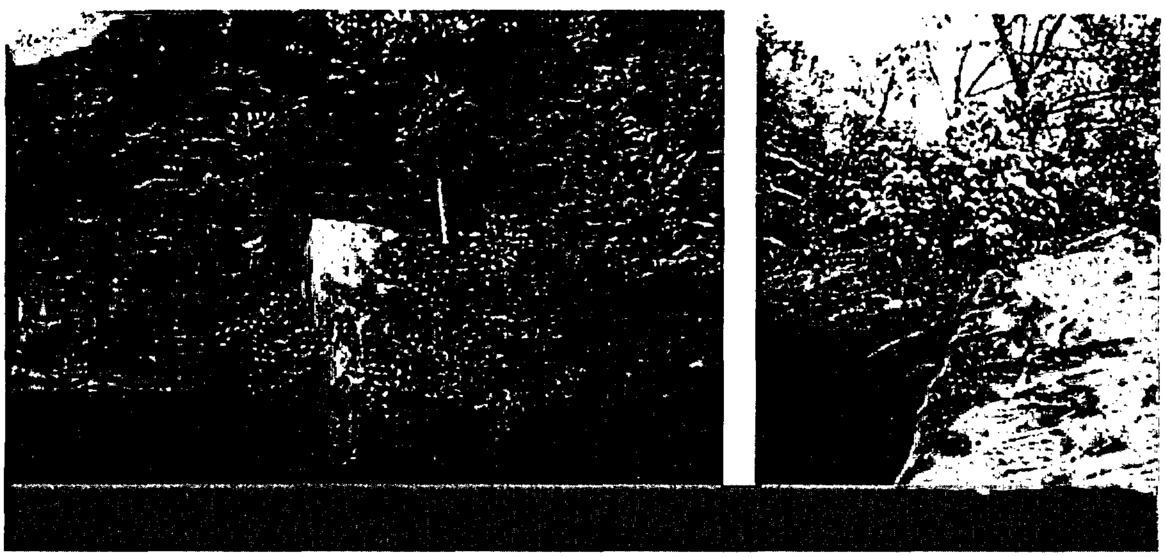
Environmental Assessment Bear Creek Reservoirs Land Management Plan



FINDING OF NO SIGNIFICANT IMPACT (FONSI)

BEAR CREEK RESERVOIRS LAND MANAGEMENT PLAN
FRANKLIN, MARION, AND WINSTON COUNTIES, ALABAMA

Background
TVA develops reservoir land management plans to assist in managing the public lands around its lakes. In the late 1960s and 1970s, TVA constructed four reservoirs in the Bear Creek watershed of northwestern Alabama. Lands above the maximum projected pool level were acquired by TVA for recreational and residential development and reservoir and shoreline protection. Lands bought through negotiation were acquired in the name of the Bear Creek Development Authority, while lands acquired through eminent domain were acquired in the name of the U.S. (TVA). In 1997, BCDA transferred 11,879 acres of land to TVA, including much of the land inundated by the reservoirs as well as other lands above the normal summer pool. In order to determine future management direction for this land and the previously acquired TVA land, TVA has prepared a land allocation plan for TVA-owned land on the four reservoirs of the Bear Creek watershed. TVA currently owns 930 ha (2,296 acres) of land above normal pool on Bear Creek Reservoir, located between Red Bay and Hackleburg; 1,112 ha (2,747 acres) of land above normal pool on Cedar Creek Reservoir, located between Red Bay and Russellville; 1,196 ha (2,955 acres) of land on Upper Bear Creek Reservoir, located east of the town of Bear Creek; and 478 ha (1,180 acres) of land on Little Bear Creek Reservoir, located between Cedar Creek and Bear Creek Reservoir. The proposed land allocation plan is the first to be prepared for the four northwest Alabama reservoirs. Lands administered by the BCDA were not allocated in this planning effort.

TVA notified the public and environmental agencies of its land planning effort for the Bear Creek Reservoirs by letter in February 1999 and through a public meeting on February 23, 1999. At the public meetings, there was much concern over the status of private docks that had been previously approved by the BCDA, in addition to land allocation issues. In order to reassure those citizens who had water use facilities of TVA's intentions in regard to facility permitting, TVA decided to complete a separate EA on the grandfathering of approximately 180 private docks which existed on the lands transferred from BCDA in 1997. The environmental impacts of grandfathering existing docks on three reservoirs were assessed in a separate EA and FONSI completed on May 24, 2000. This May 2000 EA described facility standards, including vegetation management, needed as part of TVA's approval for grandfathering of the docks. Existing docks were grandfathered, in accordance with the 1999 Shoreline Management EIS and Record of Decision.

A draft EA on the land allocations was released for comment in April 2000. Comments were received by mail and at public meetings held on April 27, 2000, in the town of Phil Campbell and on May 9, 2000, in Belgreen. After considering all comments, TVA developed a Final Environmental Assessment and Land Management Plan. The major issue in public comments was the status of lake properties and the determination whether these properties were allocated to residential access (zone 7) or resource conservation uses (zone 3, Sensitive Resource Management; or zone 4, Natural Resource Conservation). Property owners who owned land adjacent to the reservoir, but who did not have residential access rights, requested that they be granted these rights. In the final plan, TVA proposes to grant residential access rights subject to Section 26a review for docks only when these properties are located in a shoreline reach where a cluster of previously permitted docks already exists, where deeded access rights exist, or adjacent to potential BCDA subdivisions. Also, in the proposed final plan, the allocation of three parcels fronting BCDA property was changed from Zone 7 (Residential Access) to Zone 4 (Natural Resource Conservation), at the request of BCDA. BCDA indicated that these lands were not planned for residential subdivision development and therefore residential access designations would not be appropriate.

Agencies commenting on the land plan draft included the U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (FWS), and Alabama Historical Commission. USACE, by letter of June 14, 2000, indicated no comments at this time. FWS, by letter of June 15, 2000, concurred with selection of Alternative B and indicated that species diversity and abundance would likely increase. AHC requested that the EA address archaeological monitoring. Because the potential effects on historic properties are regional in scope and cannot be fully determined prior to the approval of the land plan, and plan implementation has the potential to affect historic properties eligible for listing in the National Register of Historic Places, TVA initiated efforts to prepare a Programmatic Agreement (PA) consistent with regulations implementing the National Historic Preservation Act. The PA includes provisions for monitoring of reservoir shorelines. The PA was executed in February 2001. The Advisory Council for Historic Preservation, TVA, the Alabama State Historic Preservation Officer, the Eastern Band of Cherokee Indians, and the Chickasaw Nation are signatories in the PA, and the Alabama Indian Affairs Commission is a concurring party.

Alternatives

The EA evaluates the potential environmental impacts of two alternatives, no action (Alternative A), and the proposed Reservoir Land Management Plan (Alternative B). The EA and accompanying Land Use Plan are attached and incorporated by reference. Under Alternative A, TVA would continue management of its properties pursuant to TVA policies, including the recently adopted Shoreline Management Policy, without benefit of a land management plan. Requests for use of TVA land would be handled on a case-by-case basis. Approximately 288 ha (712 acres) fronting BCDA lands on Upper Bear, Cedar, and Little Bear Creek Reservoirs are potentially developable over the long term, and another 2,834 ha (7000 acres) are undesignated. In the interim, TVA would likely continue basic land stewardship activities such as boundary maintenance and property protection on these lands. Land that has been previously conveyed for particular uses would remain in that use. Rights for water use facilities would exist for the existing grandfathered sites; and on two subdivisions developed by BCDA--Tanglewood Subdivision on Upper Bear Creek and Lick Creek Cove on Cedar Creek.

Under Alternative B, 3,716 ha (9,178 acres) would be allocated into six planning zones, as follows: TVA Project Operations (344.7 ha or 851.4 acres), Sensitive Resource Management (2,805.3 ha or 6,929.2 acres), Natural Resource Conservation (213.3 ha or 526.8 acres), Industrial/Commercial Development (5.5 ha or 13.7 acres), Recreation (249.3 ha or 615.7 acres), and Residential Access (97.7 ha or 241.3 acres). The planning zones in Alternative B take into account the results of resource inventories for sensitive resources such as rare species, archaeological resources, significant visual resources, and wetlands. As a result of these inventories, additional Habitat Protection Areas and a Small Wild Area are proposed to be designated. Alternative B grandfathers previous land use commitments and allocates uncommitted TVA land to zones emphasizing resource stewardship. Residential access would be considered on land where groups of shoreline alterations have already been approved or areas where outstanding rights exist for such requests. In addition, residential access would be granted on three parcels adjacent to BCDA lands subject to Section 26a review, should BCDA decide to grant these rights.

Impacts Assessment

Under either alternative, the EA finds that impacts to environmental resources would be insignificant. Under Alternative A, the individual project review process would avoid or minimize impacts to sensitive environmental resources. By contrast, Alternative B provides enhanced protection to sensitive resources (such as cultural sites, wetlands, and rare species) by allocating certain lands (75 percent) to the Sensitive Resource Management category, thereby reducing the potential that these sensitive lands would be put to incompatible uses. Sensitive resources would be further protected by establishment of buffer zones around cave entrances and through administrative designation of habitat protection areas and a small wild area on tracts supporting rare plants and animals and uncommon ecological communities. The EA identifies Alternative B as the preferred alternative since it emphasizes conservation while continuing to allow compatible public uses on certain tracts.

Conclusion and Findings

As indicated above, TVA prepared a PA to ensure that the effects on historic properties are taken into account in lands planning and plan implementation on the Bear Creek Reservoirs. Execution and implementation of the PA evidences that TVA has taken into account the effects on historic properties and TVA has complied with its obligations under Section 106 of the National Historic Preservation Act.

TVA also consulted with FWS on impacts to federally-listed endangered and threatened species. The June 15, 2000, letter from the FWS indicated that Alternative B would result in improved natural resources protection and management benefiting the gray bat and the bald eagle. Thus, TVA concludes that the requirements of Section 7 of the Endangered Species Act have been met.

After review of the EA, we agree that the proposed allocation of 9,178 acres of land on the four Bear Creek Reservoirs into six planning zones would not have a significant impact on the quality of the environment. Accordingly, an environmental impact statement is not required. This FONSI is contingent upon successful implementation of the provisions of the "Programmatic Agreement Among the Tennessee Valley Authority, The Advisory Council on Historic Preservation, and the Alabama State Historic Preservation Officer Regarding the Implementation of Reservoir Land Management Plans in Alabama" and the commitments contained in Section 3.13 of the attached EA.

Harold M. Draper — March 13, 2001

Jon M. Loney — Date
for Manager, NEPA Administration
Environmental Policy & Planning
Tennessee Valley Authority

ENVIRONMENTAL ASSESSMENT
BEAR CREEK RESERVOIRS
LAND MANAGEMENT PLAN

RESOURCE STEWARDSHIP
Pickwick Watershed Team

TENNESSEE VALLEY AUTHORITY

March 2001

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Approved by TVA Board of Directors
March 28, 2001

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Acronyms and Abbreviations

ADEM	Alabama Department of Environmental Management
ADT	Average Daily Traffic
ALNHP	Alabama Natural Heritage Program^{SM}
ARPA	Archaeological Resources Protection Act
BCDA	Bear Creek Development Authority
BCEEC	Bear Creek Environmental Education Center
BCM	Bear Creek Mile
BCWA	Bear Creek Watershed Association
BMPs	Best Management Practices
CAA	Clean Air Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	Carbon Monoxide
CWA	Clean Water Act
DEA	Draft Environmental Assessment
DO	Dissolved Oxygen
EA	Environmental Assessment
EM	Emergent
EO	Executive Order
EPA	Environmental Protection Agency
EIS	Environmental Impact Statement
FO	Forested
HU	Hydrologic Unit
LBMP	Little Bear Millennium Project
L/min	Liters per minute
LMA	Labor Market Area
LOS	Level of Service
m	meters
mg/m^3	milligrams per cubic meter
m/km	meters per kilometer
msl	mean sea level

$\mu g/m^3$	Micrograms per cubic meter
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	Nitrogen Dioxide
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
O_3	Ozone
P	Palustrine
PA	Programmatic Agreement
Parkway	Natchez Trace Parkway
Pb	Lead
Plan	Reservoir Land Management Plan
PM	Particulate matter
ppm	Parts per million
PSD	Prevention of Significant Deterioration
ROD	Record of Decision
SHPO	State Historic Preservation Office
SMI	Shoreline Management Initiative, TVA
SMP	Shoreline Management Policy, TVA
SO_2	Sulfur Dioxide
SS	scrub-shrub
TVA	Tennessee Valley Authority
U. S.	United States
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U. S. Geological Survey
Waterway	Tennessee-Tombigbee Waterway
WUF	Water-Use Facility

1. PURPOSE OF AND NEED FOR ACTION

1.1 Background

In October 1961, local citizens in Franklin, Colbert, Marion, and Winston Counties, Alabama, and in Tishomingo County, Mississippi, organized the Bear Creek Watershed Association (BCWA), a nonprofit economic development organization. The association was chartered under Alabama law "to plan, promote, and sustain a program of full development of the land and water resources of the Bear Creek watershed." Association members soon recognized that prevention of flooding of farmland, the need for a wider range of recreational opportunities, and expanding water demands represented the primary needs of the area. As plans began to develop, these local citizens also became aware that their loose, informal association could not execute the necessary contracts, acquire and use public funds, and carry out long-range plans necessary to achieve their purposes. In 1965, at the urging of the citizens of northwest Alabama, the state legislature created the Bear Creek Development Authority (BCDA). BCDA was organized as a "public corporation and political subdivision of the state of Alabama." The Tennessee Valley Authority (TVA) and BCDA became the two agencies primarily responsible for developing the Bear Creek watershed.

Literally hundreds of citizens were active members of BCWA through their involvement in various work groups. Work groups, including agriculture, business and industry, forestry, human resources and education, health, minerals, recreation, water supply and use, and public finance and services worked on many worthwhile projects. They adopted objectives and developed specific annual workplans in support of the objectives.

TVA Involvement With BCWA and BCDA

TVA has responsibilities under the TVA Act relating to the control and use of the Tennessee River and its tributaries, and the development and use of the resources of the Tennessee Valley. Since 1933, TVA has cooperated with other public agencies, landowners, and industries in comprehensive resource development in the Tennessee Valley region. In the late 1950s and early 1960s, TVA began an initiative to duplicate benefits that had occurred on the mainstream Tennessee River to its tributaries. This initiative developed from a broad base of support within TVA. Many TVA programs began working with groups of citizens in the tributary areas to help plan and implement projects in fields, such as education, agriculture, forestry, and community and economic development. In 1961, the Office of Tributary Area Development was established to coordinate TVA's program activities with other cooperating public agencies and with representative citizen groups active in furthering resource development in tributary areas.

These citizen groups formed associations such as BCWA, and it was not unusual to have several hundred members from all backgrounds in each association. These associations became strong supporters of TVA and its programs. Also, the associations were formidable lobby groups for their respective regions. As their activities increased, it was recognized that a stronger legal entity would be necessary. State legislatures were petitioned, and independent state agencies such as BCDA were formed. These agencies have broad enabling legislation for "comprehensive resource development activities" in their respective regions.

