rivers and lower reaches of large creeks on cobble/boulder substrates near riffles.
Campeloma decampi	slender campeloma	E	Li	--	Large creeks in soft sediments (sand or mud) or detritus.
Pyrgulopsis pachyta	armored snail	E	Li	--	Shallow, still water along the edge of pools on tree roots and detritus of creeks.
Mussels					
Cumberlandia monodonta	spectaclecase	C	Co La Li Mo	--	Large rivers with swiftly flowing water, among boulders in patches of sand, cobble, or gravel in areas where current is reduced.
Epioblasma brevidens	Cumberlandian combshell	E	Co Fr Li	Ti	Coarse sand to mixtures of gravel, cobble and boulder-sized rocks in medium to large rivers; tends to occur at depths less than 1m (3 ft).
Lampsilis abrupta	pink mucket	E	Co La Li Mo	--	Larger rivers in gravel or sand.
Lexingtonia dolabelloides	slabside pearlymussel	C	Co Fr Li	Ti	Moderate to high gradient riffles in medium to large rivers.
Pleurobema plenum	rough pigtoe	E	Co La Li Mo	--	Medium to large rivers in sand or gravel.
Fish					
Etheostoma boschungi	slackwater darter	T	Li	--	Gravel-bottomed pools and runs of creeks and small rivers.

(a) Co = Colbert; Fr = Franklin; It = Itawamba; La = Lawrence; Li = Limestone; Mo = Morgan; Ti = Tishomingo; – = not listed.

(b) Status: C = candidate, E = endangered, T = threatened.

Sources: ADCNR 2003; Cummings and Mayer 1992; FWS 1990b, 2000b, 2004c; Johnson and Wehrle 2004; MMNS 2002; MNHP 2002; NatureServe 2004; NCWRC 2004; Page and Burr 1991; TVA 2003, 2004a.

lower section Sequatchie River, Marion County, Tennessee (FWS 1997b). This population occurs well upstream from the BFN site. The other surviving population is restricted to a relatively short reach of lower Limestone Creek, Limestone County, Alabama (FWS 1997b). Limestone Creek is crossed at three locations by a BFN transmission line and is closely paralleled by the transmission line along two stream segments (TVA 2004b). However, the BFN transmission line does not cross or parallel the lower section of Limestone Creek where the snail is known to occur. Anthony's riversnail inhabits large rivers and the lower reaches of larger creeks, occurring on cobble/boulder substrates in the vicinity of riffles. However, it does not always occur in strongly flowing sections (NatureServe 2004). At the two sites in Limestone Creek where Anthony's riversnail is known to occur, its density reaches several hundred individuals per square meter. However, both Sequatchie and Limestone Creeks have been severely impacted in the past, and continue to be impacted, by siltation and other sources of pollution (e.g., pesticide spraying and mining effluents). A single catastrophic pollution event could potentially destroy all populations of the snail within a creek (FWS 1994, 1997b). A recovery plan for Anthony's riversnail has been prepared (FWS 1997b).

The staff visited the site and reviewed the life history information about Anthony's riversnail. Based on this information, and that previously described for the TVA transmission line rights-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, Anthony's riversnail.

Slender Campeloma (*Campeloma decampi*)

The slender campeloma is Federally listed as endangered throughout its entire range (FWS 2000a). It is known to occur in only several isolated populations along Limestone, Piney, and Round Island Creeks in northern Alabama (NatureServe 2004). All three creeks are crossed by BFN transmission lines. Piney Creek is crossed once, while Round Island and Limestone Creeks are each crossed three times. Segments of Round Island and Limestone Creeks are also closely paralleled by the transmission lines. The slender campeloma has been found within 4.8 km (3.0 mi) of the Trinity, Maury, and Athens transmission lines in Limestone County, Alabama (TVA 2004b). The slender campeloma typically burrows in soft sediment or detritus. Impacts to slender campeloma include siltation and other pollutants from poor land-use practices and waste discharges (FWS 2000a).

The staff visited the site and reviewed the life history information about the slender campeloma. On the basis of this information and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the slender campeloma.

Armored Snail (*Pyrgulopsis pachyta*)

The armored snail (or armored marstonia) is Federally listed as endangered throughout its entire range (FWS 2000a). It is known to occur in Alabama from several isolated sites in Limestone and Piney Creeks near Mooresville, Alabama (NatureServe 2004). Piney Creek was formerly a tributary of Limestone Creek before the construction of Wheeler Reservoir (NatureServe 2004). The BFN transmission lines cross both of these streams. BFN transmission lines cross Limestone Creek at three locations and closely parallels along two segments of the creek. Both streams are crossed several miles upstream from Mooresville. The armored snail has been collected within 4.8 km (3.0 mi) of the Maury transmission line in Limestone County, Alabama (TVA 2004b). The armored snail is found in shallow, still water along the edge of pools on tree roots and detritus. It probably also occurs on mud (NatureServe 2004). Impacts to the armored snail include siltation and other pollutants from poor land-use practices and waste discharges (FWS 2000a).

The staff visited the site and reviewed the life history information about the armored snail. On the basis of this information and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the armored snail.

Spectaclecase (*Cumberlandia monodonta*)

The spectaclecase is a candidate for Federal listing. Its historic range includes Alabama, Arkansas, Iowa, Indiana, Illinois, Kentucky, Missouri, Nebraska, Ohio, Tennessee, Virginia, and Wisconsin (FWS 2004c). It has been largely reduced to a relatively few disjunct sites. The mussels at some of the sites may no longer be capable of reproduction because of loss of fish hosts or adverse environmental conditions (e.g., hypolimnetic releases from reservoirs) (NatureServe 2004). In Alabama, the spectaclecase is known from Limestone and Morgan Counties. The spectaclecase is usually found in areas with a strong current. In medium-sized rivers, it prefers coarse substrates such as cobble, gravel, or cracks in bedrock. In large rivers, substrates used are typically finer and include sand or mud. The spectaclecase may be associated with shoals, bars, and islands (NatureServe 2004). It is often found in small clusters of the same-aged individuals (NatureServe 2004). Fish hosts for the spectaclecase are unknown (Schulz and Marbain 1998). Live specimens have been collected in the main stem of the Tennessee River in Colbert, Lauderdale, Limestone, and Morgan Counties as recently as 2000. Recent collections in the mainstem of the Tennessee River have been made in the tailwaters downstream of dams. Weathered shells were collected in the Elk River, Limestone County, Alabama, in 1998 and 1974 (Butler 2002).

The staff visited the site and reviewed the life history information about the spectaclecase. On the basis of this information and information previously described for the TVA transmission line

right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the spectaclecase.

Cumberlandian Combshell (*Epioblasma brevidens*)

The Cumberlandian combshell is Federally listed as endangered throughout its entire range (FWS 1997a), except where proposed for establishment as a nonessential experimental population in the free-flowing reach of the Tennessee River from the base of Wilson Dam downstream to the backwaters of Pickwick Reservoir (about 19 km [12 mi]) and the lower 8 km (5 mi) of all tributaries to this reach in Colbert and Lauderdale Counties, Alabama (FWS 2001). A draft recovery plan has been prepared for the species (FWS 2003). The Cumberlandian combshell is known to occur in Alabama, Kentucky, Tennessee, and Virginia (FWS 1997a). The Cumberlandian combshell is now restricted to populations in limited areas of five drainages, and some of these may no longer be reproducing. The species was eliminated from much of its historic range by impoundments. Existing populations are in decline due to pollution (especially from mining activities), impoundments, and siltation (FWS 1997a). It was last collected from Muscle Shoals (the area now incorporated within the upper reaches of Pickwick Reservoir through Wilson Reservoir and into Wheeler Reservoir) in 1925 (Garner 1997). The Cumberlandian combshell is typically associated with riffle and shoal areas in medium and large rivers in substrates of coarse sand to cobble. It has been apparently eliminated from the main stem of the Tennessee and Cumberland Rivers (FWS 2004d). In Alabama, moribund specimens were found in the late 1990s in Bear Creek, a tributary of the Tennessee River (NatureServe 2004). Fish hosts for the Cumberlandian combshell include darters and sculpins (Schulz and Marbain 1998). Critical habitat has been designated for the species within the Tennessee and Cumberland River basins, including a portion of Bear Creek that flows through Colbert County, Alabama, and Tishomingo County, Mississippi (FWS 2004d). One of the BFN transmission lines crosses Bear Creek in Tishomingo County, Mississippi, within the proposed reach of critical habitat.

The staff visited the site and reviewed the life history information about the Cumberlandian combshell. On the basis of this information, information previously provided on the aquatic resources within the Wheeler Reservoir, and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the Cumberlandian combshell.

Pink Mucket (*Lampsilis abrupta*)

The pink mucket is Federally listed as endangered throughout its entire range (FWS 1976). It is known to occur in Alabama, Arkansas, Illinois, Indiana, Kentucky, Louisiana, Missouri, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia (NatureServe 2004). It is apparently

surviving and reproducing in river segments that have been altered by impoundments; however, its range has diminished (e.g., it has been extirpated from Ohio, Pennsylvania, and Illinois) (NatureServe 2004). Within Alabama, the pink mucket occurs in Colbert, Lauderdale, Limestone, Madison, Marshall, and Morgan Counties (NatureServe 2004). Suitable hosts for the glochidia of the pink mucket include freshwater drum, largemouth bass, smallmouth bass, spotted bass, sauger, and walleye (Fuller 1974; Barnhart et al. 1997). Use of mostly piscivorous hosts by this mussel is consistent with the display of a relatively large fish-like lure used by the mussel to attach hosts (Barnhart et al. 1997). The pink mucket inhabits areas of large rivers with swift currents at depths ranging from 0.5 to 8.0 m (1.6 to 26.2 ft) and mixed sand/gravel/cobble substrate (Barclay 2004). They are generally collected in the tailwater areas downstream from the Tennessee River drainage dams (Barclay 2004). Therefore, it is unlikely that the pink mucket exists in Wheeler Reservoir in the areas near or downstream from BFN. The pink mucket has been found within 4.8 km (3.0 mi) of the Union transmission line in Lawrence County, Alabama (TVA 2004b). Sixteen specimens of the pink mucket were collected near Hobbs Island (over 64 km [40 mi] upstream of BFN) in 1998 (Yokely 1998). Past and ongoing threats to the pink mucket include habitat loss and modification from dams and dredging, water quality degradation, and commercial over-harvesting (NatureServe 2004). The zebra mussel would also pose a threat to the pink mucket in areas where they co-exist.

The staff visited the site and reviewed the life history information about the pink mucket. On the basis of this information, information previously provided on the aquatic resources in Wheeler Reservoir, and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the pink mucket.

Slabside Pearlymussel (*Lexingtonia dolabelloides*)

The slabside pearlymussel is a candidate for Federal listing. Its historic range includes Alabama, Kentucky, Tennessee, and Virginia (FWS 2004c). Most surviving individuals are restricted to two or three populations; and the long-term viability of all extant occurrences is questionable (NatureServe 2004). It historically occurred in the Cumberland River, although it is now extirpated from the entire Cumberland River system. The slabside pearlymussel was once prevalent in the Tennessee River system. Historically, it was fairly common from Muscle Shoals (the area is now incorporated within the upper reaches of Pickwick Reservoir through Wilson Reservoir and into Wheeler Reservoir) to the Tennessee River headwater tributaries in Virginia and the Duck River drainage. It was last collected from Muscle Shoals in 1963 (Garner 1997). Remaining populations occur in a number of tributary streams of the Tennessee River system, but not in the main stem of the Tennessee River (NatureServe 2004). Bear Creek is the only one of these streams that is crossed by a BFN transmission line. Fish hosts for the slabside pearlymussel include the smallmouth bass and, possibly, various minnow species (Schulz and Marbain 1998). Threats to the species include channel alterations, impoundments, siltation, pollution, commercial clamming, and gravel and coal mining (NatureServe 2004). It is

generally found in areas of moderate to swift current velocities with substrates ranging from coarse sand to heterogenous assemblages of larger-sized particles (NatureServe 2004).

The staff visited the site and reviewed the life history information about the slabside pearlymussel. On the basis of this information, information previously provided on the aquatic resources within the Wheeler Reservoir, and information previously described for the TVA transmission line rights-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the slabside pearlymussel.

Rough Pigtoe (*Pleurobema plenum*)

The rough pigtoe is Federally listed as endangered throughout its entire range (FWS 1976). It has a wide, but very fragmented, distribution in Alabama, Indiana, Kentucky, Pennsylvania, Tennessee, and Virginia (NatureServe 2004). The distribution of the rough pigtoe in Alabama includes Colbert, Lauderdale, Limestone, and Morgan Counties. Within the Tennessee River, the rough pigtoe is currently present in tailwaters downstream of Pickwick, Wilson, and Guntersville Dams (NatureServe 2004). The rough pigtoe occurs in medium to large rivers in sand, gravel, and cobble substrates in shoals, although it is occasionally found on flats and muddy sand (NatureServe 2004). It does not occur in the impounded sections of rivers (FWIE 1996). Therefore, it is unlikely that the rough pigtoe exists in Wheeler Reservoir in the areas near or downstream from BFN. One specimen was collected near Hobbs Island (over 64 km [40 mi] upstream of BFN) in 1998 (Yokely 1998). Possible host fish for the rough pigtoe are bluegill and rosefin shiner (*Lythrurus ardens*) (Schulz and Marbain 1998). The long-term viability of most populations is in jeopardy, particularly for those in large rivers where zebra mussels are established (NatureServe 2004). Other threats to the rough pigtoe include impoundments, channelization, dredging, industrial and residential discharges, siltation, herbicide and fertilizer run-off, loss of fish hosts, and natural predators (NatureServe 2004).

The staff visited the site and reviewed the life history information about the rough pigtoe. On the basis of this information and information previously described for the TVA transmission line right-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the rough pigtoe.

Slackwater Darter (*Etheostoma boschungi*)

The slackwater darter is Federally listed as threatened throughout its entire range (FWS 1977b). Critical habitat was also designated for the species (FWS 1977b). It is known to occur in Alabama and Tennessee. The slackwater darter occupies five tributaries of the Tennessee River: Buffalo River and upper Shoal Creek in Lawrence County, Tennessee; Flint River, Madison County, Alabama; Swan Creek, Limestone County, Alabama, and Cypress Creek, Lauderdale County, Alabama (NatureServe 2004). Swan Creek is crossed by the Maury

transmission line. The slackwater darter has been found within 4.8 km (3.0 mi) of the Trinity and Maury transmission lines in Limestone County, Alabama (TVA 2004b). Critical habitat for the slackwater darter includes many of the permanent and intermittent streams that are tributaries to Cypress Creek in Lauderdale County, Alabama, and Wayne County, Tennessee (FWS 1977b). None of these streams are located near BFN transmission lines. The slackwater darter typically occurs in gravel-bottomed pools in sluggish areas of creeks and small rivers that are not more than 12 m (39 ft) wide and 2 m (6.6 ft) deep. They often inhabit slow waters beneath undercut banks or accumulations of leaf litter or detritus. Spawning occurs in very shallow (5 to 10 cm [2 to 4 in.]) clear, flowing seepage water characterized by the presence of *Juncus* spp. and *Eleocharis* spp. in fields and open woods. Threats to the species include habitat loss and degradation. In some locations, the heavy use of groundwater causes seepage areas used for spawning to dry up (NatureServe 2004).

The staff visited the site and reviewed the life history and distribution of the slackwater darter. On the basis of this information and information provided by TVA, the staff concludes that continued operation of BFN over the 20-year license renewal term may affect, but is not likely to adversely affect, the slackwater darter.