TVA programs and activities with BCDA and BCWA multiplied during the 1960s. Many brainstorming and planning sessions were held with large groups of citizens to determine the best resource development activities possible. Numerous projects were conducted, including erosion control, tree planting, junk car removal, recreation planning, rural fire protection, and downtown revitalization projects. The most evident results of these planning sessions are the existing tributary dams and reservoirs. These were planned for flood control, water supply, recreation, and economic development.

In order to construct the dams and reservoirs, TVA received special congressional appropriations. Land was acquired by negotiation and, in some cases, through eminent domain. Generally, land bought by negotiation was acquired in BCDA's name, which in turn granted TVA a first mortgage on that land. Land acquired through eminent domain was acquired in the name of the United States (U.S.) Government where it remains until needed for specific development projects or program purposes.

To achieve all the expected benefits of these projects, land above the projected maximum pool level was obtained. This land was intended for recreational development, residential development, and reservoir and shoreline protection. BCDA's mission is to help achieve expected benefits of these projects to the entire watershed by developing and selling residential lots and using the proceeds for resource development projects throughout the watershed. In recognition of the numerous benefits provided by the development of the reservoirs, a local obligation was created whereby BCDA agreed to repay TVA $2,500,000. In lieu of cash payments to TVA, BCDA has a set schedule of area development credits to achieve. Specific guidelines have been established for the use of area development funds generated by BCDA. In the event of default by BCDA on any portion of its area development obligation, the remaining obligation is due and payable in cash.

TVA has an operating agreement with BCDA (Contract TV-64000A) which describes the responsibilities of each party. Generally, this agreement provides for BCDA to have responsibility for development, operation, and maintenance of public recreation facilities, development and sale of residential property, and provision of area development programs. Until late 1997, BCDA also had management responsibility for all shoreline property and permitting of water-use facilities. TVA's Pickwick Watershed Team now has that responsibility.

In 1997, in accordance with Contract TV-64000A, BCDA transferred approximately 12,000 acres of land to TVA. This included much of the land inundated by the reservoirs as well as many acres above the normal summer pools. TVA determined that a land management plan would assist in future management of this land. In order to meet their future development responsibilities, BCDA retained most of the land that was considered developable in initial project planning efforts, while transferring to TVA much of the land that was originally intended for shoreline protection.

The Project

The Bear Creek Project consists of four dams and reservoirs (Bear, Upper Bear, Little Bear, and Cedar), a 9-mile floodway along an 18-mile stretch below Bear Creek Dam, and a 26-mile recreational floatway below Upper Bear Dam. The reservoirs have a combined surface area of 8,300 acres and a shoreline length of approximately 284 miles. Flood control features of the project substantially reduce flooding on about 15,000 acres of farmland. The project provides other benefits by adding controlled flood storage to the TVA control system.

Generally, land was acquired above the maximum pool elevations to minimize severance damage, to avoid leaving land which would be without access in private ownership, and to ensure effective development and use of the shoreline.

<u>Bear Creek Dam and Reservoir</u>

Construction was completed in 1969 at a cost of $4.5 million. The dam is located at Bear Creek Mile (BCM) 74.6 in Franklin County, Alabama, 30 miles southwest of Sheffield and 10 miles southeast of Red Bay. The reservoir lies partly within Franklin and Marion Counties. The reservoir provides flood control, recreation, and environmental education benefits.

For project data on Bear Creek Reservoir, see Table 1.1-1.

Table 1.1-1. Bear Creek Reservoir Project Data	
TVA land (acres)	2,296
Length of reservoir	12 miles
Length of shoreline	52 miles
Spillway crest elevation	602 feet msl
Top of dam elevation	618 feet msl
June 1 summer level	576 feet msl
January 1 winter level	565 feet msl
Impoundment at elevation 576	690 acres; volume of 9,600 acre-feet

Cedar Creek Dam and Reservoir

Construction was completed in 1979 at a cost of $8.9 million. The dam is located at Cedar Creek Mile 23.1 in Franklin County, Alabama, 22 miles southwest of Sheffield and 14 miles west of Russellville. The reservoir lies entirely within Franklin County. The reservoir provides flood control, recreation, and residential development benefits.

For project data on Cedar Creek Dam and Reservoir, see Table 1.1-2.

Table 1.1-2. Cedar Creek Reservoir Project Data	
TVA land (acres)	2,747
Length of reservoir	9 miles
Length of shoreline	83 miles
Spillway crest elevation	584 feet msl
Top of dam elevation	597 feet msl
June 1 summer level	580 feet msl
January 1 winter level	566 feet msl
Impoundment at elevation 580	4,200 acres; volume of 93,940 acre-feet

Upper Bear Creek Dam and Reservoir

Construction was completed in 1978 at a cost of $5.9 million. The dam is located at BCM 114.7 in Marion County, Alabama, 5 miles northwest of Haleyville and 16 miles southwest of Russellville. The reservoir lies in Franklin, Marion, and Winston Counties. The reservoir provides flood control, water supply, recreation, and residential development benefits.

For project data on Upper Bear Creek Dam and Reservoir, see Table 1.1-3.

Table 1.1-3. Upper Bear Creek Reservoir Project Data	
TVA land (acres)	2,955
Length of reservoir	14 miles (2 arms at 7 miles each)
Length of shoreline	105 miles
Spillway crest elevation	799 feet msl
Top of dam elevation	813 feet msl
June 1 summer level *	797 feet msl
Impoundment at elevation 797	1,850 acres; volume of 37,400 acre-feet

*Reservoir storage is used to supply water for the Bear Creek Floatway. Normally the reservoir is drawn down to elevation 793 during the summer months.

Little Bear Creek Dam and Reservoir

Construction was completed in 1976 at a cost of $4.4 million. The dam is located at Little BCM 11.6 in Franklin County, Alabama, 27 miles southwest of Sheffield and 15 miles west of Russellville. The reservoir lies entirely within Franklin County. The reservoir provides flood control, water supply, recreation, and residential development benefits.

For project data on Little Bear Creek Reservoir, see Table 1.1-4.

Table 1.1-4. Little Bear Creek Reservoir Project Data	
TVA land (acres)	1,180
Length of reservoir	6 miles
Length of shoreline	45 miles
Spillway crest elevation	623 feet msl
Top of dam elevation	638 feet msl
June 1 summer level	620 feet msl
January 1 winter level	608 feet msl
Impoundment at elevation 620	1560 acres; volume of 45,320 acre-feet

1.2 Purpose and Need for Action

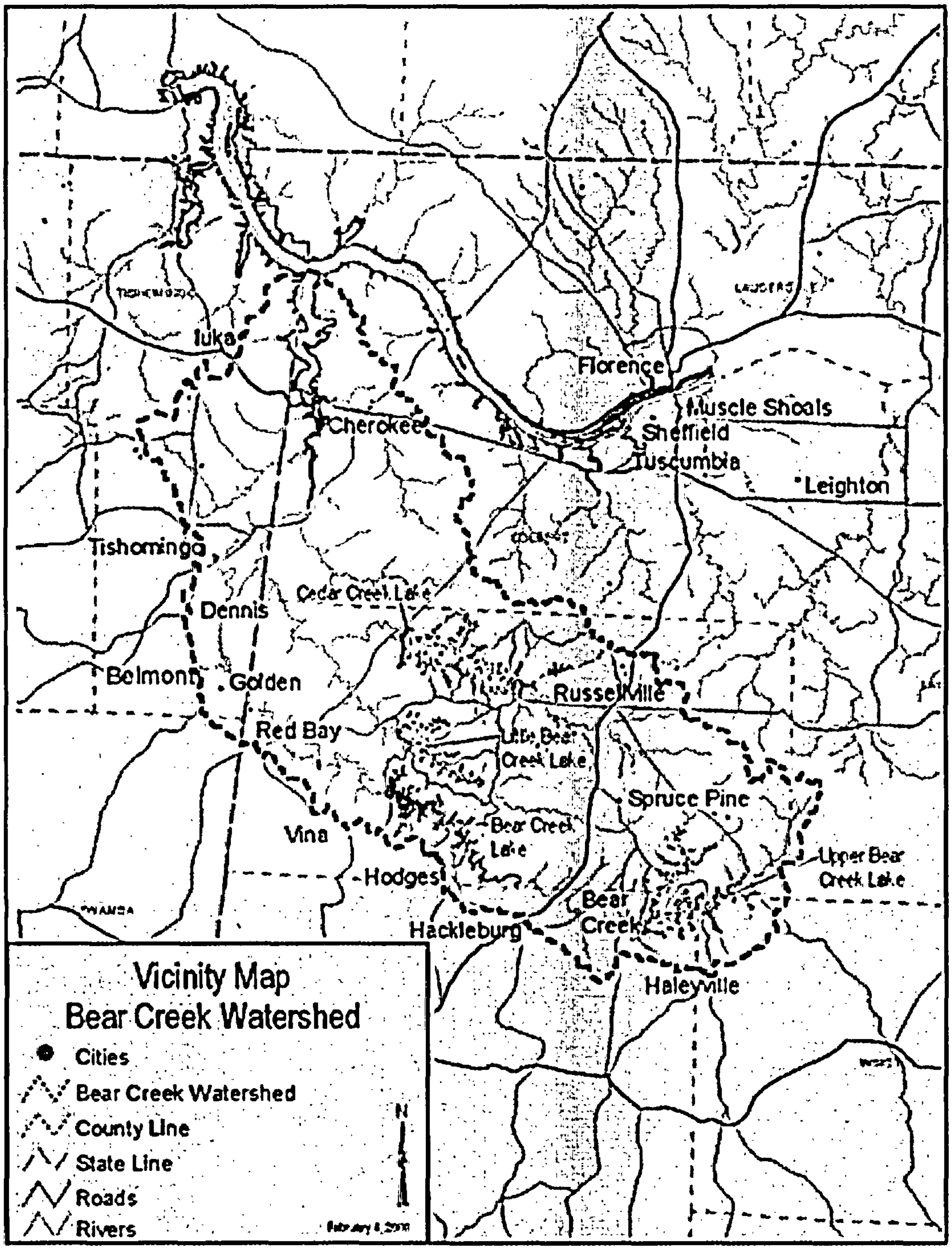
In order to systematically manage its land, TVA develops reservoir land management plans. These plans seek to integrate land and water resources, provide for the optimum public benefit, and balance competing and sometimes conflicting resource uses. By providing a clear statement of how TVA intends to manage land and by identifying each parcel for specific purposes, TVA hopes to balance conflicting land uses and facilitate decision making for use of its land. Plans are approved by the TVA Board of Directors, and adopted as agency policy to provide for long-term land stewardship and accomplishment of TVA's mission under the 1933 TVA Act.

During the planning and feasibility evaluations for the Bear Creek Project, land was identified for various project purposes. This included land necessary for the reservoirs, reservoir and shoreline protection, recreation, and residential development. Acquisition decisions regarding land above the reservoir pool were based primarily on general topographical considerations. Since that time, with the exception of planning evaluations for specific recreation facilities, no general land plan has been prepared for the Bear Creek Project.

Land management plans have been completed and implemented for seven mainstream and two tributary reservoirs, and are now being developed for selected tributary reservoirs and mainstream reservoirs with plans older than 10 years. The purpose of this Environmental Assessment (EA) is to examine the impacts of possible alternative uses of TVA's remaining land on the Bear Creek Reservoirs. Refer to Figure 1.2-1 for a map of the area.

This EA is accompanied by the Bear Creek Reservoirs Land Management Plan. The two documents are intended to be read together.

Figure 1.2-1. Map of Bear Creek Reservoirs



1.3 Other Pertinent Environmental Reviews or Documentation

In 1972, TVA completed an Environmental Impact Statement (EIS) for the proposed development of a four-reservoir multipurpose water resource development project, the Bear Creek Project. In that report, TVA addressed the environmental and socioeconomic consequences of constructing the project.

Development of the Water Resources of the Bear Creek Watershed (TVA, 1965). In 1965, TVA reported the results of comprehensive investigations leading to a proposal for multiple-purpose development of the water resources of the Bear Creek watershed. The proposed plan of development consisted of four dams and reservoirs and approximately 80 miles of channel improvements.

Tennessee River and Reservoir System Operation and Planning Review (TVA, 1990). In December 1990, TVA completed an EIS addressing changes to the operation of its reservoir system, with emphasis on water quality and reservoir levels. In the EIS, TVA also addressed the environmental and socioeconomic consequences of changes in reservoir operations on land and shoreline development. Following completion of the review, TVA delayed the late summer drawdown of tributary reservoirs until August 1. It also began a systemwide program, now nearing completion, to improve water quality below dams.

Shoreline Management Initiative (SMI): An Assessment of Residential Shoreline Development Impacts in the Tennessee Valley (TVA, 1999a). In 1999, TVA completed an EIS on residential shoreline development impacts throughout the Tennessee Valley. The Record of Decision (ROD) for SMI was signed on May 24, 1999. The Blended Alternative, adopted in the ROD, established the premise that no additional residential access rights will be granted across public shorelines unless a "maintain and gain" policy to prevent losses of public shoreline is implemented. SMI acknowledged TVA's long-standing contractual agreements with other agencies providing economic development of project lands on Bear Creek, Tims Ford, Tellico, and Beech Reservoirs. Individual land management plans for these reservoirs will determine the level of additional development that may be pursued by these agencies. However, the Bear Creek Reservoirs Land Management Plan would comply with SMI to the extent allowable by the terms and conditions of the existing Contract TV-64000A.

1.4 The Decision

The TVA Board of Directors would decide whether to adopt a new Bear Creek Reservoirs Land Management Plan to guide implementation of future policy or continue the use of existing TVA policies.

1.5 Public Involvement and Issue Identification

Obtaining a broad range of public comment is an important initial step in the planning and environmental evaluation of TVA land in the Bear Creek Project. Two key actions between TVA and BCDA occurred during 1998 that have generated much public speculation and anticipation concerning the Bear Creek Project—the transfer of direct shoreline management responsibilities from BCDA to TVA, and the transfer of BCDA land considered unnecessary for accomplishing its goals to TVA. The shoreline management change raised issues of possible changes in issuance of water-use facility permits and new charges for use of TVA land by adjoining private property owners.

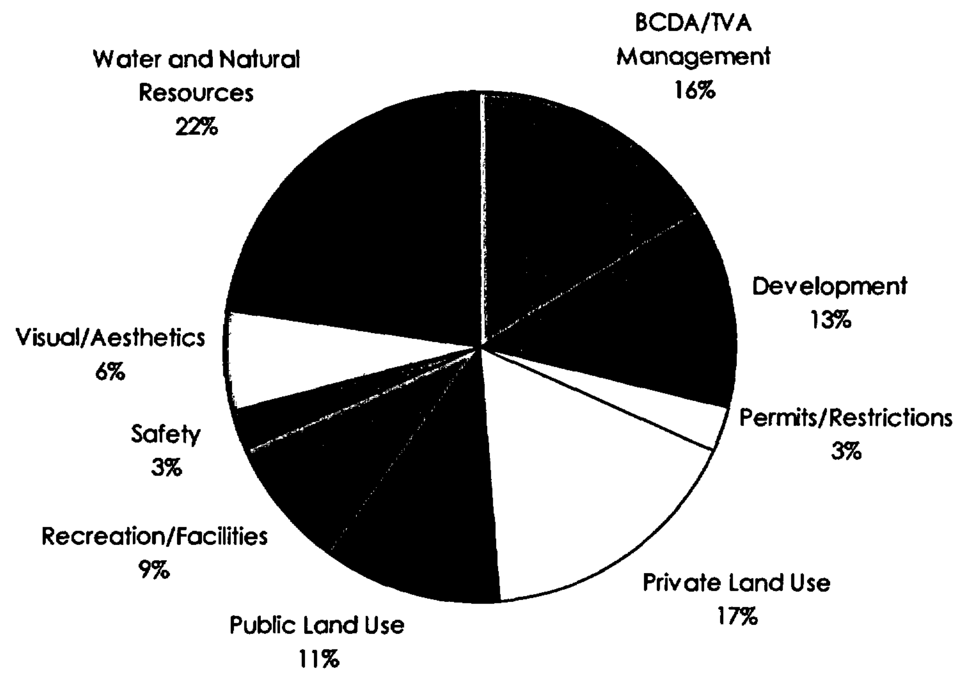
TVA conducted formal public scoping from February through March, 1999. Public input was solicited with news releases in five major area newspapers that announced a public meeting and offered various means by which the public could provide written and verbal comments (i.e., written, e-mail, or phone). During the scoping process TVA staff also met with the BCDA Board of Directors and local government officials. A public meeting was held in Phil Campbell, Alabama, at the Northwest Shoals Community College campus on February 23, 1999. Attendees were invited to participate in small group facilitated discussions to solicit information regarding what they valued about Bear Creek Project public lands, and what issues should be addressed in formulating a land management plan. Figure 1.5-1 displays the major issues that were raised during the small group discussions. Percentages reflect the relative priority given to an issue by participants.

In summary, attendees stated that they value water quality and protection of natural resources, limited and restricted development and timber cutting around the lake, providing land access for private water-use facilities, preserving private and public use, providing fishing and water sport opportunities, and the natural beauty of the area.

Participants reported that the major problems or issues for consideration over the next 10 years include: loss of water quality, maintaining lake levels for recreation use, a fair shoreline management program, the lease/resale of property to adjoining property owners, TVA's fairness in dealing with landowners concerning shoreline management, BCDA's role in residential development, and day-use fees and permits.

Additional issues raised included boating safety and the need for patrols around the lake, control of litter and livestock pollution, loss of natural state due to development and increased population, and the need for more boating docks and ramps. A complete listing of responses and comments was shown in Appendix B of the draft EA (DEA) (TVA, 2000).

Figure 1.5-1. Major Issues Raised During Small Group Discussions



A survey instrument was developed and distributed as an additional means of soliciting public input. The public notices and toll-free number referenced the survey and encouraged citizens to request a survey as a means of providing input. Approximately 250 surveys were mailed to public officials, lake users, adjoining private property owners, and other agencies. Additionally, surveys were placed in areas receiving high visitation from users of the TVA land and Bear Creek Lakes, including area bait shops, the BCDA office, and the Bear Creek Environmental Education Center (BCEEC).

One hundred and three surveys were returned. Survey results revealed that the primary uses for all four lakes are fishing and boat launching, while the primary uses of the floatway are canoeing and kayaking. Respondents expressed that they would use the land on Cedar Creek for special events, golfing, hiking, and marina/boating if facilities and opportunities existed. In regard to Bear Creek, respondents expressed a need for boat launching and hiking opportunities. In reference to Little Bear, respondents expressed they would support golfing, hiking, and bicycle riding, while in regard to Upper

Bear, respondents would support golfing and marina/boating facilities. In reference to the floatway, respondents expressed support for hunting opportunities. The survey document, and a complete listing of comments were included in Appendix B of the DEA.

Issue Identification

Internal scoping and historical information, as well as comments from the general public, public officials, stakeholders, peer agencies, and focus groups were used to identify the following resources/issues that are considered in this EA:

- Aesthetics and visual resources
- Cultural resources
- Endangered and threatened species and species of concern
- Terrestrial ecology, natural areas, and other significant natural features
- Wetlands and riparian areas
- Recreation
- Water quality
- Aquatic ecology
- Socioeconomic impacts
- Air quality
- Floodplains
- Infrastructure and utilities
- Traffic

After the DEA was issued in March 2000, public meetings were held to solicit additional public input at the Phil Campbell, Alabama, Community Center on April 27, 2000, and at the Belgreen, Alabama, High School on May 9, 2000. At these open house type meetings, the public was encouraged to submit comments either in writing, or verbally to a court stenographer for transcription. An additional open house was conducted on January 9, 2001, for public review of changes that were made to the draft document.

As a result of public input, changes in allocations were made to six parcels. Three parcels fronting BCDA property were changed from Zone 7-Residential Access to Zone 4-Natural Resource Conservation. Three parcels fronting private residential developments were changed to Zone 7-Residential Access; one from Zone 4-Natural Resource Conservation and two from Zone 3-Sensitive Resource Management. One new parcel, Zone 5-Industrial/ Commercial, was created from portions of the Little Bear Dam Reservation. This 14-acre parcel was created due to a pending request for a water treatment plant at this site. Since the DEA, the request has been withdrawn; however, the planning team decided to leave the Zone 5 allocation.

1.6 Necessary Federal Permits or Licenses

No federal permits are required to develop a reservoir land management plan. To the extent possible, site-specific information on reservoir resources has been characterized in this EA, and potential impacts on these resources were considered in making land use allocations. Appropriate agencies regulating wetlands, endangered species, and historic resources have been consulted during this planning process. When specific actions, such as a dock, building, road, or walking trail are proposed that could affect sensitive resources, additional review and appropriate permits or consultations may be required in order to gain approval for the action.

In accordance with Section 7 of the Endangered Species Act, the land plan was reviewed by the U.S. Fish and Wildlife Service (USFWS). By letter of June 15, 2000, USFWS indicated that Alternative B would benefit federal-listed species.

In order to take historic properties into account, TVA executed a Programmatic Agreement (PA) that will apply to implementation of all reservoir land plans in the state of Alabama. The PA evidences that TVA has complied with Section 106 of the National Historic Preservation Act for the Bear Creek Reservoirs Land Management Plan.

2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This chapter describes the alternatives for implementation of the proposed action and summarizes the environmental consequences associated with each alternative.

2.1 The Proposed Action

The proposed action is to formulate a comprehensive Reservoir Land Management Plan (Plan) for 171 parcels of TVA public land on the Bear Creek Reservoirs. The Plan is intended to provide a clear statement of how TVA would manage its land in the future, based on scientific, cultural, and economic principles. This Plan will address sensitive resources and issues and concerns raised by the public and major stakeholders. In the Plan, TVA will also seek to integrate management of land and water resources to provide increased public benefits and to balance competing and sometimes conflicting resource uses. The Plan is intended to guide TVA resource and property management decisions for the foreseeable future.

2.2 Alternatives

TVA is considering two alternatives for making land use decisions for the 9,178 acres of TVA land around the Bear Creek Project Reservoirs. Under the No Action Alternative (Alternative A), TVA would not adopt a prepared plan, but would continue management of its properties pursuant to TVA policies, largely on a case-by-case basis. Under the Action Alternative (Alternative B), TVA would use the new Bear Creek Project Land Management Plan to guide future land use decisions.

For either alternative, Section 26a of the TVA Act requires that TVA approval be obtained prior to construction, operation, or maintenance of any dam, appurtenant works, or other obstruction affecting navigation, flood control, public lands, or reservations along or in the Tennessee River and its tributaries. TVA will consider Section 26a applications for residential shoreline alterations and related land use approvals only on lands specifically allocated for residential development or where the back-lying property owners have the necessary rights for such use. A common feature of both alternatives is categorization of the residential shoreline. In accordance with the TVA Shoreline Management Policy Record of Decision, the following three categories will be used:

- **Shoreline Protection** for shoreline segments that support sensitive ecological resources, such as federal-listed threatened or endangered species, high priority state-listed species, wetlands with high function and value, archaeological or historical sites of national significance, and certain navigation restrictions zones. Within this category, all significant resources will be protected.

- **Residential Mitigation** for shoreline segments where resource conditions or certain navigation restrictions would require special analysis of individual development proposals, additional data, or specific mitigation measures.
- **Managed Residential** for shoreline segments where no sensitive resources are known to exist. Routine environmental review would be completed for any proposed action.

A resource inventory for threatened and endangered species, wetlands, and cultural resources was conducted, and the results were used to categorize the residential shoreline. The residential shoreline on all the Bear Creek Reservoirs comprises 13.2 miles or 5 percent of the total 284 miles of shoreline. Depending on the sensitivity of the resource, the shoreline reaches were placed in either the Shoreline Protection or Residential Mitigation categories.

As new data are collected on the spatial location and significance of endangered species, wetlands, and cultural resources, TVA expects that adjustments to category boundaries may be necessary. Over time, some Managed Residential areas could be moved into the Residential Mitigation category if new information supports such a change. Similarly, some Shoreline Protection or Residential Mitigation areas could be moved into Managed Residential areas if new resource information warrants such a change. Property owners should check with the appropriate TVA watershed team office for the current status of an area.

2.2.1 Alternative A—No Action Alternative

Under the No Action Alternative, TVA would continue management of its properties pursuant to TVA policies, including the recently adopted Shoreline Management Policy (SMP) without the benefit of a Plan.

Because no Plan would exist, the plannable project land could be considered for a variety of uses. Requests for TVA land would be handled on a case-by-case basis. Upon receipt of a proposal, the proposed use would be evaluated for program compatibility including 26a, then approved or denied based upon a review of potential environmental effects and other considerations.

Under this alternative, only Bear Creek Project land, land titled in the name of either TVA or BCDA, developed and subdivided by BCDA for residential purposes would be eligible to apply for water-use facility permits. Under TVA policies, only property owners having appropriate deeded land rights that allow ingress and egress to the reservoir are eligible to build water use related structures. The only property owners with existing deeded land rights on the Bear Creek Reservoirs are located in Tanglewood Subdivision on Upper Bear and Lick Creek Cove Subdivision on Cedar Creek. One hundred seventy-six water-related facilities have previously been permitted by BCDA that are not located within the two subdivisions listed above. While these facilities have been identified for "grandfathering," subject to acquisition of proper land rights from TVA, no other water-use-related facilities would be allowed outside of BCDA-developed subdivisions.

Under the No Action Alternative, land that has been conveyed for various uses, including industrial, recreation, water treatment facilities, and highway rights-of-way would continue in effect. Existing short-term (interim) land uses would remain in place until expiration or termination. TVA would continue to issue permits and licenses on a case-by-case basis; however, the TVA property would not be divided into parcels and assigned uses based on existing conditions and foreseeable needs.

2.2.2 Alternative B – Reservoir Land Management Plan Alternative

Alternative B, the proposed Plan, was developed using information obtained from the public, existing and newly collected field data, both on land conditions and resources, and technical knowledge from TVA staff. It would allocate land into categories that emphasize sensitive resource management (preservation and enhancement of wetlands, biodiversity, and archaeological and historic resources) and natural resource conservation.

TVA considered a wide range of possible land uses in the development of this Plan. Each parcel of land was reviewed to determine its physical capability for supporting certain uses and the needs of the public. Based on this information, the Pickwick Watershed Planning Team (see Appendix B for list of team members) allocated land parcels to one of seven categories or planning zones. These are described in Table 2.2.2-1.

Table 2.2.2-1. Planned Land Use Zone Definitions

	Zone	Definition
1	**Non-TVA Shoreland**	Shoreland located above summer pool elevation that TVA does not own in fee or land never purchased by TVA. TVA is not allocating private or other non-TVA land. This category is provided to assist in comprehensive evaluation of potential environmental impacts of TVA's allocation decision. Non-TVA shoreline includes: • ***Flowage easement land***—e.g., privately or publicly owned land where TVA has purchased the right to flood and/or limit structures. Flowage easement land is generally purchased to a contour elevation. Since this land is subject to TVA's Section 26a permitting requirements, the SMP guidelines discussed in the definition of Zone

Table 2.2.2-1. Planned Land Use Zone Definitions		
Zone		**Definition**
		7 would apply to flowage easement fronting private residential development. • ***Privately owned reservoir land***—Including, but not limited to, residential, industrial/commercial, or agricultural.
2	**TVA Project Operations**	All TVA reservoir land currently used for TVA operations and public works projects includes: • ***Land adjacent to established navigation operations***—Locks, lock operations and maintenance facilities, and the navigation work boat dock and bases. • ***Land used for TVA power projects operations***—Generation facilities, switchyards, and transmission facilities and rights-of-way. • ***Dam reservation land***—Areas used for developed and dispersed recreation, maintenance facilities, watershed team offices, research areas, and visitor centers. • ***Navigation safety harbors/landings***—Areas used for tying off commercial barge tows and recreational boats during adverse weather conditions or equipment malfunctions. • ***Navigation dayboards and beacons***—Areas with structures placed on the shoreline to facilitate navigation. • ***Public works projects***—Includes fire halls, public water intakes, public treatment plants, etc. (These projects are placed in this category as a matter of convenience and may not relate specifically to TVA projects.) • ***Land planned for any of the above uses in the future.***
3	**Sensitive Resource Management**	Land managed for protection and enhancement of sensitive resources. Sensitive resources, as defined by TVA, include resources protected by state or federal law or executive order (EO) and other land features/natural resources TVA considers important to the area viewscape or natural environment. Natural resource activities such as hunting, wildlife observation, and camping on undeveloped sites may occur in this zone, but the overriding focuses are protecting and enhancing the sensitive resource the site supports. Areas included are: • TVA-designated sites with potentially ***significant archeological resources***. • TVA lands with ***sites/structures listed on or eligible for listing on the National Register of Historic Places (NRHP).*** • ***Wetlands***—Aquatic bed, emergent (EM), forested (FO), and scrub-shrub (SS) wetlands as defined by TVA. • ***TVA land under easement, lease, or license to other agencies/individuals for resource protection purposes.*** • ***TVA land fronting land owned by other agencies/individuals*** for resource protection purposes.