5.2.2 Additional Aquatic Species

In addition to the nine species discussed above, there are 29 additional Federally listed aquatic species (including one candidate species) whose distribution includes, or historically included, the Wheeler Reservoir portion of the Tennessee River or other streams, rivers, or caves within the counties of Alabama and Mississippi within which the BFN transmission lines occur (Table 3). However, these 29 species would not currently be expected to occur within Wheeler Reservoir near or downstream of BFN (i.e., the portions of the Tennessee River that could be affected by BFN operations) or within the streams crossed by the transmission lines associated with BFN. The rationale for this determination is based on the following: (1) the species are presumed extinct; (2) the species are presumed to be extirpated from the region; (3) there are no recent records of the species in the BFN project area; (4) there are no collection records for the species from pertinent locations; and/or (5) project areas of concern do not have appropriate habitat for the species (e.g., county records are for streams or caves that are not crossed by the BFN transmission lines). The notes column of Table 3 provides the rationale for each species. The staff reviewed the design, operation, and location of the intake and discharge structures at BFN and the impingement and entrainment data collected during plant operation. The staff also visited the site and reviewed the life history information about these 29 species. On the basis of this information, information previously provided on the aquatic resources within the Wheeler Reservoir, and information previously described for the TVA transmission line rights-of-way maintenance procedures, the staff concludes that continued operation of BFN over the 20-year license renewal term would have no effect on these species. Therefore, these species are not evaluated in any detail in this BA.

Table 3. Federally Listed Aquatic Species in Northwestern Alabama and Northeastern Mississippi that are Considered Unlikely to be Present Near the Browns Ferry Nuclear Power Plant, Units 1, 2, and 3 Site or Its Transmission Line Rights-of-Way.

Scientific Name (Common Name)	Status[b]	County Listings[a] AL	MS	Notes
		Mussels		
Cyprogenia stegaria (fanshell)	E	Co	--	Relatively deep water in gravelly substrates with moderate currents in medium to large rivers. Last collected in Muscle Shoals[c] circa 1976 to 1978. Live specimen last reported from Wheeler Reservoir in 1979. Possibly extirpated from Alabama.
Dromus dromas (dromedary pearlymussel)	E	Co Li Mo	--	Sand and gravel substrates in riffles and shoals of medium to large rivers. Last collected in Muscle Shoals in 1931. Only current Tennessee River records are from Meigs County, Tennessee. Possibly extirpated from Alabama.
Epioblasma capsaeformis (oyster mussel)	E	Co	--	Usually in small- to medium-sized rivers in substrates of coarse sand to boulder substrates in moderate to swift currents. Last collected from Muscle Shoals circa 1925. No longer present in the mainstem of the Tennessee River. Presumed extirpated from Alabama.
Epioblasma florentina florentina (yellow-blossom pearlymussel)	E	Co	--	Riffle and shoal areas of small-sized to medium-sized streams. Last collected from Muscle Shoals circa 1925. Not collected anywhere since 1970. Possibly extinct.
Epioblasma florentina walkeri (tan riffleshell)	E	Li	--	Headwaters, riffles, and shoals in sand and gravel substrates. Only one reproducing population known (Indian Creek of the upper Clinch River, Virginia). Presumed extirpated from Alabama.
Epioblasma penita (Southern combshell)	E	--	It	Riffles or shoals of medium-sized rivers with sandy gravel to gravel-cobble substrates in moderate to swift current. Currently limited to the East Fork Tombigbee River, Sipsey River, and Buttahatchie River, well south of the BFN project area. Presumed extripated from Alabama.
Epioblasma torulosa torulosa (tubercled blossom pearlymussel)	E	Co Li Mo	--	Sandy gravel substrates in riffles and shoals in rapid currents of medium to large rivers. Last collected from Muscle Shoals in 1931. Presumed extirpated from Alabama, species possibly extinct.
Epioblasma turgidula (turgid blossom pearlymussel)	E	Co Fr	--	Sand and gravel substrates of shallow, fast-flowing streams. Last collected from Muscle Shoals circa 1925. Not collected anywhere since the mid-1960s, possibly extinct.

Table 3. (contd)

Scientific Name (Common Name)	Status[b]	County Listings[a] AL	County Listings[a] MS	Notes
Fusconaia cor (shiny pigtoe)	E	Co	--	Shoals and riffles in clear streams with moderate to fast current. Last collected from Muscle Shoals circa 1925. No recent collections from the Tennessee River or its tributaries that are crossed by the BFN transmission lines. Currently exists in the North Fork of the Holston River, the Clinch and Powell Rivers in Tennessee, and in the Paint Rock River in Alabama.
Fusconaia cuneolus (finerayed pigtoe)	E	Fr Li	--	Firm cobble and gravel substrates of clear, high-gradient streams. Last collected from Muscle Shoals circa 1925. No recent collections from the Tennessee River or its tributaries that are crossed by the BFN transmission lines. Currently persists in Clinch and Powell Rivers, the North Fork of the Holston River, and in the Paint Rock River.
Hemistena lata (cracking pearlymussel)	E	Co Li	--	Sand, gravel and cobble substrates in swift currents or mud and sand in slower currents of medium to large rivers. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama. May exist in the Clinch River, Tennessee.
Lampsilis perovalis (orangenacre mucket)	T	--	It	Medium and large rivers in gravel/cobble or gravel/coarse sand substrates. Survives in a few Tombigbee, Black Warrior, and Alabama River tributaries well south of the BFN transmission lines.
Lampsilis virescens (Alabama lampmussel)	E	Co Fr	--	Sand and gravel substrates in shoal areas of medium to large rivers. Last collected from Muscle Shoals circa 1925. Extirpated from most of its range. Only one live specimen found in recent years from Paint Rock River drainage in Jackson County, Alabama, well upstream from the BFN project area.
Lemiox rimosus (birdwing pearlymussel)	E	Co Li	--	Riffle areas with sand and gravel substrates in moderate to fast currents of creeks to medium-sized rivers. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama. Only a few known occurrences in the Clinch, Powell, Elk, and Duck Rivers in Tennessee and Virginia.

Table 3. (contd)

Scientific Name (Common Name)	Status[b]	County Listings[a] AL	County Listings[a] MS	Notes
Obovaria retusa (ring pink)	E	Co Li Mo	--	Gravel and sand bars of large rivers. Last collected from Muscle Shoals in 1992. Empty shells collected from Wheeler Reservoir in 1991. Possibly extirpated from Alabama.
Plethobasus cicatricosus (white wartyback pearlymussel)	E	Co	--	Gravel substrates of large rivers. No living specimens found in the Tennessee River since the 1960s, although fresh dead specimens collected in 1979 and 1982 downstream of Pickwick Dam near Savannah, Tennessee. Possibly extinct.
Plethobasus cooperianus (orangefoot pimpleback)	E	Co Li Mo	--	Sand, gravel, and cobble substrates in riffles and shoals in deep water and steady current of large rivers. Last collected from Muscle Shoals in 1978. Possibly extirpated from Alabama.
Pleurobema clava (clubshell)	E	Co	--	Medium to large rivers in clean gravel or mixed gravel and sand. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama.
Pleurobema curtum (black clubshell)	E	--	It	Sandy gravel to gravel-cobble substrates in riffles and shoals with moderate to fast currents in medium to large rivers. Current range limited to the East Fork Tombigbee River. Possibly extinct.
Pleurobema decisum (southern clubshell)	E	--	It	Sand and gravel substrates of medium to large rivers. Very few viable populations occur in the Sipsey River (Tombigbee River drainage), Chewacla Creek (Tallapoosa River drainage), and the Conasauga River (upper Coosa River drainage); all three waterbodies located well outside the BFN project area. It does not occur in the Tennessee River drainage.
Pleurobema perovatum (ovate clubshell)	E	--	It	Moderate gradient pools and riffles of medium to large rivers. Currently found in Tombigbee River tributaries and Chewacla Creek in the Tallapoosa River drainage. It does not occur in the Tennessee River drainage.
Pleurobema taitianum (heavy pigtoe)	E	--	It	Riffles and shoals on sandy gravel to gravel-cobble substrates in areas of moderate to fast currents of medium to large rivers. Not known from the Tennessee River drainage. Currently only found in the Alabama River in Dallas and Lowndes Counties, Alabama.

Table 3. (contd)

Scientific Name (Common Name)	Status[b]	County Listings[a] AL	MS	Notes
Ptychobranchus subtentum (fluted kidneyshell)	C	Li	--	Small to medium rivers in areas with swift current or riffles; larger rivers in shoal areas. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama.
Quadrula intermedia (Cumberland monkeyface)	E	Co Li	--	Sand and gravel substrates in shallow riffle and shoal areas of headwater streams to bigger rivers at depths to 0.6 m (2 ft). Last collected from Muscle Shoals circa 1925. Possibly extirpated from Alabama.
Toxolasma cylindrellus (pale lilliput)	E	Co	--	Firm rubble, gravel, and sand substrates in shallow riffles and shoals of clean, fast-flowing streams. Currently known only from the Paint Rock River drainage in Jackson County, Alabama, well upstream from the BFN project area.
Villosa trabalis (Cumberland bean)	E	Mo	--	Sand, gravel, and cobble substrates in waters of moderate to swift currents and depths less than 1m (3 ft) in medium to large rivers. Last collected from Muscle Shoals circa 1925. Presumed extirpated from Alabama.
		Shrimp		
Palaemonias alabamae (Alabama cave shrimp)	E	Co	--	Silt-bottom pools in caves. Currently known to occur in two caves in Madison County, Alabama. No BFN transmission lines occur near these caves.
		Fishes		
Cyprinella monacha (spotfin chub)	E	Co	--	Rocky riffles and runs of clean small to medium riffles. Currently only known to exist in Tennessee and North Carolina. It is possibly extirpated from Alabama.
Etheostoma wapiti (boulder darter)	E	Li	--	Fast, rocky riffles of small to medium rivers. Presently restricted to the Elk River in Tennessee and Alabama, and Richland and Indian Creeks in Giles County, Tennessee. No BFN transmission lines cross these waterbodies.

(a) Co = Colbert; Fr = Franklin; It = Itawamba; La = Lawrence; Li = Limestone; Mo = Morgan. Ti = Tishomingo; – = not listed.
(b) Status: C = candidate, E = endangered, T = threatened.
(c) Muscle Shoals is the area now incorporated within the upper reach of Pickwick Reservoir, through Wilson Reservoir, and into Wheeler Reservoir.

Sources: ADCNR 2003; Ahlstedt and McDonough 1992; Cummings and Mayer 1992; FWS 1976, 1977a, b, 1987b, 1988a, b, 1989a, b, 1990a, b, c, 1993a,b, 1997a, 2000b, 2004c; Garner 1997; Johnson and Wehrle 2004; MMNS 2002; MNHP 2002; NatureServe 2004; NCWRC 2004; Page and Burr 1991; Rogers et al. 2001; TVA 2003, 2004a.

6.0 Conclusions

The staff identified nine terrestrial and nine aquatic species listed as threatened, endangered, or candidate under the Endangered Species Act that have a reasonable potential to occur in the vicinity of BFN or along the transmission line rights-of-way (including Wheeler Reservoir near and downstream of BFN and within streams crossed by the BFN transmission lines). Two terrestrial species were evaluated and determined that they would not occur in the project area. In addition, 29 aquatic species listed by FWS were identified by the staff as having no reasonable potential to occur in the project areas and were not evaluated in detail.

None of the terrestrial or aquatic species are known to inhabit areas within 4.8 km (3.0 mi) of BFN. The transmission line rights-of-way may cross or contain suitable habitat for some of these species, including designated critical habitat for the Cumberlandian combshell. Given this possibility, TVA has designed and implemented maintenance procedures for its transmission line rights-of-way that protect listed species and their habitats.

The staff determined that license renewal for BFN would have no effect on the red-cockaded woodpecker, the American hart's tongue fern, and 29 of the aquatic species. License renewal may affect, but is not likely to adversely affect, the bald eagle, gray bat, Indiana bat, Price's potato bean, leafy prairie clover, Eggert's sunflower, fleshy-fruited gladecress, lyrate bladder pod, Tennessee yellow-eyed grass, Anthony's riversnail, slender campeloma, armored snail, spectaclecase, Cumberlandian combshell, pink mucket, slabside pearlymussel, rough pigtoe, and the slackwater darter.

7.0 References

10 CFR Part 51. Code of *Federal Regulations*, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Regulatory Requirements."

10 CFR Part 54. Code of *Federal Regulations*, Title 10, *Energy*, Part 51, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Ahlstedt, S. A. and T. A. McDonough. 1992. "Quantitative Evaluation of Commercial Mussel Populations in the Tennessee River Portion of Wheeler Reservoir of Wheeler Reservoir, Alabama." Tennessee River Authority, Norris and Knoxville, Tennessee. Available on the Internet under Accession No. ML041530161, May 27, 2004 at http://www.nrc.gov/reading-rm/adams.html.

Alabama Department of Conservation and Natural Resources (ADCNR). 2003. "County-by-County Listing of Alabama Species on the Federal List for Threatened and Endangered Species or Whose Status Is a Concern." Alabama Department of Conservation and Natural Resources, Montgomery, Alabama. Accessed on the Internet, March 25, 2004 at http://dcnr.state.al.us/watchable-wildlife/regulations/endangered-county.cfm.

Alabama Department of Environmental Management (ADEM). 2003. NPDES Permit Modification Rationale Fact Sheet. Revised August, 13, 2003, Montgomery, Alabama.

Atomic Energy Act of 1954. 42 USC 2011, et seq.

Barclay, L. A. 2004. *Biological Opinion of the Tennessee Valley Authority's Proposed Reservoir Operation Study.* U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office, Cookville, Tennessee.

Barnhart, M. C., F. A. Riusech, and A. D. Roberts. 1997. "Fish Hosts of the Federally Endangered Pink Mucket, *Lampsilis abrupta.*" Triannual Unionid Report No. 13. Accessed on the Internet, January 19, 2004 at http://ellipse.inhs.uiuc.edu/FMCS/TUR/TUR13.html.

Baxter, D. S. and J. P. Buchanan. 1998. *Browns Ferry Nuclear Plant Thermal Variance Monitoring Program Including Statistical Analyses. Final Report.* Tennessee Valley Authority, Water Management Environmental Compliance. Available on the Internet under ADAMS Accession No. ML041530161, May 27, 2004, at http://www.nrc.gov/reading-rm/adams.html.

Butler, R. S. (Leader). 2002. "Status Assessment Report for the Spectaclecase, *Cumberlandia monodonta*, Occurring in the Mississippi River System (U.S. Fish and Wildlife Service Regions 3, 4, 4, and 6)." U.S. Fish and Wildlife Service, Ohio River Valley Ecosystem Team, Mollusk Subgroup, Asheville, North Carolina. Accessed on the Internet, January 20, 2004 at http://midwest.fws.gov/endangered/clams/spectaclecase-sa.pdf.

Carroll, B. B. 1982. Letter from B. B. Carroll, Chief, Fisheries and Aquatic Ecology Branch, Division of Water Resources, to L. W. Colaw, Assistant Director, Industrial Development, Office of Economic and Community Development, Subject: "Mallard-Fox Mussel Survey - Report." September 30, 1982. Available on the Internet under ADAMS Accession No. ML041530161, May 27, 2004, at http://www.nrc.gov/reading-rm/adams.html.

Cummings, K. S. and C. A. Mayer. 1992. "Field Guide to Freshwater Mussels of the Midwest. Illinois Natural History Survey, Manual 5." Illinois Natural History Survey, Urbana, Illinois. Accessed on the Internet, March 15, 2004 at http://www.inhs.uiuc.edu/chf/pub/mussel_man/cover.html.

Endangered Species Act of 1973. 16 USC 1531, et seq.

Fish and Wildlife Information Exchange (FWIE). 1996. "Endangered Species Information System." Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Accessed on the Internet, May 20, 2004 at http://fwie.fw.vt.edu/WWW/esis/index.html.