Table 2.2.2-1. Planned Land Use Zone Definitions

Zone		Definition
		• ***TVA Natural Area-Habitat Protection Areas***—These Natural Areas are managed to protect populations of species identified as threatened or endangered by the U.S. Fish and Wildlife Service (USFWS), state-listed species, and any unusual or exemplary biological communities/geological features. • ***TVA Natural Area-Ecological Study Areas***—These Natural Areas are designated as suitable for ecological research and environmental education by a recognized authority or agency. They typically contain plant or animal populations of scientific interest or are of interest to an educational institution that would utilize the area. • ***TVA Natural Area-Small Wild Areas***—These Natural Areas are managed by TVA or in cooperation with other public agencies or private conservation organizations to protect exceptional natural, scenic, or aesthetic qualities that can also support dispersed, low-impact types of outdoor recreation. • ***River Corridor with sensitive resources***—A River Corridor is a linear green space along both streambanks of selected tributaries entering a reservoir managed for light boat access at specific sites, riverside trails, and interpretive activities. These areas will be included in Zone 3 when identified sensitive resources are present. • ***Significant scenic areas***—These are areas designated for visual protection because of their unique vistas or particularly scenic qualities. • ***Champion tree site***—Areas designated by TVA as sites that contain the largest known individual tree of its species in that state. The state forestry agency "Champion Tree Program" designates the tree, while TVA designates the area of the sites for those located on TVA land. • ***Other sensitive ecological areas***—Examples of these areas include heron rookeries, uncommon plant and animal communities, and unique cave or karst formations. • ***Land planned for any of the above uses in the future.***
4	**Natural Resource Conservation**	Land managed for the enhancement of natural resources for human use and appreciation. Management of resources is the primary focus of this zone. Appropriate activities in this zone include hunting, resource management, wildlife observation, and camping on undeveloped sites. Areas included are: • ***TVA land under easement, lease, or license*** to other agencies for wildlife or forest management purposes. • ***TVA land fronting land owned by other agencies*** for wildlife or resource management purposes. • ***TVA land*** managed for wildlife or forest management projects. • ***Informal recreation areas*** maintained for passive, dispersed recreation activities such as hunting, hiking, bird watching,

Table 2.2.2-1. Planned Land Use Zone Definitions		
Zone		Definition
		photography, primitive camping, bank fishing, and picnicking. • ***Shoreline conservation areas***—Narrow riparian strips of vegetation between the water's edge and TVA's back-lying property that are managed for wildlife, water quality, or visual qualities. • ***TVA Natural Area-Wildlife Observation Areas***—TVA Natural Areas with unique concentrations of easily observed wildlife that are managed as public wildlife observation areas. • ***River Corridor without sensitive resources present***—A River Corridor is a linear green space along both streambanks of selected tributaries entering a reservoir managed for light boat access at specific sites, riverside trails, and interpretive activities. River Corridors will be included in Zone 4 unless sensitive resources are present (see Zone 3). • ***Islands of 10 acres or less.*** • ***Land planned for any of the above uses in the future.***
5	**Industrial/ Commercial Development**	Land managed for economic development purposes. Areas included are: • ***TVA land under easement, lease, or license to other agencies/individuals*** for industrial or commercial purposes. • ***TVA land fronting land owned by other agencies/individuals*** for industrial or commercial purposes. • ***Sites planned for future industrial use.*** Types of development that can occur on this land are: • ***Business parks***—TVA waterfront land which supports industrial or commercial development. • ***Industrial access***—Access to the waterfront by back-lying property owners across TVA property for water intakes, wastewater discharge, or conveyance of commodities (i.e., pipelines, rail, or road). Barge terminals are associated with industrial access corridors. • ***Barge terminal sites***—Public or private facilities used for the transfer, loading, and unloading of commodities between barges and trucks, trains, storage areas, or industrial plants. • ***Fleeting areas***—Sites used by the towing industry to switch barges between tows or barge terminals which have both off-shore and on-shore facilities. • ***Minor commercial landing***—A temporary or intermittent activity that takes place without permanent improvements to the property. These sites can be used for transferring pulpwood, sand, gravel, and other natural resource commodities between barges and trucks. (Commercial recreation uses, such as marinas and campgrounds, are included in Zone 6.)
6	**Recreation**	All reservoir land managed for concentrated, active recreation activities

Table 2.2.2-1. Planned Land Use Zone Definitions		
Zone		Definition
		that require capital improvement and maintenance, including: • ***TVA land under easement, lease, or license to other agencies/individuals*** for recreational purposes. • ***TVA land fronting land owned by other agencies/individuals*** for recreational purposes. • ***TVA land developed for recreational purposes*** such as campgrounds, day use areas, etc. • ***Land planned for any of the above uses in the future.*** Types of development that can occur on this land are: • ***Commercial recreation***, e.g., marinas, boat docks, resorts, campgrounds, and golf courses. • ***Public recreation***, e.g., local, state and federal parks, and recreation areas. • ***Greenways***, e.g., linear parks located along natural features such as lakes or ridges, or along man-made features including abandoned railways or utility rights-of-way, which link people and resources together. • ***Water access sites***, e.g., boat ramps, courtesy piers, canoe access, fishing piers, vehicle parking areas, picnic areas, trails, toilet facilities, and information kiosks.
7	Residential Access	TVA-owned lands where Section 26a applications and other land use approvals for residential shoreline alterations are considered. Requests for residential shoreline alterations are considered on parcels identified in this zone where such use was previously considered and where the proposed use would not conflict with the interests of the general public. As provided for in the SMP, residential access would be divided into three categories based on the presence of sensitive ecological resources. The categories are: (1) Shoreline Protection, for shoreline segments that support sensitive ecological resources, such as federal-listed threatened or endangered species, high priority state-listed species, wetlands with high function and value, archaeological or historical sites of national significance, or which contain navigation restrictions; (2) Residential Mitigation, for shoreline segments where resource conditions or navigation conditions would require special analysis and perhaps specific mitigation measures, or where additional data is needed; and (3) Managed Residential, where no sensitive resources are known to exist. Types of development/management that can occur on this land are: • ***Residential water-use facilities***, e.g., docks, piers, launching ramps/driveways, marine railways, boathouses, enclosed storage space, and nonpotable water intakes. • ***Residential access corridors***, e.g., pathways, wooden steps, walkways, or mulched paths which can include portable picnic tables and utility lines.

Table 2.2.2-1. Planned Land Use Zone Definitions	
Zone	**Definition**
	• ***Shoreline stabilization***, e.g., bioengineering, riprap and gabions, and retaining walls. • ***Shoreline vegetation management*** on TVA-owned residential access shoreland. • ***Conservation easements*** for protection of the shoreline. • ***Other activities***, e.g., fill, excavation, grading, etc. • ***Docks and other shoreline developments*** are not permitted on land categorized as Shoreline Protection.

A basic premise of the reservoir land planning process is that land currently committed to a specific use would be allocated to that current use unless there is an overriding need to change the use. Commitments include: transfers, leases, licenses, contracts, areas pre-identified for nondevelopment, TVA projects, such as the dam reservation or power lines, outstanding land rights, or TVA-developed recreation areas. Agricultural licenses would be excluded because they are considered to be an interim use of TVA land. For planning purposes, a total of 5,127 acres of Bear Creek Project land is considered committed. Table 2.2.2-2 summarizes the allocation of committed land on the Bear Creek Project Reservoirs. Table 2.2.2-3 indicates committed land by individual reservoir. Individual parcels of committed land by reservoir are indicated in Appendix D.

Table 2.2.2-2. Summary of Committed Land		
Number of Occurrences	**Land Use Zone**	**Acres**
4	Zone 2 - TVA Project Operations	851.0
24	Zone 3 - Sensitive Resource Management	3,696.0
14	Zone 6 - Recreation	553.4
2	Zone 7 - Residential Access	27.7

The balance of Bear Creek Project land was considered "plannable land;" that is, land that was not previously committed to a use. Field data were collected on all plannable land by technical specialists, such as archaeologists, historic architects, wetland specialists, visual specialists, and biologists to identify all areas containing sensitive resources.

Table 2.2.2-3. Summary of Committed Land by Reservoir		
Number of Occurrences	Proposed Land Allocations	Acres
Little Bear		
1	Zone 2 - Project Operations	211.4
9	Zone 3 - Sensitive Resource Management	625.2
3	Zone 6 - Recreation	65.4
	Subtotal	902.0
Cedar Creek		
1	Zone 2 - Project Operations	277.6
3	Zone 3 - Sensitive Resource Management	235.6
4	Zone 6 - Recreation	171.9
1	Zone 7 - Residential Access	26.4
	Subtotal	711.5
Upper Bear		
1	Zone 2 - Project Operations	192.0
9	Zone 3 - Sensitive Resource Management	946.1
4	Zone 6 - Recreation	79.8
1	Zone 7 - Residential Access	1.3
	Subtotal	1,219.2
Bear Creek		
1	Zone 2 - Project Operations	170.4
3	Zone 3 - Sensitive Resource Management	1,889.0
3	Zone 6 - Recreation	236.2
	Subtotal	2,295.6

A key planning assumption of Alternative B was that areas identified as having sensitive resources would be regarded as committed and would be placed into Zone 3, Sensitive Resource Management. However, if parcels with existing commitments (leases, licenses, contracts, etc.) contain sensitive resources, these parcels would remain zoned for the committed uses. In addition, environmental review would be needed prior to future activities that would impact the identified sensitive resources.

A review of all plannable land was conducted by TVA. TVA staff were asked to rate each parcel high, medium, or low by a given set of criteria (see Appendix C for rating criteria) and to rank the parcels high, medium, or low depending on stakeholder and program needs. Customer needs were identified during the scoping process to help determine the most suitable use for the land.

After the ranking exercise, the planning team and technical specialists met to allocate the plannable parcels to six of the seven planning zones. No land was allocated to Zone 1 (see definition, Table 2.2.2-1). Using resource maps and all of the information collected during the planning process, including stakeholder input, the capability and suitability of each parcel were discussed. Allocation decisions were made by consensus.

These allocations were used to prepare the draft Bear Creek Reservoirs Land Management Plan. The draft Plan contains an explanation of the planning process, an overview of the reservoirs' history and development, a description of each parcel, and maps of the proposed Land Management Plan. Table 2.2.2-4 summarizes the number of parcels allocated to each of the six zones. The proposed Land Plan Map for Alternative B shows the location and zone of each parcel.

Table 2.2.2-4. Summary of Land Use Allocations for Alternative B (Including Committed Land)

Number of Occurrences	Proposed Land Allocations	Acres
4	2 - Project Operations	851.4
101	3 - Sensitive Resource Management	6,929.2
29	4 - Natural Resource Conservation	526.8
1	5 - Industrial/Commercial Development	13.7
20	6 - Recreation	615.7
16	7 - Residential Access	241.3
	*TOTAL	9,178.1

*Deed research during the planning process indicated 12 acres shown as BCDA land in the draft actually was titled to TVA.

Table 2.2.2-5 indicates the land use allocations by reservoir.

Table 2.2.2-5. Land Use Allocations for Alternative B

Number of Occurrences	Proposed Land Allocations	Acres
Bear Creek		
1	Zone 2 - Project Operations	170.4
3	Zone 3 - Sensitive Resource Management	1,889.0
3	Zone 6 - Recreation	236.2
7	**Subtotal**	**2,295.6**
Upper Bear		
1	Zone 2 - Project Operations	192.0
41	Zone 3 - Sensitive Resource Management	2,401.1
17	Zone 4 - Natural Resource Conservation	231.4
5	Zone 6 - Recreation	81.8
5	Zone 7 - Residential Access	49.3
69	**Subtotal**	**2,955.5**
Cedar Creek		
1	Zone 2 - Project Operations	277.6
29	Zone 3 - Sensitive Resource Management	1,826.5
11	Zone 4 - Natural Resource Conservation	270.7
8	Zone 6 - Recreation	227.4
8	Zone 7 - Residential Access	144.4
57	**Subtotal**	**2,746.6**
Little Bear		
1	Zone 2 - Project Operations	211.4
28	Zone 3 - Sensitive Resource Management	812.6
1	Zone 4 - Natural Resource Conservation	24.7
1	Zone 5 - Industrial/Commercial Development	13.7
4	Zone 6 - Recreation	70.4
3	Zone 7 - Residential Access	47.6
38	**Subtotal**	**1,180.4**
171	**Grand Total**	**9,178.1**

2.3 Comparison of Alternatives

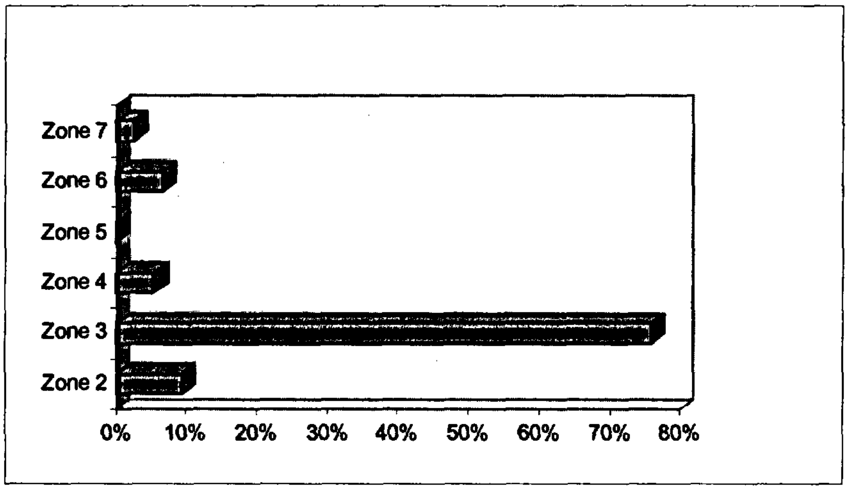
Alternative B proposes to allocate 9,178 acres to six planning zones. These zones are comprised of land which under Alternative A are classified as follows: dam reservation - 865 acres; recreation - 556 acres; residential - 28 acres; undeveloped - 7,005 acres; and developable 712 acres (see Table 2.3-1).

Table 2.3-1. Comparison of Alternatives - Acreage		
	Existing	**Alternative B**
Zone		
1 - Non-TVA Shoreland	0	0
2 - Project Operations	865	851
3 - Sensitive Resource Management	0	6,929
4 - Natural Resource Conservation	0	527
5 - Industrial/Commercial	0	14
6 - Recreation	556	616
7 - Residential Access	28	241
Developable*	712	
Undeveloped	7,017	
Total	**9,178**	**9,178**

*TVA land fronting BCDA on Upper Bear, Cedar, and Little Bear.

The Bear Creek Reservoirs Land Management Plan (Alternative B) provides better information for decision making and consistency in reviewing stakeholder requests. The data base obtained in the development of the Plan (usable under either alternative) has resulted in the ability to better evaluate reservoir impacts of the decisions; to have better knowledge of the resource base, which includes more up-to-date and accurate information; and to have fewer conflicts between TVA and the public due to better communications. The majority of land placed in the Sensitive Resource Management Zone reflects the results of stakeholder input as well as actual resource information provided by the data gathering process (see Figure 2.3-1). The high percentage of land placed in Zone 3 is further evidence that BCDA retained most of the developable back-lying land that was acquired for the Bear Creek Project, while the TVA land is the least desirable for development.

Figure 2.3-1. Bear Creek Reservoirs - Alternative B - Percent of Land Allocated by Zone



Zone	Acres	Shoreline Miles
Zone 2 - TVA Project Operations	851	4.0
Zone 3 - Sensitive Resource Management	6,929	217.0
Zone 4 - Natural Resource Conservation	527	24.0
Zone 5 - Industrial/Commercial	14	0.3
Zone 6 - Recreation	616	26.0
Zone 7 - Residential Access	241	13.0

Under both alternatives, adjacent private lands are expected to receive continued pressure for residential development. This would likely increase the need for protecting natural resources on TVA land. Under the No Action Alternative (Alternative A), the land shown as residential access is the land fronting the two BCDA-developed subdivisions. There would be no provisions for residential access other than fronting these and future BCDA subdivisions. Alternative B recognizes additional BCDA-developable subdivisions on Cedar Creek, Little Bear, and Upper Bear and recognizes existing clusters of private back-lying development as residential access areas where requests for additional private water-use facilities would be considered. In areas of private back-lying development outside of Alternative B, Zone 7-Residential Access, there would be no consideration of requests for additional private water-use facilities.

While only 16 parcels (9 percent of the parcels) are zoned for residential access, there are an additional 33 parcels (19 percent of the parcels) with existing private water-use facilities which are not in Zone 7 - Residential Access, representing a total of 49 parcels (29 percent) affected by residential development. These water-use facilities, 55 in all, are generally scattered throughout the three reservoirs; occur on public land where there are no deeded access rights; and are located on areas that are zoned for Sensitive Resource Management, Natural Resource Conservation, or Recreation under Alternative B (see Table 2.3-2). Deeded access rights are necessary for TVA to allow private water-use facilities. These facilities have been identified for grandfathering, however, no additional docks or shoreline development will be allowed in these zones. The remainder of the 185 water-use facilities occur on parcels zoned for residential access under Alternative B.

Table 2.3-2. Existing Private Water-Use Facilities (WUFs)

	Existing WUFs	Existing WUFs in Zone 7	Existing WUFs in Other Zones	Total Parcels With WUFs	Parcels With WUFs in Zone 7	Other Parcels With WUFs
Little Bear	34	22	12	8	2	6
Cedar Creek	106	84	22	18	6	12
Upper Bear	45	24	21	19	4	15
Total	185	130	55	45	12	33

The largest category of existing acreage is Undeveloped. The majority of undeveloped acreage would be placed in Sensitive Resource Management in Alternative B because it has been identified as containing sensitive resources such as sensitive species, archaeological resources, significant visual resources, and/or wetlands. While other uses may be consistent with this land, the overriding objective for managing a particular parcel of land is the protection of the sensitive resources identified.

Although both alternatives allow for a wide variety of land uses, the proposed Plan utilizes stakeholder input received during the scoping meetings. The environmental review process for specific land use requests would ensure that impacts to sensitive resources be considered. By contrast, Alternative B provides enhanced protection to sensitive resources by allocating land with such resources to Zone 3, with the overriding objective of that zone being protection of the sensitive resources. Alternative B places more emphasis on conservation, while continuing to allow public use.

2.4 The Preferred Alternative

The preferred alternative is Alternative B, because it emphasizes conservation while continuing to allow public use and provides for public involvement in the land planning process. This Plan grandfathers previous land use commitments and allocates uncommitted TVA land into zones that allow for a balance of development and conservation.

3. AFFECTED ENVIRONMENT AND POTENTIAL EFFECTS

Introduction
Federal resource management agencies (Environmental Protection Agency [EPA], Natural Resources Conversation Service [NRCS], U.S. Geological Survey [USGS], and the U.S. Forest Service) have determined that Bear Creek, Cedar Creek, and Little Bear Creek Reservoirs are located in the Transition Hills ecoregion of the Southeastern Plains. This is the same ecoregion that includes Pickwick Dam. On the ridgetops of this area, coastal plain deposits of silt, sand, clay, and gravel overlay limestone, shale, and chert. Forests of the region are dominated by oaks, hickories, and pines, with pine plantations common on forest industry lands. Some cropland and pasture are found in valley bottoms and ridgetops. In contrast, Upper Bear Creek Reservoir has been classified by resource management agencies as being in the Dissected Plateau ecoregion of the Southwestern Appalachians. These are low mountains, and the lands around the reservoir exhibit a greater variety of rock formations and mountain plants such as hemlock. Coal and iron mining also have occurred around the reservoir in this ecoregion. The William B. Bankhead National Forest and Lewis Smith Lake are also in this ecoregion. Ecoregions denote areas of general similarity in the type, quality, and quantity of environmental resources. They also tend to show similar patterns of human use and disturbance (EPA, 1999).

The existing environment affected by the proposed actions and the potential environmental consequences of each alternative action are described in this chapter. Resources and environmental consequences common to the area are discussed first, then points pertinent to individual reservoirs are addressed.

3.1 Visual Resources

3.1.1 Affected Environment

Bear Creek

Smallest of the Bear Creek Reservoirs, Bear Creek averages about 200-yards-wide in its lower area, and is about 200-feet-wide in its upper reaches. Two day use areas and Piney Point and Horseshoe Bend Campgrounds provide public access to the reservoir. An Environmental Education Center is located just upstream of the Horseshoe Bend Campground and Recreation Area.

Bear Creek is characterized by its steep shoreline, much of which exhibits rock formations and sections of limestone bluff fronting stands of large hardwoods. In contrast, some of the shoreline in the upper reaches has low-lying stretches of shoreline with patches of river birch and willow. The reservoir provides a natural lake setting absent of homes and the associated water-use facilities.

Some areas of eroded shoreline caused by high water and swift currents during flood stages are visible on the reservoir. The Bear Creek Floatway ends in the upper reaches of the reservoir.

Cedar Creek

Largest of the Bear Creek Reservoirs, the more lake-like area exceeds 6 miles in length. The riverine upper reach is a little over 2 miles long. Cedar Creek is the more open of the Bear Creek Reservoirs, with more gently sloping shoreline. One of its more distinctive characteristics is the large area of standing timber which was allowed to remain in the reservoir. The more open nature of the reservoir surface has left the shoreline more vulnerable to erosion. A number of shoreline stretches exhibit bare clay banks eroded by boat traffic and weathering. Shoreline vegetation ranges from open pasture, reverting fields, stands of mixed pine, cedar, and hardwood, to mowed lawns that reach from some residences to the shoreline. Occasional docks and groupings of docks are scattered around the reservoir. A few unpermitted boathouses can also be seen in portions of the reservoir. Because of the gently sloping topography around much of the reservoir, a number of wetland pockets evidenced by willow and cattails are present.

Five public launching ramps are evenly spaced around the reservoir. One major public use area with campground and day-use facilities is located on the south side, near the middle of the reservoir. In addition to the standing timber, an occasional rock outcrop or bluff make up the more distinctive scenic resources on the reservoir. Most noticeable of the man-made features would be Britton Bridge and the electric transmission lines found in the upper portion of the reservoir.

Upper Bear Creek

Upper Bear Creek Reservoir differs somewhat from the other three reservoirs in that it is located near, and between, the small towns of Bear Creek, Haleyville, and Phil Campbell. As a result, there appears to be a greater number and wider variety of lake residences and a greater number of associated water-use facilities. In addition, Upper Bear Creek has a somewhat greater diversity of visual resources than do the other reservoirs. Three public recreation areas are located on Upper Bear, four boat launching ramps, and one campground. The reservoir has two arms, Little Bear and Bear Creeks.

The Little Bear Creek arm supports a variety of land uses and features ranging from agricultural fields with barns and outbuildings to managed timber stands with clear-cuts. Transmission lines and three bridges cross this arm of the reservoir with an additional bridge crossing in the planning stages. Housing is scattered along most of the length of this portion of the reservoir. Housing types range from camper trailers and mobile homes to small cottages and large, upscale homes. Lawn and shoreline treatments associated with these residences vary from badly eroded, cleared and mowed to the waterline, to homes nicely nestled in the trees and only partially visible from the reservoir. The upper reaches of the Little Bear Creek arm support some of the more visually sensitive resources of any of the Bear Creek Reservoirs. Gas Branch with its standing timber and absence of homes is bordered at its mouth by rock bluffs and a natural, triple-bridge, rock formation. Other rock bluffs of varying heights and shapes can be seen in Turkey Creek and the uppermost portions of Little Bear Creek.

The Bear Creek arm of the reservoir supports a similar variety of development and scenic resources. Most of the residential development occurs on the lower portion of Bear Creek with a similar mix of housing types and water-use facilities as are seen elsewhere on the reservoir. Evidence of reclaimed mining lands are noticeable along the midsection of the Bear Creek arm. Vegetative cover varies from near barren to heavily wooded. In addition to a number of bluffs and shoreline rock formations, large stands of hardwoods and pines are visible to the lake user. Hemlocks and big leaf magnolias add diversity to the vegetative cover seen along the shoreline in the upper reaches of both arms of the reservoir. Standing timber can also be seen in a number of coves and embayments. One bridge currently exists on this arm of the reservoir as do two power line crossings. A new bridge is proposed to cross upstream of the existing bridge and the Winston County/Marion County line.

<u>Little Bear</u>
Little Bear Creek Reservoir is one of the two smaller of the Bear Creek Reservoirs. It is less than 5 miles in length, and about 1/2 mile in width at its widest point. Only three embayments exceeding 1 mile in length extend off of the main reservoir. Little Bear has the second-largest number of public recreation facilities of the Bear Creek Reservoirs with two campgrounds and day use areas and three boat launching ramps. These areas generate the largest number of lake users.

The reservoir's shoreline is moderately steep and tree covered. Timber consists of predominately hardwood with mixed components of pine and cedar. Occasional rock outcroppings are visible to the lake user with the more noticeable being upstream from the Williams Hollow Public Use Area.

A large transmission line crossing at the approximate midpoint of the reservoir is the most noticeable man-made feature seen on Little Bear. Views of the line can also be seen at the rear of coves off of Trace Branch, the largest embayment off the main channel. An occasional house and dock can be seen scattered about the reservoir with only two subdivisions creating any concentrations of residences. The reservoir upstream of Williams Hollow Public Use Area becomes riverine with various rock bluffs and ledges. One of the most scenic of these rock shoreline features is a small waterfall entering the reservoir on the right bank. Occasional clumps of river birch and willow mark the low-lying areas of the shoreline that support various wetlands. Docks and residences are absent in the upper section of the reservoir as it becomes narrow and shallow and less accessible to powerboat use.

3.1.2 Environmental Consequences

Bear Creek

Alternative A - Under a No Action Alternative, Bear Creek Reservoir would continue to be operated much as it has been in the past. No private water-use facilities would be permitted, and the only forms of development would continue to be in the two public recreation areas, the dam reservation, and the BCEEC.

Alternative B - The preferred alternative allows more assurance of sensitive resource management of visual/aesthetic resources around the reservoir. Scenic values would continue to be protected for the enjoyment of the lake user and visitor to this area. Preservation of scenic resources will continue to be of utmost importance to users of the Bear Creek Floatway as they utilize the upstream reaches of this reservoir. Approximately 84 percent of the shoreline mileage and 82 percent of the publicly held reservoir acreage would receive sensitive resource management under this alternative.

Cedar Creek

Alternative A - Under the No Action Alternative, permits for private water-use facilities would only be issued in BCDA-developed subdivisions. Private docks would not continue to appear in a scattered fashion around the reservoir. Sections of scenic reservoir shoreline would likely be periodically interrupted by the introduction of water-use facilities and other forms of development. Portions of the reservoir where standing timber has become a somewhat unique scenic resource could be visually impacted by shoreline development. The cumulative effects of a continuation of this unchecked development of the reservoir could alter the visual/aesthetic diversity currently exhibited on Cedar Creek.

Alternative B - The adoption of the planned alternative would attempt to protect the visual/aesthetic resources of Cedar Creek Reservoir. While existing water-use facilities would be "grandfathered" after conforming to SMI standards, the addition of future facilities would only be allowed fronting designated tracts. Approval of additional water-use facilities in Zone 7 would not significantly affect visual resources. The lake user would have the security of knowing that certain coves and sections of the reservoir were being retained and protected for public use and enjoyment. Approximately 69 percent of the shoreline mileage and 67 percent of the publicly held reservoir acreage would receive visual resource management under this alternative.

Upper Bear Creek

Alternative A - Under the No Action Alternative, development and the permitting of water-use facilities could continue as it has in the past. Upper Bear Creek Reservoir's geographic location between the towns of Bear Creek, Haleyville, and Phil Campbell put greater pressures on it for development than do the other Bear Creek Reservoirs. Sections of highly scenic shoreline as well as those of the more common visual quality would continue to be at risk of development with the additions of private-use facilities. The natural scenic quality of rock bluffs and shoreline plant diversity would run the risk of being impacted by development as well as the interruption of quiet coves which currently afford the angler and boater a peaceful getaway. The cumulative effect of these possible alterations could ultimately reduce the visual/aesthetic quality of Upper Bear Creek Reservoir as it would take on more the appearance of a private lake.

Alternative B - The adoption of the planned alternative would attempt to protect the visual/aesthetic resources of Upper Bear Reservoir. While existing water-use facilities would be "grandfathered" after conforming to SMI standards, the addition of future facilities would only be allowed fronting designated tracts. Approval of additional water-use facilities in Zone 7 would not significantly affect visual resources. The lake user would have the security of knowing that certain coves and sections of the reservoir were being retained and protected for public use and enjoyment. Approximately 78 percent of the shoreline mileage and 81 percent of the publicly held reservoir acreage would receive resource management or conservation under this alternative.

<u>Little Bear</u>

Alternative A - Under the No Action Alternative, private water-use facility permits would continue to be issued. Private docks would continue to appear in a scattered fashion about the reservoir. Sections of highly scenic shoreline as well as shoreline of more common visual quality would continue to be at risk for the construction of these private facilities. The natural scenic quality enjoyed by the lake user would possibly be reduced as stretches of currently natural shoreline and quiet coves off the main body of the reservoir could be interrupted by private facilities. The cumulative effect of these possible additions could ultimately reduce the visual/aesthetic quality of Little Bear Reservoir, resulting in it taking on the appearance of a private lake.

Alternative B - The adoption of the planned alternative would attempt to protect the visual/aesthetic resources of Little Bear Reservoir. While existing water-use facilities would be "grandfathered" after conforming to SMI standards, the addition of future facilities would only be allowed fronting designated tracts. Approval of additional water-use facilities in Zone 7 would not significantly affect visual resources. The lake user would have the security of knowing that certain coves and sections of the reservoir were being retained and protected for public use and enjoyment. Approximately 76 percent of the shoreline mileage and 69 percent of the publicly held reservoir acreage would receive sensitive resource management protection under this alternative.

3.2 Cultural Resources

3.2.1 Affected Environment

Cultural resources include, but are not limited to prehistoric and historic archaeological sites, historic structures, and historic sites that were the location of important events where no material remains of the event are present. There are seven historic properties listed in the NRHP in Franklin, Marion, and Winston Counties, Alabama, but none of the properties are within the lands plan. However, through cultural resources investigations, a long record of human use and occupation within the Bear Creek watershed has been identified. As a result, there are resources identified within the Bear Creek watershed that are potentially eligible for listing on the NRHP.

Archaeological Resources

Archaeological research in the Bear Creek watershed was conducted in association with the construction of the reservoirs, as well as the more recent lands plan and SMI resource inventory. Archaeological research has indicated human occupation of the Bear Creek watershed has occurred from the Paleo-Indian to the Historic Periods. Prehistoric archaeological periods are based on changing settlement and land use patterns and artifact styles. In the Bear Creek watershed, prehistoric chronology is generally broken into five broad time periods: Paleo-Indian, Archaic, Gulf Formational, Woodland, and Mississippian (Walthall, 1980; McNutt and Weaver, 1985). Each of these broad periods is generally broken into subperiods (generally early, middle, and late), which are also based on artifact styles and settlement patterns. Smaller time periods, known as "phases" are representative of distinctive sets of artifacts.

The Paleo-Indian Period (12000-8000 B.C.) represents the first human occupation of the area. The settlement and land use pattern of this period was dominated by highly mobile bands of hunters and gatherers. The subsequent Archaic Period (8000-1000 B.C.) represents a continuation of the hunter-gatherer lifestyle. Through time, there is increasing social complexity and the appearance of horticulture late in the period. The settlement pattern during this period is characterized by spring and summer campsites situated along river ways that exploit riverine resources and dispersed fall and winter campsites in the adjacent uplands. It is during the Gulf Formational Period (1100-300 B.C.) when pottery first appears in the Bear Creek watershed. This period represents a continuation of the preceding Archaic Period and is roughly correlated with the Late Archaic and Early Woodland Periods to the north of the watershed in the Tennessee River Valley. Increased social complexity, reliance on horticulture and agriculture, and a continuation and fluorescence of ceramic technology characterize the Woodland Period (300 B.C.-900 A.D.). The increased importance of horticulture is associated with a less mobile lifestyle as suggested by semipermanent structures. Residential base camps were located on floodplains and alluvial terraces with specialized procurement sites in the adjoining uplands. The Mississippian Period (900-1600 A.D.), the last prehistoric period in the Bear Creek watershed, is associated with the pinnacle of social complexity in the southeastern U.S. In the Bear Creek watershed, this period is characterized by permanent settlements, maize agriculture, and chiefdom level societies. Sites during this period tend to be situated on older alluvial river terraces.