Fuller, S. L. H. 1974. "Clams and Mussels (Mollusca: Bivalvia)." In *Pollution Ecology of Freshwater Invertebrates,* Hart, C. W., Jr. and S. L. H. Fuller (eds.), Chapter 8, Academic Press, Inc.

Garner, J. T. 1997. "Mussels of Muscle Shoals." *Triannual Unionid, Report* Number 13. Accessed on the Internet, March 25, 2004 at http://ellipse.inhs.uiuc.edu/FMCS/TUR/TUR13.html.

Hopping, P.N. 2004. "Heat Rejection and Water Flows." Email of model results to C.L. Wilson and A. Stegen, Tennessee Valley Authority Environmental Hydraulics, May 2004, Knoxville, Tennessee. Available on the Internet under ADAMS Accession No. ML041530161, dated May 27, 2004, at http://www.nrc.gov/reading-rm/adams.html.

Johnson, R. and B. Wehrle. 2004. "Threatened and Endangered Species of Alabama: A Guide to Assist with Forestry Activities. Invertebrates." Private Forest Management Team, Auburn University, Auburn, Alabama. Accessed on the Internet, January 20, 2004 at http://www.pfmt.org/wildlife/endangered/invertebrates.htm.

Mississippi Museum of Natural Science (MMNS). 2002. "Natural Heritage Inventory: Search Animal Database." Jackson, Mississippi. Accessed on the Internet, March 17, 2004 at http://www.mdwfp.com/museum/html/research/query_animals.asp?cntyID=71.

Mississippi Natural Heritage Program (MNHP). 2002. "Endangered Species of Mississippi." Museum of Natural Science, Mississippi Department of Wildlife, Fisheries, and Parks, Jackson, Mississippi. Accessed on the Internet, March 25, 2004 at http://www.mdwfp.com/museum/html/heritage/tandelist.pdf.

Muncy, J. A., C. Austin, C. Brewster, A. Lewis, K. Smithson, T. Broyles, and T. Wojtalik. 1999. *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities.* Chattanooga, Tennessee.

NatureServe. 2004. "NatureServe Explorer: An Online Encyclopedia of Life." Version 3.1, NatureServe, Arlington, Virginia. Accessed on the Internet, May 26, 2004 at http://www.natureserve.org/explorer.

North Carolina Wildlife Resources Commission (NCWRC). 2004. "North Carolina Freshwater Mussels – Species Information and Status." North Carolina Wildlife Resources Commission, Nongame and Endangered Wildlife Program, Raleigh, North Carolina. Accessed on the Internet, March 26, 2004 at http://www.ncwildlife.org/fs_index_07_conservation.htm.

Page, L. M. and B. M. Burr. 1991. *A Field Guide to Freshwater Fishes.* Houghton Mifflin Company, Boston, Massachusetts.

Pryor, R. J. 1982. Letter from R. J. Pryor, Program Manager, Aquatic Resource Protection, Fisheries and Aquatic Ecology Branch, Division of Water Resources, TVA, to J. D. Henson, Supervisor, Radiological and Environmental Protection Section, Controls and Test Branch, Division of Nuclear Power, TVA, Subject: "Browns Ferry Nuclear Plant (BFNP) – Proposed Barge Facility." April 13, 1982. Available on the Internet under ADAMS Accession No. ML041530161, May 27, 2004, at http://www.nrc.gov/reading-rm/adams.html.

Rogers, S. O., B. T. Watson, and R. J. Neves. 2001. "Life History and Population Biology of the Endangered Tan Riffleshell (*Epioblasma Florentina Walkeri*) (Bivalvia: Unionidae)." *Journal of the North American Benthological Society* 20(4):582-594.

Schulz, C. and K. Marbain. 1998. "A List of Host Species for Rare Freshwater Mussels in Virginia." Triannual Unionid Report No. 15. Accessed on the Internet, January 19, 2004 at http://ellipse.inhs.uiuc.edu/FMCS/TUR/TUR15.html.

Tennessee Valley Authority (TVA). 1972. *Final Environmental Statement Browns Ferry Nuclear Plant Units 1, 2, and 3.* Office of Health and Environmental Science, Chattanooga, Tennessee.

Tennessee Valley Authority (TVA). 1978. "Biological Effects of Intake Browns Ferry Nuclear Plant. Volume 4: Effects of the Browns Ferry Nuclear Plant Cooling Water Intake on the Fish Populations of Wheeler Reservoir." Tennessee Valley Authority, Division of Forestry, Fisheries, and Wildlife Development, Fisheries and Waterfowl Resources Branch, Norris, Tennessee. Available on the Internet under ADAMS Accession No. ML041530161, May 27, 2004, at http://www.nrc.gov/reading-rm/adams.html.

Tennessee Valley Authority (TVA). 2002a. *Final Supplemental Environmental Impact Statement for Operating License Renewal of the Browns Ferry Nuclear Plant in Athens, Alabama.* Tennessee Valley Authority. Chattanooga, Tennessee.

Tennessee Valley Authority (TVA). 2002b. "Sport Fishing Index Ratings." Accessed on the Internet http://www.tva.gov/environment/water/sportfish.htm on January 19, 2004.

Tennessee Valley Authority (TVA). 2003. *Applicant's Environmental Report – Operating License Renewal Stage Browns Ferry Nuclear Plant Units 1, 2, and 3.* Tennessee Valley Authority, License Nos. 50-259, 50-260, and 50-296, Tennessee Valley Authority, Knoxville, Tennessee.

Tennessee Valley Authority (TVA). 2004a. *Final Programmatic Environmental Impact Statement Tennessee Valley Authority Reservoir Operations Study Volume 1 – Environmental Impact Study.* Tennessee Valley Authority, Chattanooga, Tennessee.

Tennessee Valley Authority (TVA). 2004b. Email from Chuck Wilson, Tennessee Valley Authority, to Mike Sackschewsky, Pacific Northwest National Laboratory. Available on the Internet under ADAMS accession no. ML042520143, September 2, 2004, at http://www.nrc.gov/reading-rm/adams.html

Tennessee Valley Authority (TVA). 2004c. *Browns Ferry Nuclear Plant (BFN), Unit 1, Proposed Technical Specifications (TS) Change TS-431, Request for License Amendment for Extended Power Uprate Operation, Browns Ferry Unit 1 Extended Power Uprate Environmental Report.* Tennessee Valley Authority, Decatur, Alabama.

U.S. Environmental Protection Agency (EPA). 2004. "Ecoregions of Alabama and Georgia." Accessed on the Internet, May 11, 2004 at http://www.epa.gov/wed/pages/ecoregions/alga_eco.htm

U.S. Fish and Wildlife Service (FWS). 1976. "Endangered and Threatened Wildlife and Plants; Endangered Status for 159 Taxa of Animals." *Federal Register* 41(115):24062-24067.

U.S. Fish and Wildlife Service (FWS). 1977a. "Determination that the Tan Riffle Shell Is an Endangered Species." *Federal Register* 42(163):42351-42353.

U.S. Fish and Wildlife Service (FWS). 1977b. "Final Threatened Status and Critical Habitat for Five Species of Southeastern Fishes." *Federal Register* 42(175):45526-45530.

U.S. Fish and Wildlife Service (FWS). 1987a. *Habitat Guidelines for the Bald Eagle in the Southeast Region*, Revision 3, Atlanta, Georgia.

U.S. Fish and Wildlife Service (FWS). 1987b. "Endangered and Threatened Wildlife and Plants; Endangered Status for Marshall's Mussel (*Pleurobema marshalli*), Curtus' Mussel (*Pleurobema curtum*), Judge Tait's Mussel (*Pleurobema taitianum*), the Stirrup Shell (*Quadrula stapes*), and the Penitent Mussel (*Epioblasma* (=*Dysnomia*) *penita*)." *Federal Register* 52(66):311162-11169.

U.S. Fish and Wildlife Service (FWS). 1988a. "Endangered and Threatened Wildlife and Plants: Determination of Endangered Species Status for the Boulder Darter." *Federal Register* 53(170):33996-33998.

U.S. Fish and Wildlife Service (FWS). 1988b. "Endangered and Threatened Wildlife and Plants; Endangered Status for the Alabama Cave Shrimp, Palaemonias Alabamae." *Federal Register* 53(173):34696-34698.

U.S. Fish and Wildlife Service (FWS). 1989a. "Endangered and Threatened Wildlife and Plants: Designation of the Cracking Pearly-Mussel as an Endangered Species." *Federal Register* 54(187):39850-39853.

U.S. Fish and Wildlife Service (FWS). 1989b. "Endangered and Threatened Wildlife and Plants: Designation of the Ring Pink Mussel as an Endangered Species." *Federal Register* 54(188):40109-40112.

U.S. Fish and Wildlife Service (FWS). 1990a. "Fanshell (*Cyprogenia stegaria* [=*C. irrorta*])." U.S. Fish and Wildlife Service, Region 4 (Southeast Region), Atlanta, Georgia. Accessed on the Internet, May 24, 2004 at http://endangered.fws.gov/i/f/saf14.html

U.S. Fish and Wildlife Service (FWS). 1990b. "Endangered and Threatened Wildlife and Plants: Designation of the Freshwater Mussel, the Fanshell, as an Endangered Species." *Federal Register* 55(120):25591-25596.

U.S. Fish and Wildlife Service (FWS). 1990c. "Species Accounts. Alabama Cave Shrimp *Paleamonaias (sic) alabamae*." U.S. Fish and Wildlife Service, Jackson, Mississippi. Accessed on the Internet, May 20, 2004 at http://endangered.fws.gov/i/k/sak07.html

U.S. Fish and Wildlife Service (FWS). 1993a. "Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the Northern Riffleshell Mussel (*Epioblasma Torulosa Rangiana*) and the Clubshell Mussel (*Pleurobema Clava*)." *Federal Register* 58(13):5638-5642.

U.S. Fish and Wildlife Service (FWS). 1993b. "Endangered and Threatened Wildlife and Plants: Endangered Status for Eight Freshwater Mussels and Threatened Status for Three Freshwater Mussels in the Mobil (*sic*) River Drainage." *Federal Register* 58(50):14330-14340.

U.S. Fish and Wildlife Service (FWS). 1994. "Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the Royal Snail and Anthony's Riversnail." *Federal Register* 59:17994-17998.

U.S. Fish and Wildlife Service (FWS). 1997a. "Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean, and Rough Rabbitsfoot." *Federal Register* 62(7):1647-1658.

U.S. Fish and Wildlife Service (FWS). 1997b. *Recovery Plan for Anthony's Riversnail.* U.S. Fish and Wildlife Service, Region 4 (Southeast Region), Atlanta, Georgia.

U.S. Fish and Wildlife Service (FWS). 2000a. "Endangered and Threatened Wildlife and Plants; Endangered Status for the Armored Snail and Slender Campeloma." *Federal Register* 65(38):10033-10039.

U.S. Fish and Wildlife Service (FWS). 2000b. "Endangered and Threatened Species of Mississippi (Federally Listed Species by County)." U.S. Fish and Wildlife Service, Mississippi Ecological Services Field Office, Jackson, Mississippi. Accessed on the Internet, March 25, 2004 at http://southeast.fws.gov/jackson/MsCo_TE.html

U.S. Fish and Wildlife Service (FWS). 2001. "Endangered and Threatened Wildlife and Plants: Establishment of Nonessential Experimental Population Status for 16 Freshwater Mussels and 1 Freshwater Snail (Anthony's Riversnail) in the Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, Alabama." *Federal Register* 66(115):32250- 32264.

U.S. Fish and Wildlife Service (FWS). 2003. *Agency Draft Recovery Plan for Cumberland Elktoe (Alasmidonta Atropurpurea), Oyster Mussel (Epioblasma Capsaeformis), Cumberlandian Combshell (Epioblasma Brevidens), Purple bean (Villosa Perpurpurea), and Rough Rabbitsfoot (Quadrula Cylindrica Strigillata).* Prepared by R. S. Butler and R. G. Biggins, Asheville Field Office, U.S. Fish and Wildlife Service, Asheville, North Carolina for U.S. Fish and Wildlife Service, Southeast Region, Atlanta, Georgia.

U.S. Fish and Wildlife Service (FWS). 2004a. "Alabama's Federally Listed Species." U.S. Fish and Wildlife Service, Daphne Ecological Services Field Office, Daphne, Alabama. Accessed on the Internet, January 20, 2004 at http://daphne.fws.gov/es/specieslst.htm

U.S. Fish and Wildlife Service (FWS). 2004b. "U.S. Fish and Wildlife, Species Information, Threatened and Endangered Animals and Plants." Accessed on the Internet, May 26, 2004 at http://endangered.fws.gov/wildlife.html

U.S. Fish and Wildlife Service (FWS). 2004c. "Endangered and Threatened Wildlife and Plants: Review of Species that Are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions." *Federal Register* 69(86):24876-24904.

U.S. Fish and Wildlife Service (FWS). 2004d. "Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Five Endangered Mussels in the Tennessee and Cumberland River Basins." *Federal Register* 69(168)53136-53180.

U.S. Fish and Wildlife Service (FWS). 2004e. Letter from L. E. Goldman, Field Supervisor, U.S. Fish and Wildlife Service, Daphne Field Office, Daphne, Alabama, to M. Masnik, U.S. Nuclear Regulatory Commission, Division of Regulatory Improvement Programs, Washington, D.C., Subject: "List of Protected Species within the Area under Evaluation for the Browns Ferry Nuclear Plant License Renewal." May 19, 2004.

U.S. Nuclear Regulatory Commission (NRC). 2004. Letter from P.T. Kuo, U.S. Nuclear Regulatory Commission, to L. Goldman, U.S. Fish & Wildlife Service, Requesting List of Protected Species Within the Area Under Evaluation for the BFN License Renewal. Available on the Internet under ADAMS accession No. ML040680881, March 5, 2004, at http://www.nrc.gov/reading-rm/adams.html

Yokely, P., Jr. 1998. "Mussel Study near Hobbs Island on the Tennessee River for Butler Basin Marina." Unpublished report prepared for MST Engineering, Decatur, Alabama. Available on the Internet under ADAMS accession no. ML041530161, May 27, 2004, at http://www.nrc.gov/reading-rm/adams.html

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1208-B Main Street
Daphne, Alabama 36526

IN REPLY REFER TO:

04-0760b

December 1, 2004

Mr. Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Kuo:

Thank you for your letter of October 25, 2004, providing the biological assessment for the review of re-licensing for an additional 20 year period of the Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 (BFN), located in Limestone County, Alabama, on the north bank of the Tennessee River. The Service has also received the Generic Environmental Impact Statement for License Renewal of Nuclear Plants regarding Browns Ferry Nuclear Plant, Units 1,2,and 3. We are providing the following comments in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. et seq.) and the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

We have prepared this letter to acknowledge we have received your BA and the Draft Supplemental Environmental Impact Statement (SEIS) prepared for this project. As soon as our ongoing review of both documents and discussions with colleagues is completed, we will provide our final comments, as well as make a determination about whether formal consultation under section 7 of the Endangered Species Act will be necessary.

On December 1, 2004, Mr. Rob Hurt, Daphne FO biologist, contacted Dr. Michael Masnik, of your office, via the telephone, to discuss the status of our review of this project. Dr. Masnik informed Mr. Hurt of the public meeting scheduled at Athens State University in Athens, Alabama on January 25, 2005 and requested his attendance at one of the two sessions planned that day. Dr. Masnik also offered to meet with Mr. Hurt and other Service staff on January 26, 2005 to further discuss details of the project if needed.

We appreciate the opportunity to review the BFN re-license proposal and to work with your agency on this project. If you have any questions or need additional information, please contact Mr. Rob Hurt at (256) 353-7243 ext. 29. In correspondence, please refer to the reference number above.

www.fws.gov

PHONE: 251-441-5181

TAKE PRIDE IN AMERICA

FAX: 251-441-6222

Sincerely,

Larry E. Goldman
Field Supervisor

cc: Mr. Chuck Wilson, TVA-Nuclear, Chattanooga, TN
Ms. Peggy Shute, TVA, Knoxville, TN
Dr. Michael Masnik, US NRC, Washington, D.C.

Appendix F

GEIS Environmental Issues Not Applicable to Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Appendix F

GEIS Environmental Issues Not Applicable to Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

Table F-1 lists those environmental issues listed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996; 1999)[a] and Title 10 of the Code of Federal Regulations (CFR) Part 51, Subpart A, Appendix B, Table B-1, that are not applicable to Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) because of plant or site characteristics.

Table F-1. GEIS Environmental Issues Not Applicable to Browns Ferry Nuclear Power Plant, Units 1, 2, and 3

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
SURFACE WATER QUALITY, HYDROLOGY, AND USE (FOR ALL PLANTS)			
Altered salinity gradients	1	4.2.1.2.2 4.4.2.2	The BFN cooling system does not discharge to an estuary.
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING TOWER BASED HEAT DISSIPATION SYSTEMS)			
Entrainment of fish and shellfish in early life stages	1	4.3.3	This issue is related to heat-dissipation systems that are not used at BFN.
Impingement of fish and shellfish	1	4.3.3	This issue is related to heat-dissipation systems that are not used at BFN.
Heat shock	1	4.3.3	This issue is related to heat-dissipation systems that are not used at BFN.

(a) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

Table F-1. (contd)

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	Category	GEIS Sections	Comment
GROUNDWATER USE AND QUALITY			
Groundwater-use conflicts (potable and service water, and dewatering; plants that use >100 gpm)	2	4.8.1.1 4.8.2.1	BFN does not use groundwater.
Groundwater-use conflicts (Ranney wells)	2	4.8.1.4	BFN does not have or use Ranney wells.
Groundwater quality degradation (Ranney wells)	1	4.8.2.2	BFN does not have or use Ranney wells.
Groundwater quality degradation (saltwater intrusion)	1	4.8.2.1	BFN does not currently use groundwater and is not near a saltwater body.
Groundwater quality degradation (cooling ponds in salt marshes)	1	4.8.3	This issue is related to a heat-dissipation system that is not installed at BFN.
Groundwater quality degradation (cooling ponds at inland sites)	2	4.8.3	This issue is related to a heat-dissipation system that is not installed at BFN.
TERRESTRIAL RESOURCES			
Cooling pond impacts on terrestrial resources	1	4.4.4	This issue is related to a heat-dissipation system that is not installed at BFN.

F.1 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Main Report*, "Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

Appendix G

NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Browns Ferry Nuclear Plant, Units 1, 2, and 3 in Support of the License Renewal Application Review

Appendix G

NRC Staff Evaluation of Severe Accident Mitigation Alternatives (SAMAs) for Browns Ferry Nuclear Plant, Units 1, 2, and 3 in Support of the License Renewal Application Review

G.1 Introduction

Tennessee Valley Authority (TVA) submitted an assessment of SAMAs for Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 as part of the Environmental Report (ER) (TVA 2003). This assessment considers all three Browns Ferry units, each operating at 120 percent of its original licensed power level. Ideally, this assessment would take advantage of a plant-specific Probabilistic Safety Assessment (PSA) that considers operation of all three units at 120 percent of their original licensed power. However, such a PSA is not currently available. Because of the progressive screening nature of the SAMA evaluation, TVA relied on the available PSA information, along with engineering knowledge of the plant, to form a basis for the three-unit SAMA assessment. This assessment was based on the most recent PSA for Unit 2 and Unit 3 available at that time, insights from a Multiple-Unit PSA performed in 1995 to bound the effects of three-unit operation, a plant-specific offsite consequence analysis performed using the MELCOR Accident Consequence Code System 2 (MACCS2) computer program, and insights from the Browns Ferry individual plant examination of external events (IPEEE) (TVA 1995a, 1996, 1997). In identifying and evaluating potential SAMAs, TVA considered SAMA candidates that addressed the major contributors to core damage frequency (CDF) and large early release frequency (LERF), as well as generic SAMAs considered in analyses performed for other operating plants that have submitted license renewal applications. TVA identified 135 potential SAMA candidates. This list was reduced to 43 unique SAMA candidates by eliminating SAMAs that were not applicable to BFN because of design differences, SAMAs that had already been implemented, SAMAs that were similar in nature and could be combined with another SAMA, or those that cost more than $6 million to implement. TVA assessed the costs and benefits associated with each of the remaining SAMAs and concluded in the ER that none of the candidate SAMAs evaluated would be cost-beneficial for BFN.

Based on a review of the SAMA assessment, the U.S. Nuclear Regulatory Commission (NRC) issued a request for additional information (RAI) to TVA by letter dated April 28, 2004 (NRC 2004). Key questions concerned the mapping of key plant damage states to release categories, reasons for the relatively large reduction in CDF since the individual plant examination (IPE), dominant risk contributors at BFN and the SAMAs that address these contributors, the rationale for increasing the Units 2 and 3 CDFs to account for Unit 1 operation; the sequence-specific impact of Unit 1 operation on the candidate SAMAs, consideration of the potential impact of external events, and details on certain SAMAs. TVA submitted additional

information by letter dated July 7, 2004 (TVA 2004a) including summaries of peer review comments and their impact on the SAMA analysis, a description of the various changes to the PSA model since the IPE, an explanation of how key plant damage states were mapped to release categories, a cross reference of the major contributors to CDF to candidate SAMAs, and discussions of the impact of the operation of Unit 1 and the impact of external events. TVA's responses addressed the staff's concerns.

Based on its review, the staff concluded that the contribution to risk from fire events would be higher than assumed in TVA's SAMA analysis. The staff adjusted TVA's risk reduction estimates to account for the contribution to risk (and risk reduction) from fire events, and found that none of the candidate SAMAs would be cost-beneficial.

An assessment of SAMAs for BFN is presented below.

G.2 Estimate of Risk for BFN

TVA's estimates of offsite risk at BFN are summarized in Section G.2.1. The summary is followed by the staff's review of TVA's risk estimates in Section G.2.2.

G.2.1 TVA's Risk Estimates

Two distinct analyses are combined to form the basis for the risk estimates used in the SAMA analysis: (1) the BFN PSA Unit 2 and Unit 3 models, and (2) a supplemental analysis of offsite consequences and economic impacts (essentially a Level 3 PSA model) developed specifically for the SAMA analysis. The SAMA analysis is based on the most recent PSA models available at the time of the ER, referred to as the Extended Power Uprate (EPU) PSA for Unit 2 and the EPU PSA for Unit 3. (A PSA for Unit 1 was not available at the time of the SAMA analysis.) The PSAs include a Level 1 analysis to determine the CDF from internally initiated events and a Level 2 analysis to assess containment performance during severe accidents. The scope of the BFN PSAs does not include external events.

The baseline CDFs for the purpose of the SAMA evaluation are approximately 2.6×10^{-6}/yr for Unit 2 and 3.4×10^{-6}/yr for Unit 3. The CDFs are based on the risk assessment for internally initiated events at EPU conditions (i.e., 120 percent of original licensed power level). TVA did not include the contribution to risk from external events within the BFN risk estimates. This is discussed further in Sections G.2.2 and G.6.2.

The breakdown of CDF by initiating event is provided in Table G-1. As shown in this table, transients and loss of offsite power-initiated events are dominant contributors to the CDF.

Table G-1. BFN Core Damage Frequency

Initiating Event or Accident Class	Unit 2 CDF (Per Year)	Unit 2 % Contribution to CDF	Unit 3 CDF (Per Year)	Unit 3 % Contribution to CDF
Transients	1.6×10^{-6}	63	1.8×10^{-6}	52
Loss of offsite power (LOOP)	4.8×10^{-7}	19	1.1×10^{-6}	32
Support system failures	2.2×10^{-7}	8	2.3×10^{-7}	7
Internal flooding	1.0×10^{-7}	4	1.6×10^{-7}	5
Loss of coolant accidents (LOCAs)	5.3×10^{-8}	2	5.4×10^{-8}	2
Stuck open relief valves	4.7×10^{-8}	2	5.8×10^{-8}	2
Interfacing system LOCA (ISLOCA)	4.6×10^{-8}	2	4.6×10^{-8}	1
Total CDF (from internal events)	**2.6×10^{-6}**	**100**	**3.4×10^{-6}**	**100**

Bypass events (i.e., ISLOCA) contribute 2 percent or less to the total internal events CDF. Anticipated transients without scram (ATWS) events and station blackout (SBO) events are not specifically identified in the internal events CDF breakdown. In response to an RAI, TVA stated that the ATWS CDF is estimated to be 2.3 x 10-7/yr for each unit, and the SBO CDF is 3.7×10^{-8}/yr for Unit 2 and 3.9×10^{-8}/yr for Unit 3 (TVA 2004a). SAMAs to address ATWS and SBO events were considered in the SAMA evaluation.

The Level 2 analysis used the plant damage state (PDS) assignment rules developed for the BFN IPE to assign each of the Level 1 accident sequences that lead to core damage to a PDS in the PDS matrix from the BFN IPE. The assignment rules consider the status of containment (intact, bypassed, not isolated/failing early, or failing late), the status of key plant systems (drywell sprays, suppression pool cooling, torus vent, and reactor protection system) and other conditions (vessel pressure and water on drywell floor) at the time of core damage in assigning each sequence to one of 37 possible PDSs. These PDSs are then condensed into a reduced set of eight key plant damage states (KPDSs). TVA states that this mapping is done conservatively on the basis of phenomenological parameters except in a few cases for which PDSs with very low relative frequencies are mapped to nonconservative KPDSs. TVA states that the overall result is a conservative estimate of risk.

Each of these KPDSs was then mapped directly to a single release category for which the release fractions and other parameters were determined by Modular Accident Analysis Program (MAAP) analyses of representative sequences. This mapping of KPDSs to release categories on a one-to-one basis was done conservatively to simplify the analysis. For example, the fraction of the KPDS that includes the dominant CDF sequences not be expected to lead to containment failure are all assumed to lead to early containment failure for the purpose of determining the fission product release fractions. This approach leads to sequences, which would normally be categorized as having no containment failure, that dominate the offsite risk.

The offsite consequences and economic impact analyses use the MACCS2 code to determine the offsite risk impacts on the surrounding environment and public. Inputs for this analysis include plant-specific and site-specific input values for core radionuclide inventory, source term and release characteristics, site meteorological data, projected population distribution (within an 80-km [50-mi] radius) for the year 2036, emergency response evacuation modeling, and economic data.

In its ER, TVA estimated the dose to the population within an 80-km (50-mi) radius of the BFN site to be approximately 0.0164 person-Sv (1.64 person-rem)/yr for Unit 2, and approximately 0.0195 person-Sv (1.95 person-rem)/yr for Unit 3. The breakdown of the total population dose by containment release mode is summarized in Table G-2. The apparent conclusion that population dose is dominated by events involving no containment failure results from the aforementioned assumption. Except for this, early containment failure resulting from ATWS events dominates the population dose risk.

Table G-2. Breakdown of Population Dose by Containment Release Mode for BFN

	Unit 2		Unit 3	
Containment Release Mode	**Population Dose (Person-rem[1] Per Year)**	**% Contribution**	**Population Dose (Person-rem[a] Per Year)**	**% Contribution**
Early containment failure or Containment isolation failure	0.636	39	0.706	36
Bypass	0.009	<1	0.009	<1
Late containment failure	0.111	7	0.156	8
No containment failure[b]	0.882	54	1.072	55
Total Population Dose	**1.64**	**100**	**1.95**	**100**

(a) One person-rem = 0.01 person-Sv
(b) Release mode is dominated by KPDSs that are assigned to release categories for which containment is assumed to fail.

The CDF described about and the population dose risk for BFN Units 2 and 3 are based on the assumption that Unit 1 is in extended lay-up and not operating. The proposed operation of Unit 1 would increase the CDF and risk for Units 2 and 3 because of the decreased availability of equipment shared between units, including diesel generators, the residual heat removal (RHR) service water system, and the emergency cooling water system. The estimation of the CDF for Unit 1, and the impact of Unit 1 operation on the CDF for Units 2 and 3 are accounted for in the SAMA analysis by applying a multiplier to the estimated SAMA benefits for Units 2 and 3. This analysis is discussed further in Section G.6.

G.2.2 Review of TVA's Risk Estimates

TVA's determination of offsite risk at BFN is based on the following major elements:

- the Level 1 and 2 risk models that form the bases for the IPE for Unit 2 (TVA 1992)
- the major modifications to the IPE models that have been incorporated in the BFN Unit 2 and Unit 3 PSAs
- the MACCS2 analyses performed to translate fission product source terms and release frequencies from the Level 2 PSA models into offsite consequence measures.

Each of these elements was reviewed to determine the acceptability of TVA's risk estimates for the SAMA analysis, as summarized below.

The staff's review of the BFN Unit 2 IPE is described in an NRC report dated September 28, 1994 (NRC 1994). In that review, the staff evaluated the methodology, models, data, and assumptions used to estimate the CDF and characterize containment performance and fission product releases. The staff concluded that TVA's analysis met the intent of Generic Letter 88-20 (NRC 1988a), with the exception of TVA's response to two parts of the containment performance improvement (CPI) program recommendations. Although the staff reviewed certain aspects of the IPE in more detail than others, it primarily focused on the licensee's ability to examine BFN Unit 2 for severe accident vulnerabilities and not specifically on the detailed findings or quantification estimates. Overall, the staff believed that TVA demonstrated an overall appreciation of severe accidents and had an understanding of the most likely severe accident sequences that could occur at BFN Unit 2.

There have been several revisions to the BFN PSA since the IPE was submitted. A comparison of internal events risk profiles between the IPE and the PSA used in the SAMA analysis indicates a decrease of almost 95 percent in the total CDF for Unit 2 (from 4.8 x 10-5/yr to 2.6 x 10^{-6}/yr). The reduction is attributed to plant and modeling improvements that have been implemented at BFN since the IPE was submitted. A summary listing of those changes that

resulted in the greatest impact on the total CDF was provided in the ER and in response to RAIs (TVA 2003, 2004a, 2004b), and are provided in Table G-3. As noted in this table, model changes to address the two CPI issues identified in the staff's Safety Evaluation Report (SER) for the IPE were also incorporated in the updated PRA.