The first permanent Historic Period (1600 A.D.-present) occupation of the Bear Creek watershed by Europeans, European Americans, and African Americans occurred in the late 18th century. Various excursions and temporary settlements by the British, French, and Spanish occurred prior to this period. Historic American Indian groups such as the Chickasaw lived in the area until their forced removal by the U. S. government in the early 19th century. European-American settlement of the area increased greatly in the first half of the 19th century following various treaties with and removal of the Chickasaw. Numerous Civil War skirmishes occurred in the area, although no recorded battles were fought in the Bear Creek watershed. Agriculture has been and remains to be an important part of the local economy, and the population of the area was primarily rural until the early to mid-20th century.

TVA is mandated, under the National Historic Preservation Act (NHPA) of 1966 and the Archaeological Resources Protection Act (ARPA) of 1979, to protect significant archaeological resources located on TVA land or land affected by TVA undertakings.

In response to this federal legislation, TVA conducts inventories of its land to record archaeological sites. Archaeological research in the Bear Creek Watershed has recorded approximately 705 archaeological sites. For the purpose of this archaeological investigation, an archaeological site was defined as an area with any grouping of five or more nonmodern historic or prehistoric artifacts. The relatively high number of sites reflects the amount of archaeological research undertaken in relation to the creation of the reservoir and the more recent inventory surveys. The recent survey included only Bear Creek and Upper Bear Creek Reservoirs (Hendryx, 1999).

<u>Bear Creek Reservoir</u>
This reservoir was investigated during the 1998 season by the University of Alabama. A total of 137 archaeological sites are recorded in the Bear Creek Reservoir area and indicate human occupation from the Paleo-Indian Period through the Historic Period. Archaeological survey and testing of the Bear Creek Reservoir have focused on areas to be inundated by the reservoir and more recently on areas that would be within the scope of TVA's SMI program.

<u>Cedar Creek Reservoir</u>
A total of 134 archaeological sites have been recorded in the Cedar Creek Reservoir area that indicate human occupation from the Paleo-Indian Period through the Historic Period. Archaeological survey and testing of the Cedar Creek Reservoir have focused on areas of the reservoir to be inundated by the reservoir and more recently on areas that would be within the scope of TVA's SMI program.

<u>Upper Bear Creek Reservoir</u>
A total of 166 archaeological sites have been recorded in the Upper Bear Creek Reservoir area that indicate human occupation from the Paleo-Indian Period through the Historic Period. Archaeological survey and testing of the Upper Bear Creek Reservoir have focused on areas of the reservoir to be inundated by the reservoir and more recently on areas that would be within the scope of TVA's SMI program.

<u>Little Bear Creek Reservoir</u>
A total of 268 archaeological sites have been recorded in the Little Bear Creek Reservoir area that indicate human occupation from the Paleo-Indian Period through the Historic Period. Archaeological survey and testing of the Little Bear Creek Reservoir have focused on areas of the reservoir to be inundated by the reservoir and more recently on areas that would be within the scope of TVA's SMI program.

Historic Structures
Historic structures include standing buildings and engineering structures, such as bridges and dams, that are generally more than 50 years old and have significant historical associations. A systematic survey of the Bear Creek watershed was conducted, identifying historic structures within and near planning parcels. Historic structures, including former farmhouses and cemeteries, have been identified on or adjacent to numerous parcels. Most of these structures are not located on TVA property; however, changes in TVA land use could adversely affect these historic properties.

<u>Bear Creek Reservoir</u>
This reservoir was not field surveyed as part of the data gathering effort for this EA. There are three previously recorded historic properties on Parcel 4 in the

Bear Creek Educational Center: the Overton Farm complex that is listed on the NRHP, the Overton Cemetery, and a moved and restored 2-story log house.

Cedar Creek Reservoir

Historic structures and cemeteries have been identified on and adjacent to numerous parcels. The Bonds Cemetery is located on Parcel 5 and near Parcels 4 and 6. The Massey Cemetery is located near Parcels 13, 14, and 15 and has been encroached on by summer cabin development and BCDA actions. The Greenhill-Ezzell Cemetery, located on Parcel 23, is enveloped and encroached on by the large BCDA Slickrock Recreation Area.

Two historic farmhouses, located off TVA property near Parcels 19, 20, 21, 22, 23, 24, and 25, are on the road leading to the BCDA Slickrock Recreation Facility. Use of the recreation area and surrounding development has already resulted in increased traffic flow near these structures.

Two significant historic farmsteads are in secluded locations near Parcels 29, 30, and 31. One is a surviving subsistence farmstead with log outbuildings that is still in operation. Two historic houses are located near Parcels 31 and 32; the rural character of these houses has been diminished somewhat due to increased traffic flow associated with the Britton Bridge boat ramp.

Three significant and restored historic houses are located near Parcel 36. One is the 1858 Ezzell home place, and the other two have been moved to the site, probably from reservoir land at the time of clearing.

Five historic farmhouses and the Bolton Cemetery are located near Parcels 39, 41, and 42. Two historic houses are located near Parcel 44; one, although presently vacant, is a historically significant farmhouse of a relatively prosperous farm, representing the classic multiple dog-trot connected units with extensive porches.

Upper Bear Creek Reservoir

Approximately 72 historic structures and cemeteries over 50 years old were identified in the reservoir area. None are considered significant for a number of reasons, including extensive alterations, deterioration, relatively recent (1930s-1940s) and ordinary/common examples and/or combinations of the above conditions. The Old Union Cemetery, located on Parcel 3, is considered a significant property.

Little Bear Creek Reservoir

No significant historic structures have, to this date, been recorded on reservoir parcels; however, numerous historic structures and cemeteries have been recorded adjacent to several parcels. Historic houses were identified near Parcels 15 and 19 and the old Nauvoo Community is near Parcels 22, 23, and 25. The significant structures associated with the old Nauvoo Community include an early 19th century log house; an 1858 two-story log, dog-trot house; two later frame houses; and a large early cemetery.

3.2.2 Environmental Consequences

Under either alternative proposed in the EA, soil-disturbing activities would be reviewed by TVA to determine potential effects on historic properties eligible or potentially eligible for inclusion on the NRHP prior to any undertaking. TVA will take necessary steps to ensure basic compliance with regulatory requirement in the NHPA and ARPA.

Property owned and administered by BCDA is also subject to NRHP and National Environmental Policy Act (NEPA) review according to Bear Creek Contract TV-64000A. Under the stipulations of paragraph 8.2 of this contract, land titled to the U.S. or BCDA is required to have TVA concurrence for any activity that excavates, disturbs, or alters the physical characteristic of the project land.

Actions that may have an adverse effect on archaeological resources include ground-disturbing actions, such as shoreline development and dredging. In addition, shoreline erosion due to cyclical inundation and wave action generally has an adverse effect on cultural resources.

Archaeological Resources

Under either described alternative in this EA and Plan, TVA is conducting the phased identification and evaluation procedure set forth in 36 CFR §800.4(b)(2), regulations of the Advisory Council on Historic Preservation implementing Section 106 of NHPA, in order to identify, evaluate, and assess effects on historic properties, and to determine the appropriate course of action prior to an undertaking. An undertaking is defined, under 36 CFR §800.16(y), as "a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring Federal permit, license, or approval; and those subject to state or local regulation administered pursuant to delegation or approval by a Federal agency." The results of archaeological testing on the Bear Creek watershed would be consulted prior to undertaking site-specific activities under either alternative. TVA would continue the present process of a case-by-case review in TVA-controlled areas and BCDA land potentially subject to ground-disturbing actions, such as dredging, shoreline development, or timber harvesting through phased identification and evaluation of historic properties. Archaeological resources within these areas are avoided whenever possible. If avoidance is not possible, then proper procedures will be implemented in the mitigation of the historic property. TVA will take the necessary steps to ensure compliance with regulatory requirements of NHPA and ARPA. Under either alternative, the cumulative impacts to significant archaeological resources would be minimized by avoidance of the resource or by mitigation through data recovery excavations pursuant to 36 CFR §800.

Indirect and cumulative effects to archaeological resources include, but are not limited to, shoreline erosion due to cyclical inundation and ground-disturbing activities. Continual shoreline erosion is practically unavoidable. Proper shoreline stabilization may minimize adverse effects to archaeological sites in some instances and needs to be addressed in a case-by-case manner.

Alternative A - The No Action Alternative provides for the continuation of TVA's current resource management at the Bear Creek watershed. Dispersed recreational activities such as fishing, camping, and hiking would have little or no impact on the historic properties; however, development of a campground, parking lot, or a launching ramp could have a significant impact on these properties. There are a number of archaeological resources that are considered potentially eligible for listing in the NRHP within the Bear Creek watershed. Under this action, site-specific activities proposed in the future would be approved, mitigated, or denied according to the significance of the resource. If mitigation is required, appropriate archaeological investigation will be necessary, and potentially impacted resources will be properly recorded and removed. This plan does not provide for specific preservation of archaeological resources. However, TVA will comply with regulatory requirements of NHPA and ARPA.

Alternative B - This alternative would incorporate the phased identification and evaluation procedure to effectively preserve historic properties. Early identification of the presence of cultural resources through zoning avoids the likelihood of soil-disturbing activities in areas known to contain historic properties. This would, in turn, save time, reduce costs, and ensure more efficient compliance of Section 106 of the NHPA than under Alternative A. All soil-disturbing activities that occur on parcels which contain historic properties would be reviewed by a TVA archaeologist. TVA will take the necessary steps to ensure compliance with regulatory requirements of NHPA and ARPA.

A PA has been prepared and executed for identification, evaluation, and treatment of historic properties that are eligible for inclusion in the NRHP. This would comprise all TVA land within Alternative B. National register eligibility will be evaluated in consultation with the Alabama State Historic Preservation Office (SHPO) according to stipulations of the PA executed with the SHPO. Furthermore, mitigation of adverse effects to any historic property will be conducted according to the stipulations in the PA.

The investigations at the Bear Creek watershed identified archaeological resources on 98 of the parcels (Table 3.2.2-1). Alternative B includes 79 percent of archaeological resources identified in the Plan under Zone 3 (Sensitive Resource Management) and Zone 4 (Natural Resource Conservation). Zones 3 and 4 would effectively preserve the resources. Further investigations will be required if the resources cannot be avoided. The remaining 21 percent of the archaeological resources are under Zone 2 (Project Operations), Zone 6 (Recreation), and Zone 7 (Residential Access). Future ground-disturbing activities undertaken in Zones 2-7 would meet the terms of the PA. Zone 7 would have the most potential for development, and the identification of archaeological resources within this zone would enable development to avoid the resources effectively. If the resources could not be avoided, then further investigations would be required to determine the resources' eligibility for inclusion in NRHP. In summary, Alternative B would have a beneficial effect in conserving archaeological resources from alteration by development, and would allow for a more efficient compliance with Section 106 of the NHPA than would Alternative A.

Table 3.2.2-1. Archaeological Resources Recorded Within Zones

Zone	Acreage	Number of Recorded Archaeological Resources	Number of Parcels	Number of Parcels Containing Archaeological Resources
2	851	20	4	4
3	6,929	405	101	73
4	527	9	29	6
5	14	0	1	0
6	616	46	20	11
7	241	47	16	4
Total	9,178	527	171	98

<u>Bear Creek Reservoir</u>
Currently, archaeological resources potentially eligible for listing in the NRHP have been identified on all seven parcels of the reservoir. Approximately 82 percent of the land within this reservoir will be allocated to Zone 3 (Sensitive Resource Management), which would effectively preserve the resources. Further investigations will be required if the resources cannot be avoided. Future ground-disturbing activities undertaken in Zones 2-7 would meet the terms of the PA.

<u>Cedar Creek Reservoir</u>
Currently, archaeological resources potentially eligible for listing in the NRHP have been identified on 18 parcels of the reservoir. Approximately 76 percent of the land within this reservoir will be allotted to Zones 3 and 4, which would effectively preserve the resources. Further investigations will be required if the resources cannot be avoided. Future ground-disturbing activities undertaken in Zones 2-7 would meet the terms of the PA.

Upper Bear Creek Reservoir

Currently, archaeological resources potentially eligible for listing in the NRHP have been identified on 40 parcels of the reservoir. Approximately 89 percent of the land within this reservoir will be allotted to Zones 3 and 4, which would effectively preserve the resources. Further investigations will be required if the resources cannot be avoided. Future ground-disturbing activities undertaken in Zones 2-7 would meet the terms of the PA.

Little Bear Creek Reservoir

Currently, archaeological resources potentially eligible to the NRHP have been identified on 33 parcels of the reservoir. Approximately 69 percent of the land within this reservoir will be allotted to Zone 3, which would effectively preserve the resources. Further investigations will be required if the resources cannot be avoided. Future ground-disturbing activities undertaken in Zones 2 - 7 would meet the terms of the PA.

Historic Structures

All historic structures have been identified and the significance assessed according to NRHP criteria. All actions considered for a TVA tract will require review for potential impacts on these historic structures. Impacts can be positive or adverse. Adverse impacts include visual changes of the environment, noise, increased road traffic, increased development (changing the existing environment), etc. Some sites are more significant and/or more sensitive to potential TVA actions. Before TVA actions are initiated, impacts to these structures and mitigative measures will be evaluated in accordance with phased-compliance provisions of the PA. Because TVA approval must be obtained prior to actions being taken on BCDA lands, these lands require the same land use reviews when potentially impacting significant historic structures as mandated under Section 106 of the NHPA.

Bear Creek Reservoir

Additional field survey is necessary to identify the significant historic structures on and adjacent to the reservoir. TVA actions that may impact historic properties on Parcel 4 would be evaluated in accordance with the PA.

Cedar Creek Reservoir

TVA actions that may impact historic properties would be evaluated in accordance with the PA. Of particular concern on Cedar Creek Reservoir properties would be future actions proposed at the following locations:

- Actions that may compromise the visual or natural integrity and solemnity of the Bonds Cemetery, the Massey Cemetery, and the Greenhill-Ezell Cemetery.

- Actions (e.g., road improvements) that may impact the two historic farmhouses located off TVA property near Parcels 19, 20, 21, 22, 23, 24, and 25.

- Actions that may affect the rural nature and visual integrity of the two secluded farmsteads near Parcels 29, 30, and 31. Development near Parcels 31 and 32, as well as the increased traffic flow associated with the Britton Bridge boat ramp, could diminish the rural character of the historic farmhouses located near these tracts.

- Activities (e.g., road improvements) on and near Parcels 36, 39, 41, 42, 44, and 45 could affect the visual quality and integrity of the historic structures near there.

Upper Bear Creek Reservoir

TVA actions on Parcel 3 and adjacent parcels that could affect the partially isolated environment and natural scenic setting of the Old Union Church Cemetery would be evaluated in accordance with the PA.