Table G-3. Level 1 PSA Summary

Level 1 PSA Version	Unit Operating Status	Summary of Changes from Prior Version	Mean CDF (per year)
Unit 2 IPE Rev. 0 1992 (TVA 1992)	Unit 2 operating, Units 1 and 3 in lay-up	Original IPE submittal, addressed only single unit operation	4.8×10^{-5} (Unit 2)
Unit 2 IPE Rev. 1A 1995 (TVA 1995c)	Unit 2 operating, Units 1 and 3 in lay-up	- Used plant-specific diesel generator failure rates - Credited powering of the Unit 2 4 KV shutdown boards - Used the electric power recovery curves from NUREG/CR-5032 (NRC 1988b)	7.6×10^{-6} (Unit 2)
Multiple-unit PSA 1995 (TVA 1995b)	All units operating	- Modeled multiple-unit initiators (e.g., loss of offsite power) - Changed success criteria for shared systems (e.g., residual heat removal service water) - Addressed and closed out the two containment performance improvement program (CPI) open items from the Unit 2 IPE SER	2.8×10^{-5} (Unit 2)
Unit 2 PSA with Unit 3 operating May 1996 (NRC 1997b)	Units 2 and 3 operating, Unit 1 in lay-up	- Refined the model for floods in the turbine building	5.4×10^{-6} (Unit 2)
Unit 3 PSA with Unit 2 operating June 1996 (NRC 1997b)	Units 2 and 3 operating, Unit 1 in lay-up	- Responded to staff request for a Unit 3 PSA	9.2×10^{-6} (Unit 3)
PSA Rev. 0 2002	Units 2 and 3 operating, Unit 1 in lay-up	- Used revised transient initiating event frequencies from NUREG/CR-5750 (NRC 1999) - Used updated plant-specific component failure rates, and - Used revised common cause failure parameters - Reevaluated human error probability - Resolved BWROG certification facts and observations	1.3×10^{-6} (Unit 2) 1.9×10^{-6} (Unit 3)

Table G3. (contd)

Level 1 PSA Version	Unit Operating Status	Summary of Changes from Prior Version	Mean CDF (per year)
EPU PSA 2004 (TVA 2004b)	Units 2 and 3 operating at uprated (120 percent) conditions , Unit 1 in lay-up	- Eliminated credit for the control rod drive (CRD) system alone as makeup to the reactor pressure vessel at high pressure	2.6×10^{-6} (Unit 2) 3.4×10^{-6} (Unit 3)
PSA Rev. 2 August 2004 (TVA 2004b)	Unit 1 at uprated (120 percent) conditions, with Units 2 and 3 in service at uprated conditions	- Incorporated all applicable design changes planned for implementation up to Unit 1 restart	1.86×10^{-6} (Unit 1)

At the time the SAMA analysis was performed, TVA did not have a completed PSA model for Unit 1. TVA completed the PSA model for Unit 1 in August 2004, and subsequently provided a summary report to the staff describing the Unit 1 PSA results (TVA 2004b). The initial conditions of the Unit 1 PSA model are based on Unit 1 operating at EPU power with Units 2 and 3 in service at EPU operating conditions. The CDF for Unit 1 is 1.86×10^{-6}/yr. This compares to the CDF ascribed to Unit 1 in the SAMA analysis of approximately 1×10^{-5}/yr. The breakdown of the Unit 1 CDF by initiating event is similar to that shown in Table G-1 for Units 2 and 3.

The results of the recently completed Unit 1 PSA suggest that the use of the multipliers to estimate the impacts of multiple-unit operation in the SAMA analysis is conservative. These results indicate than either multiple-unit operation reduces the CDF for Units 1 and 2 (rather than increase the CDF, as assumed in the SAMA analysis), or that the CDF for Unit 1 is noticeably lower than that for Unit 2. The staff has not reviewed the details of the Unit 1 PSA, and cannot validate the stated values. However, even if the Unit 1 CDF is substantially greater than the value estimated in the Unit 1 PSA, it would likely be bounded by the benefits assumed in the SAMA analysis (which were based on applying a multiplier of four to the benefit estimates for Unit 2 CDF, as discussed in Section G.6).

The CDF value for BFN is comparable to the CDF values reported in the IPEs for other boiling water reactor (BWR) facilities. Figure 11.2 of NUREG-1560 shows that the IPE-based total internal events CDF for BWR 3/4 plants ranges from 1×10^{-6} to 8×10^{-5} /yr (NRC 1997a). It is recognized that other plants have reduced the values for CDF subsequent to the IPE submittals because of modeling and hardware changes. The current internal events CDF results for BFN remain comparable to other plants of similar vintage and characteristics.

The staff considered the peer reviews performed for the BFN PSA, and the potential impact of the review findings on the SAMA evaluation. In 1997, the Unit 2 PSA (with Unit 3 operating) was reviewed by the Boiling Water Reactor Owners Group (BWROG) Peer Review Team. The results of the review are summarized in response to an RAI (TVA 2004a). The following areas were deemed sufficiently important to require enhancement in the model:

- use of plant-specific data for system unavailabilities
- incorporation of common cause miscalibration of low pressure interlock
- additional containment features (e.g., external ring header) and loading issues (e.g., high blowdown)
- reassessment of the truncation value used quantification process
- incorporation of containment flood and reactor pressure vessel vent into the Level 2, along with a definition of LERF consistent with the PSA Application Guide.

According to TVA, the areas noted above have all been resolved in the PSA model used for the SAMA analysis (TVA 2004a).

Improvements were needed in three additional PSA elements. These elements were in the areas of thermal hydraulic analysis, data analysis, and containment performance analysis. The Peer Review Team recommended that five specific model enhancements be implemented to address these three elements. A subsequent self assessment by TVA concluded that the facts and observations associated with the three elements have been resolved.

Given that the BFN PSA has been peer reviewed and the recommended enhancements to resolve known issues have been incorporated, that TVA satisfactorily addressed staff questions regarding the PSA (TVA 2004a, b), that the PSA reflects the current designs of the units and the planned EPU condition, and that the CDF is in the range of contemporary CDFs for similar BWR plants, the staff concludes that the Level 1 PSA model is of sufficient quality to represent the risk from the plant given the operational configuration assumed for the PSAs (i.e., Units 2 and 3 operating and Unit 1 in a defueled lay-up condition).

TVA submitted an IPEEE by letters dated July 24, 1995 (TVA 1995a), June 28, 1996 (TVA 1996), and July 11, 1997 (TVA 1997). TVA did not identify any fundamental weaknesses or vulnerabilities to severe accident risk in regard to the external events related to fire, high winds, floods, and other external events. However, a number of areas were identified for improvement in both the seismic and fire areas. In a letter dated June 22, 2000 (NRC 2000), the staff concluded that the submittal met the intent of Supplement 4 to Generic Letter 88-20, and that the licensee's IPEEE process is capable of identifying the most likely severe accidents and severe accident vulnerabilities.

The IPEEE uses a focused scope Electric Power Research Institute (EPRI) seismic margins analysis. This method is qualitative and does not provide numerical estimates of the CDF contributions from seismic initiators. TVA found that based on the EPRI assessment methodology, all of the high confidence low probability of failure (HCLPF) values were at least equal to the 0.3g review level earthquake used in the IPEEE except for two 4-kV/480-V transformers located in the Units 1 and 2 diesel generator building. These transformers were to be replaced as part of TVA's long-term polychlorinated biphenyls and asbestos removal program. In response to an RAI, TVA indicated that these transformers are still scheduled to be removed. Specific HCLPF values for other structures or components are not provided in the IPEEE; however, TVA stated that there are no other structures or components with HCLPF values less than the review level earthquake acceleration of 0.3g.

In a subsequent submittal by TVA for another risk-informed application (TVA 2004c), TVA used a published simplified methodology to estimate the seismic CDF as 2.5×10^{-6}/yr. This is based on the assumption that the plant HCLPF is equal to that for the two transformers mentioned above (0.26g).

The staff considered the impact of seismic events on the SAMA analysis from two aspects. First, would any seismic-specific SAMA be expected to be cost-beneficial, and second, would the benefit of non-seismic SAMAs be increased significantly because of their impact on seismic sequences. For the first situation, using the simplified methodology used by TVA (TVA 2004c), an increase in plant HCLPF value from 0.3g (assuming the previously limiting transformers have been removed) to 0.35g reduces the seismic CDF by approximately 0.7×10^{-6}/yr or approximately 30 percent of the Unit 2 CDF resulting from internal events. From information provided in the ER (Table IV-8), this would correspond to an averted cost-benefit in the range of $20,000 to $80,000, depending on the discount rate used. Increases in the seismic capacity of the plant would involve modifications and reanalysis of multiple components because it is expected that there are numerous components whose current HCLPF values are in the 0.3g to 0.35g range. The costs associated with the modifications and analyses would be well in excess of the estimated benefits, even when the impacts of alternative seismic hazard curves (i.e., the Lawrence Livermore National Laboratory [LLNL] curves rather than the EPRI curves), multiple-unit operation, and analysis uncertainties are considered. Based on this, the staff concludes that it is unlikely that any cost-effective seismic SAMAs would be found.

For the second situation, the additional benefit of internal-event SAMAs caused by their impact on seismic-initiated sequences are most likely realized in relatively low-g seismic events that are of sufficient magnitude to result in either non-recoverable LOOP events or other more ordinary transient events similar to those evaluated in the internal-events PSA. Plant power generation interruptions caused by seismic events might start to occur in the peak ground acceleration range of 0.15g to 0.2g (BFN has an operating basis earthquake of 0.1g). The exceedance frequency for these magnitude earthquakes is approximately 5×10^{-5}/yr. For a

seismic LOOP event, the CDF can be estimated using this frequency and the conditional core damage probability for a non-recoverable SBO. This is estimated to be on the order of 1×10^{-3}, giving a CDF of 5×10^{-8}/yr. This is small compared to the internal-events CDFs for BFN of 3×10^{-6}/yr. While the seismic SBO CDF estimated above is the same order of magnitude as the internal-events SBO CDF, the frequencies are so low that a cost-beneficial SBO related SAMA would not be expected. This conclusion is supported by the analysis of SAMA B04, "add dedicated blackout diesel generator," which indicates that this would not be cost effective even if the benefit is doubled because of the benefit from seismic events. For non-SBO sequences, the seismic transient initiating event frequency estimated above of 5×10^{-5}/yr is several orders of magnitude lower than the internal initiating event frequencies; therefore, the added benefit because of seismic sequences for the non-SBO SAMA is expected to be small.

Based on the above assessment, the staff concludes that the opportunity for seismic-related SAMAs has been adequately explored and that there are no cost-beneficial, seismic-related SAMA candidates.

The BFN fire analysis employed the fire-induced vulnerability evaluation (FIVE) methodology for screening of compartments. The licensee's overall approach in the IPEEE fire analysis is similar to other fire analysis techniques, employing a graduated focus on the most important fire zones using qualitative and quantitative screening criteria. The fire zones or compartments were subjected to at least two screening phases. In the first phase, a compartment was screened out if it was found to not contain any safety-related equipment or reactor trip initiators. In the second phase, a CDF criterion of 1×10^{-6}/yr was applied. The licensee used the PSA model (TVA 1994) of internal events to quantify the CDF resulting from a fire-initiating event. The conditional core damage probability (CCDP) was based on the equipment and systems unaffected by the fire. The CDF for each zone was obtained by multiplying the frequency of a fire in a given fire zone by the conditional core damage probability associated with that fire zone. The screening methodology applied by the licensee makes fewer and fewer conservative assumptions (e.g., equipment that may survive the fires in the area) until a fire zone is screened out. The fire CDF (based on a summation of the fire zone CDFs) was estimated in the staff's Safety Evaluation Report (SER) to be less than 1.24×10^{-5}/yr for Unit 2 and 7.5×10^{-6}/yr for Unit 3, which are about factors of five and two higher than the internal events CDF used in the SAMA analysis, respectively. The fire zones that contributed more than 1×10^{-6}/yr are:

- 1.1×10^{-6} for Unit 2, Zone 2 - 5 621 ft and North 639 ft
- 5.6×10^{-6} for Units 1 and 2, Control Room
- 3.0×10^{-6} for Unit 3, Control Room

In light of these values, the staff asked TVA to assess the impact on the initial and final screenings if the internal events risk reduction estimates were increased by a factor that would bound the risk from fire and seismic events (NRC 2004). In response to the NRC RAI, TVA stated that such an assessment is inappropriate because it contains an implicit assumption that

the systems, structures, and components important to the risk from internal events have equivalent importance to the risk from fire and seismic events (TVA 2004a). Additionally, TVA stated that the CDF values in NUREG-1742 (NRC 2002) (used by the staff to estimate the ratio of external to internal events risk) should be considered as upper bound values only, and that the mean CDF resulting from fire-related initiating events in each of the fire areas is judged to be considerably lower than these values (TVA 2004a).

The staff agrees that the BFN fire analysis contains numerous conservatisms and that a more realistic assessment could result in a substantially lower fire CDF. Based on evaluations of past ERs submitted in support of license renewal applications, the staff believes that a more realistic fire CDF is likely to be a factor of two to three less than the screening values used in the FIVE methodology. Given a factor of three reduction, the resulting fire CDF would be comparable to the internal events CDF used in the SAMA analysis. This would justify use of a multiplier of two to the averted cost estimates (for internal events) to represent the additional SAMA benefits in external events. The staff's review is described in Section G.6.2.

The BFN IPEEE evaluated high winds, floods, and other events (transportation and nearby facility accidents) using the progressive screening approach recommended in NUREG-1407 (NRC 1991). Based on this evaluation, the licensee determined that the risk from high winds, floods, and other events were not significant vulnerabilities at the plant.

The staff reviewed the process used by TVA to extend the containment performance (Level 2) portion of the PSA to an assessment of offsite consequences (essentially a Level 3 PSA). This included consideration of the source terms used to characterize fission product releases for the applicable containment release category and the major input assumptions used in the offsite consequence analyses. The MACCS2 code was used to estimate offsite consequences. Plant-specific input to the code includes the BFN reactor core radionuclide inventory, source terms for each release category, site-specific meteorological data, projected population distribution within an 80-km (50-mile) radius for the year 2036, and emergency evacuation modeling. This information is provided in Attachment E to the ER (TVA 2003).

The reactor core inventory input to the MACCS2 code was developed for an average bundle thermal power level of 5.28 MW(t), which is representative of EPU conditions. Three fission product inventories were used: (1) General Electric Uprated, Framatome Commercial, and Framatome Blended low-enriched uranium. The fission product inventory for each radionuclide group is provided in Table II-3 of Attachment E to the ER (TVA 2003).

TVA grouped the key plant damage states into a set of eight release categories based on their expected source term results. The release fractions for each of the release categories are reported in Table II-4 of Attachment E to the ER (TVA 2003). The staff concludes that the process used to assign release categories and source terms is consistent with typical PSA practices and is acceptable for use in the SAMA analysis.

TVA used site-specific meteorological data obtained from the plant meteorological tower, processed from hourly measurements for the calendar year 1980. In response to an RAI, TVA stated that the 1980 data is representative, although precipitation in 1980 was slightly higher than average. TVA further stated that use of more recent data would not yield a more accurate prediction of weather for the term of license renewal (TVA 2004a).

The population distribution TVA used as input to the MACCS2 analysis is given in Tables II-1 and II-2 of Attachment E to the ER (TVA 2003). The population distribution is based on the U.S. Census Bureau data from 1990 and 2000. The data were linearly extrapolated to 2036. Sectors with a negative growth rate were estimated to have the same population as in the year 2000 (TVA 2004b). The staff considers the methods and assumptions for estimating population reasonable and acceptable for purposes of the SAMA evaluation.

The emergency evacuation model was modeled as a single evacuation zone extending 16 km (10 mi) from the plant. It was assumed that 95 percent of the population evacuates radially at an average speed of 0.234 m/s beginning 120 minutes after the alarm (TVA 2004a). This assumption is conservative relative to the NUREG-1150 study (NRC 1990), which assumed evacuation of 99.5 percent of the population within the emergency planning zone.

Economic data were specified for the area surrounding the plant to a distance of 80 km (50 miles). The agricultural economic data were obtained from *Statistical Abstracts of the United States, 1998* (TVA 2004b). The values obtained from the reference document were inflated to the year 2016 using both 7-percent and 3-percent discount factors.
The staff concludes that the methodology used by TVA to estimate the offsite consequences for BFN provides an acceptable basis from which to proceed with an assessment of risk reduction potential for candidate SAMAs. Accordingly, the staff based its assessment of offsite risk on the CDF and offsite doses reported by TVA.

G.3 Potential Plant Improvements

The process for identifying potential plant improvements, an evaluation of that process, and the improvements evaluated in detail by TVA are discussed in this section.

G.3.1 Process for Identifying Potential Plant Improvements

TVA's process for identifying potential plant improvements (SAMAs) consisted of the following elements:

- review of the major contributors to CDF and LERF for Units 2 and 3 in the current for BFN PSA

- review of other NRC and industry documentation discussing potential plant improvements (e.g., NUREG-1560)
- review of generic SAMAs from past submittals in support of original licensing and license renewal activities for other operating nuclear power plants.

Based on this process, an initial set of 135 candidate SAMAs was identified, as reported in the ER. Of these SAMAs, 20 are specific to BFN, and 115 are generic SAMAs from past submittals. All BFN-specific SAMAs were assumed to pass the Phase 1 screening and were explicitly evaluated in Phase 2. For the 115 generic SAMAs, TVA performed a qualitative screening and eliminated SAMAs from further consideration using the following criteria:

- the SAMA is not applicable at BFN or for a BWR 4/Mark I design because of design differences
- the SAMA had already been implemented at BFN
- the SAMA is similar in nature to and could be combined with another SAMA
- the SAMA costs more than $6 million to implement (the maximum avoided cost for completely eliminating severe accidents, including the effects of multiple-unit operation and uncertainties).

Based on this screening, 92 SAMAs were eliminated. Of the 92 SAMAs eliminated, 45 were eliminated because they were not applicable to BFN, 19 were eliminated because they already had been implemented at BFN, 15 were similar to and combined with other SAMAs, 11 exceeded $6 million in cost, and two were eliminated for other reasons (TVA 2003). A benefit analysis was performed for each of the 43 remaining SAMA candidates.
The 43 remaining SAMAs were further evaluated and subsequently eliminated in the final screening, as described below in Sections G.4 and G.6.1.

G.3.2 Review of TVA's Process

TVA's efforts to identify potential SAMAs focused primarily on areas associated with internal initiating events. The initial list of SAMAs generally addressed the accident categories that are dominant CDF and LERF contributors at BFN.

The preliminary review of BFN's SAMA identification process raised some concerns regarding the completeness of the set of SAMAs identified and the inclusion of plant-specific risk contributors. The staff requested clarification regarding the portion of risk represented by the dominant risk contributors. Because a review of the importance ranking of basic events in the PSA could identify SAMAs that may not be apparent from a review of the top cut sets, the staff

also questioned whether an importance analysis was used to confirm the adequacy of the SAMA identification process. In response to the RAI, TVA stated that the reviews of the importance rankings and a review of the highest frequency CDF and LERF sequences from the Unit 2 and Unit 3 PSA models were used to identify groups of sequences contributing to CDF and LERF. TVA provided tables that cross referenced the 10 CDF and LERF significant groups with important human actions and systems (TVA 2004a). TVA also provided a cross reference of the significant groups to the SAMAs evaluated in the ER. TVA explained that if an appropriate generic SAMA did not address the plant-specific risk contributor, a BFN-specific SAMA was developed (TVA 2004a).

While TVA did identify BFN-specific candidate SAMAs for fire (B16), earthquakes (B17), and high winds, floods, transportation, and other extreme external events (B19), none were quantitatively evaluated because of the findings of the IPEEE that no vulnerabilities existed and/or that all outliers had been satisfactorily resolved as part of the IPEEE or related programs. Even though no BFN-specific external events SAMAs were quantitatively evaluated, candidate SAMAs selected because of their potential risk reduction on the risk from internal events will, in most cases, also reduce the risk due to external event initiators. The use of a multiplier of two to the benefits estimated for the internal events for these SAMAs in part addresses the lack of BFN-specific SAMAs for external events.

The staff notes that the set of SAMAs submitted is not all inclusive because additional, possibly even less expensive, design alternatives can always be postulated. However, the staff concludes that the benefits of any additional modifications are unlikely to exceed the benefits of the modifications evaluated and that the alternative improvements would not likely cost less than the least expensive alternatives evaluated, when the subsidiary costs associated with maintenance, procedures, and training are considered.

The staff concludes that TVA used a systematic and comprehensive process for identifying potential plant improvements for BFN, and that the set of potential plant improvements identified by TVA is reasonably comprehensive and, therefore, acceptable. This search included reviewing insights from the IPE and IPEEE and other plant-specific studies, reviewing plant improvements considered in previous SAMA analyses, and using the knowledge and experience of its personnel. While explicit treatment of external events in the SAMA identification process was limited, it is recognized that the absence of external event vulnerabilities reasonably justifies examining primarily the internal events risk results for this purpose.

G.4 Risk Reduction Potential of Plant Improvements

TVA evaluated the risk-reduction potential of the 43 Phase 2 SAMAs that were applicable to BFN. Many of the SAMA evaluations were performed in a bounding fashion in that the SAMA

was assumed to completely eliminate the risk associated with the proposed enhancement. Such bounding calculations over-estimate the benefit and are conservative.

For a majority of the Phase 2 SAMAs, new PSA models that incorporate individual SAMAs were developed and quantified. For several of the SAMAs, information from the PSA (e.g., system importance measures) was used to estimate their potential benefit. The CDF and population dose reductions were estimated using the EPU PSAs for Units 2 and 3. The new models or changes made to models to quantify the impact of SAMAs are detailed in Section VI of Attachment E to the ER (TVA 2003) and in response to an RAI (TVA 2004a). Table G-4 lists the assumptions considered to estimate the risk reduction for each of the 43 Phase 2 SAMAs, the estimated risk reduction in terms of percent reduction in CDF and population dose, and the estimated total benefit (present value) of the averted risk. The determination of the benefits for the various SAMAs is further discussed in Section G.6.

The staff reviewed TVA's bases for calculating the risk reduction for the various plant improvements and concludes that the rationale and assumptions for estimating risk reduction are reasonable and generally conservative (i.e., the estimated risk reduction is higher than what would actually be realized). Accordingly, the staff based its estimates of averted risk for the various SAMAs on TVA's risk reduction estimates reported in the ER, but applied a multiplier of two to the associated benefits to account for benefits in external events as discussed in Section G.6.2.

Table G-4. SAMA Cost/Benefit Screening Analysis

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
B01 Improve reliability of automatic depressurization system (ADS).	The failure probability of top event "operator depressurizes the reactor vessel" was set to zero.	58 / 45	34 / 24	1,481,000	4,500,000
B02 Improve reliability of high-pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) by adding redundant train.	The failure probability of top events "start and short-term operation of HPCI and RCIC" were set to zero.	57 / 50	32 / 31	1,489,000	21,900,000
B03 Improve reliability of safety relief valves (SRVs) by replacing valves with more reliable design.	The failure probability of top event "hardware unavailability of SRVs" was set to zero.	<1 / <1	0 / 0	6,600	21,900,000
B04 Add dedicated blackout diesel generator.	The failure probability of top event "diesel B or 3EB" was set to zero.	12 / 24	7 / 17	406,000	8,800,000
B05 Improve procedures and training to control pressure during ATWS.	The failure probability of top event "operator depressurizes vessel" was set to zero.	1 / 1	0 / <1	16,000	146,000[3]
B06 Automate standby liquid control (SLC) initiation to mitigate failure of SLC due to operator error during ATWS conditions.	The failure probability of top event "operator initiates SLC injection" was set to zero.	3 / 3	31 / 26	611,000	1,870,000
B07 Improve reliability of SLC by adding redundant train.	The failure probability of top event "hardware unavailability of SLC injection" was set to zero.	1 / 1	6 / 6	129,000	4,500,000

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
B08A Decrease frequency of Interfacing Systems loss-of-coolant accident (ISLOCA) through major hardware modifications to prevent overpressurization.	The ISLOCA initiating event frequency was set to zero.	2 / 1	<1 / <1	39,000	21,900,000
B08B Decrease frequency of ISLOCA through improved procedures and training or minor hardware modifications.	ISLOCA frequency is reduced by 50 percent.	1 / 1	0 / <1	20,000	146,000[3]
B09 Improve suppression pool cooling reliability for transients by adding redundant train or additional cross-tie capability.	The failure probability of top events "heat exchangers A and B, RHR pumps A and B, and the alignment to suppression pool cooling" were set to zero.	12 / 17	7 / 12	363,000	21,900,000
B10 Automate torus cooling on high torus temperature to avoid lack of torus cooling due to operator error.	The failure probability of top event "operator initiates torus cooling" was set to zero.	5 / 5	3 / 3	143,000	1,870,000
B11 Improve direct current (DC) reliability through increase/improved procedures to load shed.	The failure probability of top events "battery boards 1, 2, and 3" were set to zero.	2 / 1	1 / 1	54,000 [11,000][4]	146,000[3]
B12 Improve level control through improved procedures and training.	The failure probability of top event "operator controls low pressure injection" was set to zero.	<1 / <1	1 / 2	36,000	146,000[3]

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
B13 Improve suppression pool cooling by adding redundant train.	The failure probability of top events "heat exchangers A, B, C, and D, RHR pumps A, B, C, and D; operator initiates suppression pool cooling mode; and switch to suppression pool cooling mode" were set to zero.	3 / 2	1 / 1	67,000	8,800,000
B14 Reduce frequency of excessive loss-of-coolant accident (LOCA) by increasing reactor pressure vessel inspection frequency.	The "Excessive LOCA" initiating event frequency was set to zero.	<1 / <1	2 / 2	40,000	465,000
B15 Add motor-driven startup feedwater pump.	A new top event, "startup feedwater pump" was inserted in the event model. The unavailability of the startup feedwater pump if offsite power is available was set to 4.2×10^{-3}.	50 / 35	29 / 22	1,254,000	21,900,000
B16 Mitigate fire risk by adding new fire barriers, new cable routing, and training and procedures.	No quantitative assessment was performed.	not assessed	not assessed	not assessed	>21,900,000
B17 Mitigate earthquake effects by strengthening structures and equipment.	No quantitative assessment was performed.	not assessed	not assessed	not assessed	>21,900,000
B18 Implement internal flood prevention and mitigation enhancements.	The frequency of all internal flood initiators were set to zero.	4 / 5	2 / 4	118,000	>21,900,000

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
B19 Mitigate effects of high winds, floods, transportation, and other external events.	No quantitative assessment was performed.	not assessed	not assessed	not assessed	not estimated
G01 Increase CRD pump lube oil capacity.	No quantitative assessment was performed.	not assessed	not assessed	not assessed	not estimated
G02 Replace emergency core cooling system (ECCS) pump motor with air-cooled motors.	The dependency on all RHR and core spray pumps on emergency equipment cooling water (EECW) was eliminated. All split fractions associated with RHR pumps and core spray system were reduced by 20 percent.	8 / 9	4 / 6	217,000	26,400,000
G03 Implement procedures to stagger CRD pump use after a loss of service water (SW).	No quantitative assessment was performed.[5]	not assessed	not assessed	not assessed	146,000[3]
G04 Develop/enhance procedural guidance for use of cross-tied component cooling or SW pumps.	Actions necessary to align the swing pumps for EECW service are assumed to occur with a probability of 1. Reactor building closed cooling water (RBCCW) is assumed to be successful if raw cooling water (RCW) is available. The frequency of the initiator loss of RBCCW is set to zero.	2 / 2	2 / 2	74,000	146,000[3] [377,000][4]
G05 Enhance procedures and operator training in support system failure sequences, with emphasis on anticipating problems and coping.	Each of the split fractions associated with recovery of key support systems was assumed to improve by a factor of three.	<1 / <1	0 / 0	900	146,000[3]

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
G06 Improve ability to cool the RHR heat exchangers.	The failure fraction for top events SW2A, SW2C, SW2B, and SW2D was set to zero.	<1 / 5	0 / 3	26,000	4,500,000
G07 Provide a redundant train of ventilation.	The redundant train of ventilation has an availability of 1.0 and is independent of any support system such as electric power.	2 / 9	2 / 2	71,000	26,400,000
G08 Improve diagnosis of loss of switchgear room heating, ventilation, and air conditioning (HVAC) a) install high temperature alarm b) install redundant louver and thermostat.	Top events related to diesel support recovery were set to guaranteed success.	<1 / <1	0 / 0	300	a) 587,000/bldg b) 8,800,000/bldg
G09 Install a containment vent large enough to remove ATWS decay heat.	The relevant logic macro (AHEAT) was modified to reflect the vent as a potential success path.	3 / 2	2 / 3	97,000	8,700,000
G10 Use fire protection system as a back-up source for the drywell spray system.	The top event representing the containment spray function was set to success.	<1 / <1	<1 / 3	14,000	2,200,000
G11 Install a passive containment spray system.	The top event representing the containment spray function was set to success.	<1 / <1	<1 / 3	14,000	26,400,000
G12a Provide additional DC battery capacity.	Any sequence involving successful scram, no stuck open SRVs, and successful operation and control of either HPCI or RCIC was considered to be successfully mitigated.	18 / 29	10 / 21	564,000 [61,000][4]	4,500,000
G12b Use fuel cells instead of lead acid batteries.		18 / 29	10 / 21	564,000 [61,000][4]	26,400,000

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
G12c Add redundant DC control power for SW pumps.		18 / 29	10 / 21	564,000 [61,000][4]	1,500,000
G13a Incorporate an alternate battery charging capability.	Improve the unavailability of each of the three station batteries by a factor of 10.	2 / 1	1 / 1	52,000	4,500,000
G13b Replace existing batteries with more reliable ones.		2 / 1	1 / 1	52,000	26,400,000
G14 Develop procedures to repair or replace failed 4-kV breakers.	The transfer of power at the unit board level was assumed to occur without fault.	<1 / <1	0 / 0	0	146,000[3]
G15 Use fire protection system (FPS) as a back-up source for diesel cooling.	The FPS has sufficient capacity to service all 8 diesel generators. The FPS is aligned for diesel cooling in a timely manner. The FPS unavailability is set to zero.	8 / 9	4 / 6	217,000	1,500,000
G16 Improve inspection of rubber expansion joints on main condenser.	The initiating event flooding frequencies were reduced from the base case by 25 percent. The new flooding frequencies for small and large turbine building floods became 1.15×10^{-2} and 1.76×10^{-3}, respectively.	<1 / <1	<1 / <1	21,000	440,000
G17 Develop procedure to instruct operators to trip unneeded RHR/core spray pumps on loss of room ventilation.	All requirements for area cooling were removed for the top events representing RHR and core spray pumps by reducing each corresponding split fraction by 20 percent.	2 / 2	2 / 2	71,000	146,000[3] [476,000][4]

Table G-4. (contd)

Phase 2 SAMA	Assumptions	% Risk Reduction (Unit 2) / (Unit 3)		Total Baseline Benefit ($)[1]	Estimated Cost[2] ($)
		CDF	Population Dose		
G18 Increase the SRV reseat reliability.	Any valves that lift will successfully reseat.	<1 / 1	<1 / 2	30,000	3,100,000
G19 Reduce DC dependency between high pressure injection system and automatic depressurization system.	DC dependency for HPCI was completely removed.	<1 / 1	0 / <1	10,000	1,870,000
G20 Use CRD for alternate boron injection.	Actions by the operator are necessary to initiate boron injection. Any additional operator actions associated with initiating the CRD are represented by a top event. Any additional failure modes of the CRD system over that analyzed in the base case were not significant contributors to CRD system unavailability in its postulated function of delivering boron solution to the reactor.	<1 / <1	5 / 5	105,000	8,700,000

(1) Values are based on TVA averted cost estimates (using seven-percent discount rate) reported in the ER. The values include multipliers to the estimated benefits for Units 2 and 3 to account for multiple-unit operation. The values also include a multiplier of two to account for additional risk reduction benefits in external events.
(2) Estimated costs are given in calendar year 2016 dollars, and are stated for site-wide implementation unless otherwise noted.
(3) Costs for a procedure and training were estimated to be $73,000/unit (year 2016). However, due to similarities between units and shared systems, this cost was doubled to obtain a site-wide implementation cost.
(4) The information within brackets indicates revised values were provided by the licensee in response to an RAI (TVA 2004b).
(5) This SAMA would provide little benefit because the CRD system is a backup for high pressure injection, and it does not rely on SW.

G.5 Cost Impacts of Candidate Plant Improvements

TVA estimated the costs of implementing the 43 Phase 2 candidate SAMAs through the application of engineering judgment and review of prior BFN-completed capital projects for similar improvements. The cost estimates provided in the ER accounted for inflation (3 percent per year) to arrive at year 2016 estimated costs (TVA 2003).