Little Bear Creek Reservoir

The identified historic structures lie off TVA property; therefore, TVA has little direct control over development in the immediate vicinity of those structures. TVA actions on nearby parcels (i.e., 15 and 19) would be evaluated in accordance with the PA to minimize adverse effects and to maintain the visual integrity of nearby structures.

TVA activities associated with Parcels 22, 23, and 25 would be evaluated in accordance with the PA in order to minimize impacts (e.g., noise and visual integrity) to the old Nauvoo Community. The boat ramp at Parcel 25 has already generated more traffic on the paved roadway leading to the ramp, which has caused residents of this community to express concerns about noise, safety, and littering.

3.3 Threatened And Endangered Species

3.3.1 Affected Environment

Plants

Botanical surveys of specific tracts of TVA fee-owned lands on Upper Bear Creek, Little Bear Creek, and Cedar Creek Reservoirs were conducted, under contract, by the Alabama Natural Heritage Program^{SM} (ALNHP) from April through August 1999. No botanical surveys of Bear Creek Reservoir were conducted, since no parcels are allocated for residential development. These four reservoirs are located in northwest Alabama in portions of Franklin, Marion, and Winston Counties. Prior to these surveys, a review of both the

ALNHP and the TVA Natural Heritage Project databases was conducted, and a list of plant species potentially present on the subject parcels was developed (Appendix E, Table E-1). One rare plant species, jamesanthus (*Jamesianthus alabamenisis*), was known from project lands prior to the 1999 survey.

Forty-three new occurrences of 15 species of Alabama state-protected plants were found during field surveys. These species are listed in Appendix E, Table E-2, along with their state and federal status and the reservoir on which they are located. No federal-listed species are known from any parcels or lands adjacent to the four reservoirs. Descriptions of these 15 species and their habitats are provided in Appendix E. Each description includes general locations, global and statewide significance, habitat requirements, and brief management recommendations which, if implemented, would help ensure the long-term survival of the species.

Terrestrial Animals

The various types of plant communities found on Bear, Little Bear, Upper Bear, and Cedar Creek Reservoirs provide suitable habitat for a variety of federal- and state-listed terrestrial animals. These communities are quite diverse, including habitats such as upland hardwoods, bottomland hardwoods, wetlands, open-field, and agricultural habitats. In addition to being dominated by distinct vegetated communities, many features, such as seepages, extensive sandstone outcrops, and limestone outcrops that often provide unique habitats for many rare species of wildlife are located on most Bear Creek Reservoirs.

Prior to initiating surveys on TVA lands surrounding Bear Creek Reservoirs, TVA Regional Natural Heritage Project databases and ALNHP databases were queried to obtain records of rare terrestrial animals known from counties adjacent to Bear Creek Reservoirs. Additional resources including Conant and Collins (1998), Petranka (1998), Whitaker and Hamilton (1998), Choate, et al. (1994), Imhof (1976), Mount (1975), and Barbour and Davis (1969) were used to identify species of rare animals that could potentially occur on TVA lands due to the presence of suitable habitat.

Twenty-five rare terrestrial animal species have been documented from or are likely to occur in Franklin, Marion, and Winston Counties (Appendix E, Table E-3). Fifteen of these species are protected by the U.S. Fish and Wildlife Service (USFWS) or the state of Alabama. The remaining ten species are considered rare or uncommon by the ALNHP.

Few records of rare animals were reported from Bear Creek Reservoirs. Of the 25 rare species identified in Franklin, Marion, and Winston Counties, five species of rare animals have previously been reported near Bear Creek Reservoirs. These include the bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), northern long-eared myotis (*Myotis septentrionalis*), alligator snapping turtle (*Macroclemys temminckii*), and eastern hellbender (*Cryptobranchus alleganiensis*).

Terrestrial animal surveys were initiated in April 1999 and completed by late September 1999. Surveys were restricted to Upper Bear, Little Bear, and Cedar Creek Reservoirs since there is no residential development on Bear Creek Reservoir and none anticipated. Special emphasis was placed upon finding populations of federal- and state-listed animals, uncommon habitats, and natural features such as caves on each lands planning parcel. Black Warrior waterdog and flattened musk turtle were excluded from our surveys because these species are limited to Black Warrior River watershed. Of the remaining 22 species, the following six were found on TVA lands during field surveys: gray bat (*Myotis grisescens*), bald eagle, osprey, green salamander (*Aneides aeneus*), northern long-eared myotis, and barn owl (*Tyto alba*). Approximate known locations, habitat requirements, and management recommendations for these species are detailed in Appendix E. No known habitat will be adversely affected as a result of this proposal. The USFWS concurs that Alternative B will benefit the gray bat and bald eagle.

Except for the six species mentioned above, no populations of the remaining rare animal species were found during our field surveys. However, suitable habitat for many of these species exists on one or more Bear Creek Reservoirs. Early succession habitats, such as old fields, are excellent habitat for Bewick's wren (*Thryomanes bewickii*) and eastern coachwhip (*Masticophis flagellum*). This habitat is common on Cedar Creek Reservoir. Forested habitats having extensive rock outcrops, shaded sandstone bluffs, fallen logs, seepages, and narrow ravines are suitable habitat for the long-tailed weasel (*Mustela frenata*) and coal skink (*Eumeces anthracinus*). This habitat is most common on Upper Bear Creek. Forested areas, common on all Bear Creek Reservoirs, are suitable habitats for woodland species such as Cooper's hawk (*Accipiter cooperii*), eastern big-eared bat (*Corynorhinus rafinesquii*), northern pine snake (*Pituophis melanoleucus melanoleucus*), red milk snake (*Lampropeltis triangulum syspila*), seepage salamander (*Desmognathus aeneus*), four-toed salamander (*Hemidactylium scutatum*), and smallmouth salamander (*Ambystoma texanum*).

Eastern hellbenders and alligator snapping turtles have been reported from the Bear Creek watershed. Both species may exist in portions of all four Bear Creek Reservoirs. However, many streams, such as Devil's Den Creek and Little Bear Creek on Upper Bear Creek Reservoir, are heavily silted due to agriculture and mining activities, making these creeks unsuitable for eastern hellbenders and alligator snapping turtles.

Federal-endangered Indiana bats (*Myotis sodalis*) have recently been reported from caves in Winston County. Caves in the vicinity of the Bear Creek Reservoirs, including a previously unpublished pit cave were surveyed for the presence of Indiana bats, gray bats, big-eared bats, northern long-eared myotis, and southeastern myotis (*Myotis austroriparius*). Common eastern pipistrelle's (*Pipistrellus subflavus*) were found in most caves on or adjacent to TVA lands; however, no evidence of rare bats was observed.

Forested areas characterized by mature trees, hollow trees, and snags are suitable habitat for woodland species of bats including Indiana bats. Forested riparian zones having extensive sandstone bluffs along Upper Bear Creek, such as those found on Parcel 45, represent an excellent suitable habitat for Indiana, northern long-eared myotis, and big-eared bats.

No suitable habitat for red-cockaded woodpeckers (*Picoides borealis*) was observed on Bear Creek Reservoir lands. Stands of pine were observed on most reservoirs; however, few were of suitable age or were extensive enough to provide suitable nesting opportunities for this species.

Aquatic Animals
A search of the TVA Regional Natural Heritage Program database indicated that no federal- or state-protected aquatic species are known from the Bear Creek Reservoir or from the other land tracts considered in this Plan. Some protected aquatic species are known from near the mouth of Bear Creek downstream of the project area in Alabama; however, no recent surveys have been conducted in the part of this creek located in Mississippi.

3.3.2 Environmental Consequences

Plants
Alternative A - Under the No Action Alternative, use of TVA land on Bear Creek Project Reservoirs would continue to be guided by existing TVA policies and the SMP. This method does not include any areas reserved primarily for the protection of natural resources. There are 33 reported occurrences of Alabama state-listed plants on the subject parcels. Areas supporting these occurrences are found in parcels currently designated as undeveloped lands. If current designations are maintained, potential impacts to these state-listed plants would be assessed during site-specific reviews. Each proposed land use would be reviewed, and its anticipated impacts to protected plants, would be evaluated. The review process would ensure that impacts to protected plants would be negligible.

Alternative B - The Action Alternative would provide protective status for the 26 areas where the 33 occurrences of protected plants are known. If Alternative B is implemented, these areas would be allocated to Sensitive Resource Management Zones or Natural Resource Conservation Zones to provide protection and enhancement to these populations of rare plants.

Terrestrial Animals

Alternative A - Currently, decisions regarding the use of TVA Lands surrounding the Bear Creek Reservoirs are based upon TVA policies and the SMP. Effects to populations of rare terrestrial animals would be considered during TVA environmental reviews associated with specific projects; therefore, no significant impacts are expected. Although this process would protect most populations of rare terrestrial animals, our ability to address cumulative impacts to rare terrestrial animals would be limited.

Alternative B - Using the Lands Planning Allocation process, lands planning parcels that harbor populations of rare animals would be designated for Sensitive Resource Management or Natural Resource Conservation. This process would protect populations of federal- and state-listed animals and significant rare species habitat. In parcels designated as Natural Resource Conservation, habitat manipulation would be allowed in order to improve this habitat for wildlife.

This alternative would not impact federal- and state-listed species or their habitats; rather, by applying appropriate protective buffers around specific rare animal populations and unique habitats that may be used by rare terrestrial animals, these species would be benefited. Ultimately, TVA would consider developing unit plans for TVA lands surrounding each Bear Creek Reservoir. These plans would specifically designate protective zones for populations of rare terrestrial animals and their habitat, and specify wildlife management requirements and limitations for each Bear Creek Reservoir.

Aquatic Animals

Alternative A - Under the No Action Alternative, because there are no sensitive aquatic animal species known from or adjacent to land parcels considered in this plan, TVA actions under the current system would not likely adversely affect the habitat of rare species.

Alternative B - Under the Action Alternative, no parcels were identified specifically to protect habitats necessary for sensitive aquatic species. However, this alternative protects several large areas containing wetlands and other sensitive terrestrial habitats. Many of these areas will act as riparian buffer zones and, thus, will have an indirect but positive effect on aquatic habitat quality. The cumulative effects of these actions may help improve water quality and aquatic habitats downstream of the project areas, where sensitive aquatic species are known. Therefore, the Action Alternative will afford these species and/or habitats greater protection than the current system.

3.4 Terrestrial Ecology and Uncommon Communities

3.4.1 Affected Environment

Terrestrial Ecology

Plants

The Bear Creek Project area is located in three physiographic provinces designated by Fenneman (1938) as the Coastal Plain, the Interior Low Plateau, and the Appalachian Plateau. The interior edge of the Coastal Plain Province, also known as the Fall Line Hills, includes the upland areas of Cedar, Little Bear, and Bear Creek Reservoirs. This subsection of the Coastal Plain Province is typically 20 to 40 miles wide and within the Bear Creek Project is classified by Braun (1950) as the oak-hickory forest region. This forest type has a transitional belt where the ranges of trees of the central hardwood forest and of the coniferous forest of the southeast overlap. Tree species characteristic of this forest type include chestnut oak (*Quercus prinus*), loblolly pine (*Pinus taeda*), sweet bay magnolia (*Magnolia virginiana*), and, in the past, American chestnut (*Castanea dentata*).

The Interior Low Plateau Province is characterized by Braun as the western mesophytic forest. Within this portion of the western mesophytic forest, Braun further defines the Mississippi Plateau, which in Alabama, is generally hilly. Forest types characteristic of the Mississippi Plateau include a dry oak or oak-hickory forest on the south-facing slopes and ridge tops and a mixed mesophytic forest type on more moist slopes. This area is a mosaic of unlike communities including cedar glades and swamp forests.

The Appalachian Plateau Province, in the northern portions of Alabama, is defined by Braun as lying within the mixed meosphytic forest region. This region is characterized by oaks and pines with the true mixed mesophytic communities confined to the valley slopes. Tree species typical of this forest type include various species of oak, beech, maple, hemlock, and pine.

Compared to other TVA reservoirs, as well as central Alabama in general, TVA lands in the Bear Creek system have a much lower percentage of agricultural and residential use and a greater percentage of forest. The vegetation communities in association with Upper Bear Creek Reservoir support exemplary diversity and harbor several rare species (Appendix E, Table E-4). A large percentage of the land along Little Bear Creek Reservoir supports mature southern hardwoods that are indicative of the region. The quality of forests varies greatly but in general is very high. Much of the forested land has had no timber harvesting, grazing, significant fires, or other disturbances in several decades. Comparatively, the biotic communities of Upper Bear and Little Bear Creek Reservoirs possess greater ecological integrity and exhibit fewer disturbances than what is found along Cedar Creek

Reservoir. Several tracts along Cedar Creek are influenced by former silvicultural and agricultural land practices that occurred prior to TVA ownership.

In addition, geological features and substrates contribute to the distinctiveness of the three reservoirs. Upper Bear Creek Reservoir is characterized by extensive sandstone bluffs and outcroppings. Little Bear and Cedar Creek Reservoirs are predominantly surrounded by limestone substrates. The biotic communities that characterize each reservoir are greatly influenced by these geological components. The lands comprising these reservoirs enhance the overall biotic integrity of the Bear Creek Reservoir system.

Terrestrial Animals
The various plant communities and geological formations found on the Bear Creek Reservoir system provide suitable habitat for a variety of animals. A combined total of 118 species of terrestrial animals were observed or detected during field investigations on the Bear Creek Lands Planning Project. These species represent a variety of mammals, birds, reptiles, and amphibians. Most species observed are regionally common. More common species of wildlife observed include mammals, such as white-tailed deer (*Odocoileus virginianus*), armadillo (*Dasypus novemcinctus*), raccoon (*Procyon lotor*), beaver (*Castor canadensis*), eastern chipmunk (*Tamias striatus*), stripped skunk (*Mephitis mephitis*), white-footed mice (*Peromyscus leucopus*), southern flying squirrel (*Glaucomys volans*), and gray squirrel (*Sciurus carolinensis).* Common species of birds include great blue heron (*Ardea herodias*), green heron (*Butorides striatus*), eastern phoebe (*Sayornis phoebe*), barn swallow (*Hirundo rustica*), tufted titmouse (*Parus bicolor*), cardinal (*Cardinalis cardinalis*), American crow (*Corvus brachyrhynchos*), a variety of migrating neotropical birds, and large numbers of black (*Coragyps atratus*)and turkey vultures (*Cathartes aura*). Forested bluffs and exposed limestone outcrops provided habitat for numerous species of woodland salamanders, such as slimy salamander (*Plethodon glutinosus*)and long-tailed salamander (*Eurycea longicauda*). Common reptiles included ground skink (*Scincella lateralis*), box turtle (*Terrapene carolina*), and northern water snake (*Nerodia sipedon*).

Uncommon Communities

Numerous community types occur on Bear Creek Reservoir lands. Most of the vegetational communities, such as oak-hickory forests, cedar-hardwood forests, and late successional fields, are relatively wide spread and characteristic of this portion of Alabama. However, several uncommon community types occurring on the Bear Creek Reservoir lands are of state and regional significance because of their biological diversity. Uncommon communities of high quality are designated as TVA Habitat Protection Areas (Appendix E, Table E-6). Uncommon biological communities are described below.

Karst Features
Two caves are known from TVA lands in the Bear Creek Reservoir system. Both caves are located on Little Bear Creek Reservoir. Caves provide habitat for a variety of animals including bats, salamanders, and numerous species of invertebrates. A 200-foot protective vegetative buffer zone would be placed around cave openings. The state-listed northern myotis has been reported from a cave adjacent to Little Bear Creek Reservoirs (Hilton, 1994).