The staff reviewed the bases for TVA's cost estimates. For certain improvements, the staff also compared the cost estimates to estimates developed elsewhere for similar improvements, including estimates developed as part of other licensees' analyses of SAMAs for operating reactors and advanced light-water reactors. The staff reviewed the costs and found them to be consistent with estimates provided in support of other plants' analyses.

The staff concludes that the cost estimates provided by TVA are sufficient and appropriate for use in the SAMA evaluation.

G.6 Cost-Benefit Comparison

TVA's cost-benefit analysis and the staff's review are described in the following sections.

G.6.1 TVA Evaluation

The methodology used by TVA was based primarily on NRC's guidance for performing cost-benefit analysis in NUREG/BR-0184, *Regulatory Analysis Technical Evaluation Handbook* (NRC 1997c). The guidance involves determining the net value for each SAMA according to the following formula:

$$\text{Net Value} = (\text{APE} + \text{AOC} + \text{AOE} + \text{AOSC}) - \text{COE}$$

where,

APE = present value of averted public exposure ($)
AOC = present value of averted offsite property damage costs ($)
AOE = present value of averted occupational exposure costs ($)
AOSC = present value of averted onsite costs ($)
COE = cost of enhancement ($).

If the net value of a SAMA is negative, the cost of implementing the SAMA is larger than the benefit associated with the SAMA and it is not considered cost-beneficial. TVA's derivation of each of the associated costs is summarized below. For the purposes of the SAMA analysis, TVA considered the "present" to be the year 2016; therefore, all values were recalculated to the year 2016 using a 3 percent per year inflation rate.

TVA presented the results for both a 3-percent and 7-percent real discount rate. For the purposes of the staff's evaluation, the staff relied on the values given by TVA for the 7-percent real discount rate, but also considered the impact on the results of a 3-percent discount rate.

Averted Public Exposure (APE) Costs

The APE costs were calculated using the following formula:

APE = Annual reduction in public exposure (Δperson-rem/yr)
x monetary equivalent of unit dose ($3097 per person-rem, based on $2000 per person-rem inflated at 3 percent to year 2016 values)
x present value conversion factor (10.76 based on a 20-year period with a 7-percent discount rate).

As stated in NUREG/BR-0184 (NRC 1997c), it is important to note that the monetary value of the public health risk after discounting does not represent the expected reduction in public health risk resulting from a single accident. Rather, it is the present value of a stream of potential losses extending over the remaining lifetime (in this case, the license renewal term) of the facility. Thus, it reflects the expected annual loss resulting from a single accident, the possibility that such an accident could occur at any time over the license renewal term, and the effect of discounting these potential future losses to present value. For the purposes of initial screening, TVA calculated an APE of approximately $54,700 (Unit 2) and $64,900 (Unit 3) for the 20-year license renewal term, which assumes elimination of all severe accidents.

Averted Offsite Property Damage Costs (AOC)

The AOCs were calculated using the following formula:

AOC = Annual CDF reduction
x offsite economic costs associated with a severe accident (on a per-event basis)
x present value conversion factor.

For the purposes of initial screening, which assumes all severe accidents are eliminated, TVA calculated an annual offsite economic risk of about $2000 (Unit 2) and $2100 (Unit 3) based on the Level 3 risk analysis. This results in a discounted value of approximately $21,200 (Unit 2) and $23,000 (Unit 3) for the 20-year license renewal term.

Averted Occupational Exposure (AOE) Costs

The AOE costs were calculated using the following formula:

AOE = Annual CDF reduction
x occupational exposure per core damage event
x monetary equivalent of unit dose
x present value conversion factor.

TVA derived the values for averted occupational exposure from information provided in Section 5.7.3 of the regulatory analysis handbook (NRC 1997c). Best estimate values provided for immediate occupational dose (3300 person-rem) and long-term occupational dose (20,000 person-rem over a 10-year cleanup period) were used. The present value of these doses was calculated using the equations provided in the handbook in conjunction with a monetary equivalent of unit dose of $3097 per person-rem, based on $2000 per person-rem inflated at 3 percent to year 2016 values, a real discount rate of 7-percent, and a time period of 20 years to represent the license renewal term. For the purposes of initial screening, which assumes all severe accidents are eliminated, TVA calculated an AOE of approximately $1500 (Unit 2) and $2000 (Unit 3) for the 20-year license renewal term.

Averted Onsite Costs (AOSC)

AOSC include averted cleanup and decontamination costs and averted power replacement costs. Repair and refurbishment costs are considered for recoverable accidents only and not for severe accidents. TVA derived the values for AOSC based on information provided in Section 5.7.6 of the regulatory analysis handbook (NRC 1997c).

TVA divided this cost element into two parts: (1) the Onsite Cleanup and Decontamination Cost, also commonly referred to as averted cleanup and decontamination costs, and (2) the replacement power cost.

Averted cleanup and decontamination costs (ACC) were calculated using the following formula:

ACC = Annual CDF reduction
x present value of cleanup costs per core damage event
x present value conversion factor.

The total cost of cleanup and decontamination subsequent to a severe accident is estimated in the regulatory analysis handbook to be $1.7 x 10^9, based on $1.1 x 10^9 inflated at 3 percent to year 2016 values. This value was converted to present costs over a 10-year cleanup period and integrated over the term of the proposed license extension. For the purposes of initial

screening, which assumes all severe accidents are eliminated, TVA calculated an ACC of approximately $48,400 (Unit 2) and $62,000 (Unit 3) for the 20-year license renewal term.

Long-term replacement power costs (RPC) were calculated using the following formula:

RPC = Annual CDF reduction
x present value of replacement power for a single event
x factor to account for remaining service years for which replacement power is required
x reactor power scaling factor

TVA based its calculations on the value of 1190 MW(e), which is the current electrical output for Units 2 and 3. Therefore, TVA applied a power scaling factor of 1190 MW(e)/910 MW(e) to determine the replacement power costs. For the purposes of initial screening, which assumes all severe accidents are eliminated, TVA calculated an RPC of approximately $42,200 (Unit 2) and $54,000 (Unit 3) for the 20-year license renewal term.

In response to an RAI regarding the expected output under EPU conditions, TVA stated that using a scaling factor of 1250 MW(e)/910 MW(e) would result in a 5-percent increase in the replacement power costs, and a 1.6 percent (Unit 2) and 1.7 percent (Unit 3) increase in the total avoidance costs.

Using the above equations, the total "present" (i.e., year 2016) dollar value equivalent associated with completely eliminating severe accidents from internal events at Browns Ferry to be about $168,000 (Unit 2) and $206,000 (Unit 3). Considering the effect of multiple-unit operation and uncertainties, TVA conservatively established a value of $6 million for the initial screening of SAMAs that are not economically feasible.

TVA's Results

The total benefit associated with each of the 43 Phase 2 SAMAs was evaluated by TVA. These values were determined based on the equations described above for the various averted costs together with the estimated annual reductions in CDF and person-rem dose.

The CDF and population dose risk for BFN Units 2 and 3, which are used to calculate the averted costs, are based on the assumption that Unit 1 is in extended lay-up and not operating. The license renewal application presumes that Unit 1 will be returned to operation. The operation of Unit 1 will increase the CDF values calculated in the Unit 2 and Unit 3 PSAs because of the impact of shared equipment including diesel generators, the residual heat removal service water system (RHRSW), and the emergency cooling water system. This impact is estimated from the results of the Multiple-Unit PSA performed in 1995 (TVA 1995b). This study indicated that the mean CDF for Unit 2 with all three units operating (2.8×10^{-5}/yr) is a factor of four greater than in the earlier PSA (Unit 2 IPE Rev. 1A [TVA 1995c]) with only Unit 2 operating (7.6×10^{-6}/yr). For the TVA SAMA evaluation, it is assumed that with all three units

operational, the baseline CDFs and risks for Units 1 and 2 are equal and will be four times greater than the CDF from the Unit 2 EPU PSA. Because Unit 1 is more closely tied to Unit 2 than to Unit 3, it is expected that the impact of Unit 1 operation on the Unit 3 CDF and risk would be smaller than the above impact on Unit 2. Based on this reasoning, the operation of Unit 1 is assumed to result in a factor of two increase in Unit 3 CDF and risk from that indicated by the Unit 3 EPU PSA. Therefore, TVA applied a multiplier of four to the Unit 2 averted cost estimates (benefits), assumed these same benefits for Unit 1, and applied a multiplier of two to the Unit 3 averted cost estimates. As a result, all SAMAs that were evaluated were eliminated because the cost was expected to exceed the estimated benefit, as adjusted to account for multiple-unit operation.

As described below, the staff based its evaluation on TVA's estimated benefits for a 7-percent discount rate, applied the same multipliers as TVA to account for multiple-unit operation, and applied an additional multiplier of two to the averted cost estimates for each SAMA to account for the potential impact of external events. As a result, none of the SAMAs appeared to be potentially cost-beneficial. However, four SAMAs appeared to be within a factor of three of being cost-beneficial (i.e., SAMAs B11, G04, G12, and G17). TVA performed a more detailed assessment of each of these SAMAs to more realistically estimate the risk reduction and/or implementation costs for each SAMA. The revised values are denoted by brackets within Table G-4. Based on this re-assessment, none of the SAMAs is within a factor of three of being cost-beneficial.

G.6.2 Review of TVA's Cost-Benefit Evaluation

The cost-benefit analysis performed by TVA was based primarily on NUREG/BR-0184 (NRC 1997c) and was executed consistent with this guidance. However, TVA considered the "present" to be the year 2016, and therefore, inflated dollar values to the year 2016 using a 3 percent per year inflation rate. This approach was taken for both implementation costs and SAMA benefits.

The TVA BFN license renewal application is made assuming that Unit 1 is returned to service. As described above, the impact of all units operating is accounted for in the SAMA analysis by increasing the Unit 2 risk from the EPU PSA by a factor of four and the Unit 3 risk by a factor of two. The factor of four is obtained from the ratio of Unit 2 CDF in the Multiple-Unit PSA with all units considered operating (Multiple-Unit PSA = 2.8×10^{-5}/yr) to the CDF from the revised Unit 2 IPE, which considered only Unit 2 operating (Unit 2 IPE Rev. 1A [TVA 1995c] = 7.6×10^{-6}/yr). The factor of two used to adjust the Unit 3 risk was based on the judgment that the impact of all units operating would be less for Unit 3 than for Unit 2 because Units 1 and 2 share more equipment than Unit 3 shares with Units 1 and 2. The CDF for Unit 1 was assumed to be equal to the adjusted CDF for Unit 2.

The staff notes that the adjustment factors for multiple-unit operation are based on the total CDF. However, the impact of all units operating will vary from sequence to sequence depending on the failures involved in the sequences. For sequences that involve shared systems (e.g., loss of offsite power), the increase could be larger than the average factors of four (Units 1 and 2) and two (Unit 3), while for other sequences that do not involve significant shared systems, the increase could be smaller.

In response to an RAI (TVA 2004a), TVA assessed the impact of multiple-unit operation on an initiator-specific basis. The impact of multiple-unit operation was found to be greater than the multiplier of four used (for Units 1 and 2) for four initiating events. In three cases, the modeling in the Multiple-Unit PSA was found to be conservative so that the correct impact of multiple-unit operation would be expected to be less than that used (four for Unit 2 and two for Unit 3). In the fourth case, the frequency of the CDF for the initiator is so small that, even if the multiplier of four is used, the benefit of any SAMA that eliminates this initiator would not be cost effective. The impact of three-unit operation could also reduce the availability of the EECW system and the RHRSW system, which are shared between Units 1 and 2. This was also addressed by TVA in response to an RAI (TVA 2004b). While the impact of this on CDF may be larger than the multiplier of four used, the importance of these systems is small enough that the impact on CDF is expected to be so small that it would not lead to cost-effective SAMAs.

There is considerable uncertainty in the validity of the above "correction factors," or multipliers. However, based on a review of the modeling changes made for the Multiple-Unit PSA, other results such as the change in CDF when Unit 3 operation is accounted for (Unit 2 PSA with Unit 3 operating versus Unit 2 IPE Rev. 1A [TVA 1995c]), and the relatively large "effective" CDF after applying these factors compared to the CDF for other similar BWRs, the staff finds that these factors are acceptable for estimating the impact of multiple-unit operation. It is noted that during the course of the review, TVA completed a PSA for Unit 1, based on the expected configuration at the time of restart, including EPU conditions (TVA 2004b). The Unit 1 CDF is 1.86×10^{-6}/yr, which is less than the EPU PSA CDF for Unit 2 used in the SAMA analysis. As such, the use of the Unit 2 CDF with a multiplier of four to represent the Unit 1 CDF appears to be bounding and conservative for the purposes of the SAMA analysis.

In the IPEEE SER, the staff estimated a fire CDF of 1.24×10^{-5}/yr for Unit 2, and 7.5×10^{-6}/yr for Unit 3 (NRC 2000). In response to an RAI, TVA provided the control room fire CDF based on the latest fire analysis. The control room fire CDF for BFN is approximately 1×10^{-5}/yr for Unit 2, which is about a factor of four greater than the internal events CDF of 2.6×10^{-6}/yr for Unit 2 used in the SAMA analysis. TVA stated that the fire CDF values should be considered as upper bound values only, and that the mean CDF resulting from fire-related initiating events in each of the fire areas is judged to be considerably lower than these values (TVA 2004a).

The staff agrees that the BFN fire analysis contains numerous conservatisms and that a more realistic assessment could result in a substantially lower fire CDF. However, the staff believes that the information provided by TVA is not sufficient to ignore the risk contribution from external events. Based on evaluations of past ERs submitted in support of license renewal

applications, the staff believes that a more realistic fire CDF is likely a factor of two to three less than the screening values used in the FIVE methodology. If a factor of three reduction is applied to the BFN fire CDF, the external events (fire) CDF and internal events CDF are comparable. As such, this would justify use of a multiplier of two to the averted cost estimates (for internal events) to represent the additional SAMA benefits in external events. Therefore, the staff applied a multiplier of two to the averted cost estimates (for internal events) to obtain a baseline estimate of the benefits for each SAMA. This implicitly assumes that each SAMA would offer the same percentage reduction in external event CDF and population dose as it offers in internal event CDF and population dose. The adjusted benefit values are shown in Table G-4 for the 43 SAMAs. No SAMAs were found to be cost-beneficial, even after applying a multiplier of two to account for external events.

The staff notes that TVA evaluated a SAMA for a control room fire, which is one of the zones that are large contributors to the fire CDF. The averted cost was estimated to be about $479,000 (Unit 2) and $239,000 (Unit 3). After accounting for multiple-unit operation, the maximum averted cost was estimated to be $4,300,000 for the site (TVA 2004b). The estimated cost to install redundant remote shutdown panels is $5 million per unit. Therefore, this SAMA would not be cost-beneficial.

The staff also considered the impact that further increases in the contribution from analysis uncertainties would have on the estimated costs and benefits. TVA estimated that the ratio of the 95th percentile to the mean CDF is 3.2 and 2.8 for Units 2 and 3, respectively (TVA 2003). The staff considered the impact if the cost and benefits were altered by a factor of three to account for uncertainties. Four SAMAs had estimated benefits within a factor of three of the estimated implementation costs and were further evaluated.

In response to an RAI, TVA re-examined each of these SAMAs. This included re-examining the modeling assumptions that could lead to overestimation of the averted costs and refining the implementations costs to better represent the actual costs that would be incurred. The results of this reassessment are provided in the RAI response (TVA 2004b), and summarized below. The revised values are also reported in Table G-4.

- SAMA B11 involves improving/enhancing procedures for load shedding, which would improve direct current (DC) reliability. The staff estimated the benefit of this SAMA to be $54,000 for the site based on TVA's risk reduction estimate reported in the ER and a multiplier of two to account for external events. Implementation costs were estimated by TVA to be $73,000/unit. However, this is a procedural modification and, therefore, the staff estimates that such a modification would not be three times the estimated cost for three units. Because of similarities between units and shared systems, the staff doubled TVA's implementation cost from $73,000 to $146,000 to obtain a site-wide implementation cost. Thus, this SAMA was within a factor of three of being cost-beneficial. TVA's initial risk reduction estimate was bounding in that it set the unavailability of the three battery boards

to zero. TVA reassessed the potential enhancement and determined that, more realistically, only a 20 percent improvement would be achieved (TVA 2004b). Therefore, the revised benefit, or averted cost, would be 20 percent of the initial value, or approximately $10,800. Additionally, TVA stated that an engineering analysis would be necessary to determine the improvement in unavailability, if any. When compared to the implementation cost of $146,000 for the site, this SAMA is not cost-beneficial, nor would it be when considering uncertainties.

- SAMA G04 involves both procedural improvements and hardware changes for use of cross-tied component cooling or SW pumps, which would reduce the frequency of a loss of component cooling water or SW. The staff estimated the benefit of this SAMA to be $74,000 for the site based on TVA's risk reduction estimate reported in the ER and a multiplier of two to account for external events. Implementation costs were initially estimated by TVA to be $73,000/unit. However, this is a procedural modification, and therefore, the staff estimates that such a modification would not be three times the estimated cost for three units. Due to similarities between units and shared systems, the staff doubled TVA's implementation cost from $73,000 to $146,000 to obtain a site-wide implementation cost. Thus, this SAMA was within a factor of three of being cost-beneficial. According to TVA, this SAMA would require a hardware modification as well as the procedural modification (TVA 2004b). The cost of the hardware modification was not included in the initial implementation cost, and would increase the implementation cost by $77,000/unit to $150,000/unit. Because procedural modification is estimated by the staff to cost $146,000 for the site, the addition of the hardware modification ($77,000/unit or $231,000 for the site) would bring the implementation costs to $377,000 for the site. TVA also noted that the potential benefits are clearly overstated because the frequency of the loss of RBCCW initiator is assumed to be zero, and that the action to align the swing pumps is assumed to occur without error. The staff agrees with the revised implementation costs because of the need to develop new procedure(s), to perform engineering analysis to support procedure development, and to install the required hardware. The staff also agrees that the benefits would be much less if more realistic assumptions are used. The staff concludes that this SAMA has a negative net value. Accordingly, the staff agrees that this SAMA would not be cost-beneficial at BFN even when considering uncertainties.

- SAMA G12c involves the addition of redundant DC control power for the SW pumps, which would increase the reliability of the SW system and decrease the CDF because of a loss of SW. The staff estimated the benefit of this SAMA to be $564,000 for the site based on TVA's risk reduction estimate reported in the ER and a multiplier of two to account for external events. Implementation costs were estimated by TVA to be $1.5 million for the site. Thus, this SAMA was within a factor of three of being cost-beneficial. TVA's initial risk reduction estimate was bounding in that it assumed that charging capability is always available to extend the life of the batteries. The assessment also assumed that if HPCI or RCIC remain constant for 6 hours, then the scenario is successfully terminated. TVA reassessed the potential enhancement using a more realistic, but still bounding, model that assumed that the reliability of every battery would be increased as a result of the addition of

redundant dc control power; however, the unavailability of each battery was assumed to decrease by a factor of two (TVA 2004b). This resulted in a total site benefit of $61,000 (including the multiplier of two to account for external events). The staff finds the implementation cost to be reasonable and comparable to costs provided by other applicants for similar modifications. Additionally, the staff agrees that the original assessment overestimated the benefit, and that the revised assessment is more realistic. Therefore, the staff agrees that this SAMA would not be cost-beneficial even when considering uncertainties.

- SAMA G17 involves the development of procedure(s) to instruct operators to trip unneeded RHR core spray pumps on loss of room ventilation. The staff estimated the benefit of this SAMA to be $71,000 based on TVA's risk reduction estimate reported in the ER and a multiplier of two to account for external events. Implementation costs were estimated to be $73,000/unit. However, this is a procedural modification, and therefore, the staff estimates that such a modification would not be three times the estimated cost for three units. Because of similarities between units and shared systems, the staff doubled TVA's implementation cost from $73,000 to $146,000 to obtain a site-wide implementation cost. Thus, this SAMA is within a factor of three of being cost-beneficial. TVA's initial analysis assumed that the unavailability of the RHR and core spray pumps would be decreased by 20 percent if dependence of room ventilation could be removed. This value was derived from a review of the system analyses; ventilation failures contribute approximately 20 percent to the unavailability of the RHR and core spray (CS) pumps. However, engineering analyses to support the assumption that environmental conditions would remain within pump operability limits if the unneeded pumps were tripped would be required. Additionally, local area temperature time histories would have to be conducted for all three units. TVA stated that the cost of these analyses (engineering and temperature histories) were not included in the original implementation costs (TVA 2004b). The cost for these analyses is estimated to be $110,000/unit; therefore, the total implementation cost would be $476,000 for the site. The staff agrees with the revised implementation costs because of the need to develop new procedure(s) and to perform engineering analyses and other analyses. The staff concludes that this SAMA has a negative net value. Accordingly, the staff agrees that this SAMA would not be cost-beneficial at BFN even when considering uncertainties.

The staff reviewed the SAMAs analyzed by TVA to determine if lower cost alternatives had been evaluated, including the use of portable battery chargers. TVA did evaluate the use of portable battery chargers (SAMA G13) (TVA 2003). The estimated benefit associated with this SAMA is around $52,000 per site. The implementation cost provided by TVA was over $2 million per site. This implementation cost is questionable; however, the staff expects that the realistic implementation costs would be greater than the estimated benefits. In SAMA G10, TVA assessed the use of the fire protection system as a backup source to the drywell spray system. The estimated benefit associated with this SAMA is around $14,000, which is less than

the cost that would be incurred for such a modification. Although the implementation costs provided by TVA appear to be over-estimated, the expected costs would be significantly greater than the estimated benefits. The staff considers the evaluation and estimation of these lower cost alternatives reasonable and acceptable for purposes of the SAMA evaluation.

TVA estimated all costs based on 3-percent and 7-percent real discount rates. When determining if a SAMA was cost-beneficial, TVA used the values based on the 3-percent real discount rate. The use of a 3-percent real discount rate (rather than 7 percent used in the baseline) results in an increase in the maximum attainable benefit of approximately 54 percent. The results of using the 3-percent discount rate are bounded by the staff's averted cost estimates, which applied a multiplier of two to the internal events benefits to obtain a baseline estimate for each SAMA.

The staff concludes that the costs of all of the SAMAs assessed would be higher than the associated benefits. Improvements realized as a result of the IPE and IPEEE processes and resolution of seismic outliers would minimize the likelihood of identifying further cost-beneficial enhancements.

G.7 Conclusions

TVA compiled a list of 135 SAMA candidates based on the major contributors to CDF and LERF at BFN, generic SAMAs based on analyses submitted in support of licensing activities for other nuclear power plants, NRC and industry documents discussing potential plant improvements, and insights from current PSA. A qualitative screening removed SAMA candidates that (1) were not applicable at BFN because of design differences, (2) were related to reactor coolant pumps (RCP) seal leakage, (3) had already been implemented at BFN, (4) were similar in nature to and could be combined with another SAMA, or (5) cost more than $6 million to implement. A total of 92 SAMA candidates were eliminated based on the above criteria, leaving 43 SAMA candidates for further evaluation.

Using guidance in NUREG/BR-0184 (NRC 1997c), the current PSA model, and a Level 3 analysis developed specifically for SAMA evaluation, a more detailed assessment of the costs and benefits was developed for the 43 remaining SAMA candidates. TVA concluded in the ER that none of the candidate SAMAs evaluated would be cost-beneficial for BFN because their implementation costs exceeded their estimated benefits.

The staff reviewed the TVA analysis and concluded that the methods used and the implementation of those methods were sound. The unavailability of a seismic and fire PSA model precluded a detailed quantitative evaluation of SAMAs specifically aimed at reducing risk of these initiators. In view of the relative contribution to risk from fire events indicated from the BFN fire analysis, the staff applied a multiplier of two to the averted cost estimates for each SAMA to account for the potential impact of external events. Even then, however, none of the SAMAs were cost-beneficial.

The staff considered the impact if the cost and benefits were increased by a factor of three to account for uncertainties and determined that four SAMAs could be potentially cost-beneficial. TVA re-examined each of these SAMAs and provided a more realistic estimate of their benefits and/or implementation costs. As a result of this reassessment, the cost-benefit analyses showed that none of the candidate SAMAs was cost-beneficial.

Based on its review of the TVA SAMA analysis, the staff concurs that none of the candidate SAMAs is cost-beneficial. This is based on conservative treatment of costs and benefits. This conclusion is consistent with the low residual level of risk indicated in the BFN PSA and the fact that BFN has already implemented the plant improvements identified from the IPE and IPEEE processes, with the exception of the removal of the transformers, which is scheduled to occur in the future.

G.8 References

Tennessee Valley Authority (TVA). 1992. Letter from Mark O. Medford, TVA, to NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Response to Generic Letter (GL) 88-20 – "Individual Plant Examination for Severe Accident Vulnerabilities – 10 CFR 50.54(f)."

Tennessee Valley Authority (TVA). 1994. Browns Ferry Nuclear Plant Unit 2 Probabilistic Safety Assessment Individual Plant Examination. Revision 1. August 12, 1994.

Tennessee Valley Authority (TVA). 1995a. Letter from Pedro Salas, TVA, to NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Generic Letter (GL) 88-20, Supplement 4, Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities – Partial Submittal of Report

Tennessee Valley Authority (TVA). 1995b. Letter from Pedro Salas, TVA, to NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Multi-Unit Probabilistic Risk Assessment (PRA).

Tennessee Valley Authority (TVA). 1995c. Browns Ferry Nuclear Plant Unit 2 Probabilistic Risk Assessment Individual Plant Examination. Revision 1A. April 13, 1995.

Tennessee Valley Authority (TVA). 1996. Letter from Pedro Salas, TVA, to NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Units 2 and 3 – Generic Letter (GL) 87-02, Supplement 1, Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46 and GL 88-20, Supplement 4, Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities – Submittal of Seismic Evaluation Reports (TAC Nos. M69431, M69432, M83596 and M83597).

Tennessee Valley Authority (TVA). 1997. Letter from T. E. Abney, TVA, to NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Unit 3 – Generic Letter (GL) 88-20, Supplement 4, Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities – Submittal of Report Internal Fires Analysis (TAC No. M83597).

Tennessee Valley Authority (TVA). 2003. *Applicant's Environmental Report–Operating License Renewal Stage, Browns Ferry Nuclear Power Plant Units 1, 2, and 3.* Tennessee Valley Authority, Knoxville, Tennessee.

Tennessee Valley Authority (TVA). 2004a. Letter from Mark J. Burzynski, TVA, to NRC Document Control Desk. Subject: Response to Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3 (TAC Nos. MC1768, MC1769, and MC1770).

Tennessee Valley Authority (TVA). 2004b. Letter from Mark J. Burzynski, TVA, to NRC Document Control Desk. Subject: Response to Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3.

Tennessee Valley Authority (TVA). 2004c. Letter from T. E. Abney, TVA, to NRC Document Control Desk. Subject: Browns Ferry Nuclear Plant (BFN) – Units 2 and 3 – Technical Specifications (TS) Change 448 - One-Time Frequency Extension for Containment Integrated Leakage Rate Test (ILRT) Interval.

U.S. Nuclear Regulatory Commission (NRC). 1988a. Generic Letter 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities."

U.S. Nuclear Regulatory Commission (NRC). 1988b. *Modeling Time to Recovery and Initiating Event Frequency for Loss of Offsite Power Incidents at Nuclear Power Plants.* NUREG/CR-5032.

U.S. Nuclear Regulatory Commission (NRC). 1990. *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants.* NUREG-1150, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1991. *Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities.* NUREG-1407, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1994. Letter from Joseph F. Williams, NRC, to Oliver D. Kingsley, Jr., TVA. Subject: Browns Ferry Nuclear Plant Unit 2 – Individual Plant Examination Submittal for Internal Events (TAC No. M74385).

U.S. Nuclear Regulatory Commission (NRC). 1997a. *Individual Plant Examination Program: Perspectives on Reactor Safety and Plant Performance.* NUREG-1560, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1997b. Memorandum to File from Joseph F. Williams, NRC. Subject: Browns Ferry Nuclear Plant Units 2 and 3 Probabilistic Safety Assessments.

U.S. Nuclear Regulatory Commission (NRC). 1997c. *Regulatory Analysis Technical Evaluation Handbook.* NUREG/BR-0184, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Rates of Initiating Events at U.S. Nuclear Power Plants.* NUREG/CR-5750, Idaho National Engineering and Environmental Laboratory.

U.S. Nuclear Regulatory Commission (NRC). 2000. Letter from William O. Long, NRC to J. A. Scalice, TVA. Subject: Browns Ferry Units 1, 2 and 3, Individual Plant Examination of External Events (IPEEE) and Related Generic Safety Issues, Issuance of Staff Evaluation (TAC Nos. M83595, M83596, M83697).

U.S. Nuclear Regulatory Commission (NRC). 2004. Letter from Michael T. Masnik, NRC to J. A. Scalice, TVA. Subject: Request for Additional Information (RAI) Regarding Severe Accident Mitigation Alternatives for the Browns Ferry Nuclear Plant, Units 1, 2, and 3 (TAC Nos. MC1768, MC1769, and MC1770).

NRC FORM 335 (9-2004) NRCMD 3.7

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, If any.)

NUREG-1437, Supplement 21

2. TITLE AND SUBTITLE

Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)
Supplement 21
Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3
Final Report

3. DATE REPORT PUBLISHED

MONTH	YEAR
June	2005

4. FIN OR GRANT NUMBER

5. AUTHOR(S)

6. TYPE OF REPORT

Technical

7. PERIOD COVERED *(Inclusive Dates)*

8. PERFORMING ORGANIZATION - NAME AND ADDRESS *(If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)*

Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS *(If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)*

Same as 8 above

10. SUPPLEMENTARY NOTES

Docket Numbers 50-259, 50-260, 50-296

11. ABSTRACT *(200 words or less)*

This final supplemental environmental impact statement (SEIS) has been prepared in response to an application submitted to the NRC by Tennessee Valley Authority (TVA) to renew the operating licenses for Browns Ferry Nuclear Plant, Units 1, 2, and 3 (BFN) for an additional 20 years under 10 CFR Part 54. The final SEIS includes the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. It also includes the staff's recommendation regarding the proposed action.

The NRC staff's recommendation is that the Commission determine that the adverse environmental impacts of license renewal for BFN are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. This recommendation is based on (1) the analysis and findings in the GEIS; (2) the Environmental Report submitted by TVA; (3) consultation with Federal, State, and local agencies; (4) the staff's own independent review; and (5) the staff's consideration of public comments.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

Browns Ferry Nuclear Plant, Units 1, 2, and 3
BFN
Browns Ferry
Final Supplement to the Generic Environmental Impact Statement
FSEIS
National Environmental Policy Act
NEPA
License Renewal
GEIS

13. AVAILABILITY STATEMENT

unlimited

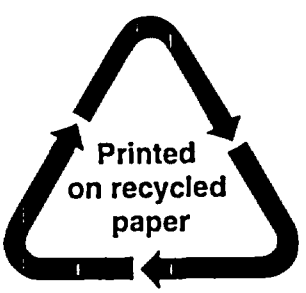
14. SECURITY CLASSIFICATION

(This Page) unclassified

(This Report) unclassified

15. NUMBER OF PAGES

16. PRICE



Federal Recycling Program

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

OFFICIAL BUSINESS