Flooded Timber
Large stands of timber were left standing in many embayments during the construction of the Bear Creek Reservoirs. These large snags provide nesting sites and perches for many birds including bald eagles and osprey. These communities also provide structure for fish and other wildlife in the reservoirs. The density of these snags restrict boat traffic in these areas; therefore, wildlife in these portions of the reservoirs receive limited disturbance from recreational traffic on the reservoirs.

Cumberland Plateau Forest
This community type occurs extensively along the slopes and ravines of Upper Bear Creek Reservoir and is characterized by mature trees of Canadian hemlock (*Tsuga canadensis*), tulip tree (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*). This community type has extensive shaded bluffs, sandstone outcrops, seepage areas, and vital plant and wildlife habitat. The green salamander is found in bluffs associated with this community along with several rare plants including Allegheny spurge (*Pachysandra procumbens*), mountain camellia (*Stewartia ovata*), and little mountain meadow-rue (*Thalictrum mirabile*).

Forested Sandstone Bluffs
Of the lands surveyed, this habitat is known exclusively from Upper Bear Creek Reservoir. The many narrow crevices within these shaded bluffs provide prime habitat for the state-protected green salamander, as well as more common amphibians and reptiles. Additionally, these habitats are used by a diverse group of small mammals, birds, and invertebrates. The cool, moist conditions at the base of bluffs and rock houses provide habitat for several rare plant species including little mountain meadow-rue, sword fern (*Dryopteris ludoviciana*), gorge filmy fern (*Hymenophyllum tayloriae*), and rock club moss (*Lycopodium porophilum*). This community type is uncommon in Alabama.

Exposed Sandstone Bluffs

These communities support different plants and animals than forested sandstone bluffs. Exposed sandstone bluffs provide suitable nesting cavities for vultures, and provide perches for osprey and bald eagles. Many of these bluffs are visible from the reservoir and are of great aesthetic value. Several sheer sandstone bluffs occur along Upper Bear Creek. The 60-foot-high, exposed bluff on Upper Bear Creek supports the only known barn owl nest on the four reservoirs of the Bear Creek system.

Muhlenberg Oak—Shumard Oak Forest

A mature forest of Muhlenberg oak (*Quercus muehlenbergii*)and Shumard oak (*Quercus shumardii*) occurs on adjacent portions of two parcels on Cedar Creek Reservoir. This community contains mature trees, has high species diversity, and contains a small population of muhly-grass (*Muhlenbergia sobolifera*), a rare plant in Alabama. This community is also characterized by high limestone bluffs and outcroppings within these mature forests. The terrain along this section is steep and supports excellent wildlife habitat. Additionally, this forest borders an area of flooded timber that provides suitable habitat for wading birds, waterfowl, and potential nesting and foraging sites for osprey and bald eagles.

Sandstone Glades

Botanically, this is one of the rarest and most significant community types known from Bear Creek Reservoir system. Sandstone glades are found exclusively on Upper Bear Creek Reservoir and are restricted to seven parcels on the reservoir. This community type is characterized by its herbaceous vegetation; woody vegetation is essentially absent from these sites. The three characteristic herbs found in these areas include Nuttall's bigelowia (*Bigelowia nuttallii*), downy coreopsis (*Coreopsis pubescens*), and small-headed blazing star (*Liatris microcephala*).

White/Red Oak—Southern Shagbark Hickory Forest

This community occurs on four parcels on Little Bear Creek Reservoir. The community shows no evidence of disturbance and provides an excellent habitat for plants and animals. It occupies gently sloping hills primarily forested with mature oaks, hickories, tulip trees, beech, and ash and supports rare plants such as golden seal (*Hyrastis canadensis*), muhly-grass, and horse-gentian (*Triosteum angustifolium*).

Significant Managed Areas

Several managed areas exist in the vicinity of the Bear Creek Reservoirs. These management areas include the following:

The Dismals (also called Dismals Wonder Garden), located on a tributary of Bear Creek, is an 80-acre sandstone gorge with vertical and overhanging walls, waterfalls, dripping rock bluffs, natural bridges, and virgin forest. It is a registered National Natural Landmark, a program administered by the National Park Service. Development is minimal with trails, swimming area, novelty shop, caretaker. It is privately owned, but seasonally open to the public for a fee.

Rock Bridge Canyon, 2 miles north of Hodges, Alabama, contains outstanding rock formations, Springs Falls, and Ball Rock (reportedly noteworthy as Alabama's largest boulder). Rock Bridge Canyon, approximately 120 acres, is privately owned with rustic development, and is seasonally open to the public for a fee. It qualified for National Natural Landmark status; however, it was never designated or registered.

Bear Creek Ravine is a canyon-like valley incised into shales and thin limestone, floristically significant, but forest has been lumbered. It is privately owned and has been evaluated for National Natural Landmark status but was never registered or designated.

William Bankhead National Forest is approximately 180,000 acres of national forest land in Franklin, Lawrence, and Winston Counties. It includes **Sipsey and Cheaha Wilderness Areas, Bee Branch Scenic Area, Sipsey Fork West Fork River** managed under the National Wild and Scenic River System, and **Black Warrior Wildlife Management Area.**

Populations of rare plants and animals, and uncommon habitats identified during field surveys are recommended as TVA Habitat Protection Areas (Appendix E, Table E-6). A mature upland hardwood forest with a series of low limestone outcrops, located on Parcel 37 on Little Bear Creek, is recommended as a TVA Small Wild Area. This area is located northeast of the Little Bear Creek Dam and would be ideal for a low impact lakeside hiking/nature trail. Dominant species of plants include eastern red cedar (*Juniperus virginiana*), chickapin oak (*Quercus prinoides*), Shumard oak, pignut hickory (*Carya glabra*), white ash (*Fraxinus americana*), American basswood (*Tilia americana*), and eastern hophornbeam (*Ostrya virginiana*). Ecologically, this site supports a diverse assemblage of animals. Suitable habitat for northern myotis, big-eared bats, long-tailed weasels, and possibly red milk snakes exists on this parcel. This tract also supports excellent nesting and foraging habitat for neotropical migrants.

3.4.2 Environmental Consequences

Terrestrial Ecology

Alternative A - Under the No Action Alternative (assuming no major changes in land use patterns occur) forested areas on TVA lands would remain forested and continue to mature with forest wildlife species remaining relatively stable at current levels. As old fields and shrub areas continue to revert to forest, there will be a decrease in wildlife species dependent on these habitat types and an increase in forest-dwelling wildlife species. TVA open lands licensed for hay crops or livestock grazing and the wildlife species using them would likely remain unchanged. Agricultural areas are considered "interim use" under current TVA policies and may be canceled at any time, while areas managed for public access (i.e., dam reservations) can increase or decrease with TVA budget fluctuations.

Any major changes in use patterns under current policies could create corresponding changes in vegetation and wildlife utilizing the affected tracts of land. For example, a change in parcels from the current use for informal recreation (i.e., hiking, camping, wildlife viewing, hunting, etc.) to recreation (i.e., formal camping, golf course, etc.) would create a major shift in vegetation and associated wildlife on the sites. However, these types of impacts would be localized and negligible on a regional or subregional basis.

No impacts are anticipated to areas off TVA managed lands associated with the Bear Creek Project. The Dismals, Rock Bridge Canyon, Bear Creek Ravine, or William Bankhead National Forest would not be affected if the No Action Alternative is selected.

Alternative B - The Action Alternative allocates 134 parcels of TVA land totaling 8,307 acres within the categories of TVA Project Operations (Zone 2), Sensitive Resource Management (Zone 3), and Natural Resource Conservation (Zone 4). These three categories comprise approximately 79-92 percent of TVA land on Little Bear, Upper Bear, Bear, and Cedar Creeks. The management of these parcels under the Action Alternative would be guided by written unit management plans, developed and reviewed with public input, that would provide for a long-term management strategy for natural resource management.

The general mix of forests and open lands in counties surrounding these reservoirs is expected to remain unchanged in the near future, with the possible exception of increased subdivision and road development. Privately owned forests and open land are therefore likely to be subject to increased development pressure in the surrounding area. By maintaining TVA land in forested and open land parcels, implementation of Alternative B could offset some negative effects of development and fragmentation on nearby private lands. Selection of the Action Alternative would have a beneficial effect on the terrestrial ecology on TVA lands.

Conclusion

Following the adoption of Alternative A (No Action), some land use actions could result in substantial impacts to terrestrial ecological resources on a localized basis. Alternative B (Action Alternative) would provide for enhanced management and protection of terrestrial resources on Bear, Upper Bear, Little Bear, and Cedar Creek Reservoirs. This would result from a longer commitment of certain land parcels to specific land use designations such as Sensitive Resource Management and Natural Resource Conservation. Also, the subsequent development of unit management plans would maintain and enhance natural biological diversity on the parcels.

Under Alternative B, seven TVA Habitat Protections Areas would be designated to protect 32 populations of rare plants and animals. These areas encompass all or portions of 17 land planning parcels on Upper Bear Creek Reservoir. Due to the temporary nature of flooded standing timber, this community would not classify as a TVA Habitat Protection Area. However, these areas would be designated as Sensitive Resource Management Zones due to their benefit to wildlife. All remaining uncommon community types would also be designated as Sensitive Resource Management Zones under Alternative B.

There would be no impacts to areas off TVA managed lands associated with the Bear Creek Project. The Dismals, Rock Bridge Canyon, Bear Creek Ravine, or William Bankhead National Forest would not be affected if Alternative B is selected.

3.5 Wetlands/Riparian Ecology

3.5.1 Affected Environment

EO 11990 (Protection of Wetlands) directs federal agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. In addition, activities in wetlands are regulated under the authority of the federal Clean Water Act (CWA) and the Tennessee Water Quality Control Act of 1977.

Wetlands are defined by TVA Environmental Review Procedures (TVA, 1983) as:

> "Those areas inundated by surface or groundwater with a frequency sufficient to support, and under normal circumstance, do or would support a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for

growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, mud flats, and natural ponds."

Wetlands are typically transitional ecosystems between terrestrial and aquatic communities. The Bear Creek Project is located in three physiographic provinces; the East Gulf Coastal Plain section of the Coastal Plain Province, the Moulton Valley district of the Highland Rim (Interior Low Plateaus Province), and the Warrior Basin district of the Cumberland Plateau (Appalachian Plateaus Province). The majority of these areas are characterized by steep slopes and deeply incised stream channels. Wetlands in this region are typically small and isolated or linear in feature and associated with the floodplain areas of streams, rivers, and in the case of the Bear Creek Project, reservoirs. In the Bear Creek Project area, wetlands represent a small percentage of the landscape relative to uplands, mainly due to the geology of the region (Hefner, et al., 1994).

Identification of wetlands in the 1999 field survey of the Bear Creek Project Reservoirs was based primarily on the presence of wetland vegetation. The wetlands have been classified according to the system developed by Cowardin, et al. (1979), for the classification of wetlands and deep water habitats as outlined in Table 3.5.1-1:

Table 3.5.1-1. Types of Palustrine (P) System Wetlands Identified During the 1999 Survey of the Bear Creek Project Reservoirs

Subsystem	Vegetation Class
FO - Forested	1 - Broad-leaved deciduous
SS - Scrub-Shrub	1 - Broad-leaved deciduous
EM - Emergent	1 - Persistent (above-ground vegetative growth persists through nongrowing season, i.e., cattails)
	2 - Nonpersistent (vegetation dies back to ground level during the nongrowing season)
Hydraulic Regime A - Temporarily flooded B - Saturated (not documented, but could occur) C - Seasonally flooded F - Semipermanently flooded	

Below is a brief description of wetland functions identified in the 1999 field survey.

Shoreline stabilization: The roots of trees, shrubs, and herbaceous vegetation, and the organic litter layer on the ground help to stabilize the shoreline soil against erosion that could result from boat wakes and storm runoff. This function is particularly important in the more developed areas that are subject to wave action from boat wakes and increased storm water runoff from residential, commercial/industrial, or recreational areas.

Retention of sediments: Vegetation and the litter layer in wetlands aid in the removal and retention of eroded soil and particulates that wash toward the reservoir from adjacent upland areas and in tributary streams. This function is particularly important to preserve those areas in which surrounding land uses could result in increased erosion and runoff, including farming operations and land development.

Retention and transformation of contaminants and nutrients: Contaminants and nutrients in dissolved and particulate form can be carried into the reservoir in storm runoff. Potential contaminants could include fertilizers and pesticides from agricultural, residential, and urban areas; excess nutrients and pathogenic bacteria from animal waste and septic system leachate; and oil and grease from roads and watercraft. Through various chemical, biological, and physical means in wetland soils, these contaminants and nutrients can be sequestered, transformed into other chemical form, or assimilated by plants.

Nutrient cycling: Nutrients are contributed to the system internally in leaf litter, plant debris, and animal waste and remains. These nutrients are cycled internally and either taken up by plants in the wetland or exported out of the wetland.

Provision of fish and wildlife habitat: Wetlands provide habitat for a large number of mammal, bird, amphibian, reptile, fish, and invertebrate species. Wetlands are essential habitats for migratory and nesting waterfowl, and many shorebird and songbird species. Many species are wetland-dependent for a part or all of their life cycle. Other species may not use the wetlands directly, but are dependent on wetlands as a source of carbon and energy. An example of this would be aquatic invertebrates which use the organic material exported from wetlands.

Provision of plant species and community diversity: Wetland plant communities consist primarily of species that can grow under low oxygen, saturated soil conditions. Although some of the species can grow outside of wetlands, most cannot grow in dry situations. The destruction of wetlands results in local removal of commonly occurring species from the landscape, and thus, over time, can lead to a reduction in the amount of plant, community, and landscape diversity in the local area or region.

Flood-flow alteration: Important functions of riverine wetlands are those associated with flood-flow alteration. These functions include short- and long-term storage of flood waters and energy reduction. This function is also important for another wetland function, the export of organic carbon. Plant and other organic material produced in the wetland is exported out of the wetland to downstream consumers during flood events.

Significant areas of wetlands were identified on 13 of the parcels (Cedar Creek Parcels 9, 31, 32, 35, 44; Upper Bear Parcels 6, 14, 15, 45, 64; Little Bear Parcels 20, 30, 31). Additional parcels were identified as having small areas of wetland vegetation, generally at the reservoir fringe; these areas were less than 0.1 acre in size and were not included in the overall wetland analysis.

All of the wetlands were classified as PSS1C, and two of the 13 areas were a mix of both PSS1C and PFO1A or PEM1F. These areas are all associated with the main lake shoreline, the heads and sides of coves and stream embayments, or tributary streams flowing into the reservoirs. The dominant vegetation species in SS and EM wetlands include black willow (*Salix nigra*), silky dogwood (*Cornus amomum*), sycamore (*Plantanus occidentalis*), buttonbush (*Cephalanthus occidentalis*), alder (*Alnus serrulata*), water willow (*Justicia americana*), soft rush (*Juncus effusus*), smartweed (*Polygonum hydropiperoides*), sedge (*Carex* spp.), cutgrass (*Leersia oryzoides*), Uruguay seedbox (*Ludwigia uruguayensis*), and wool grass (*Scirpus cyperinus*). Common species in the FO wetlands include green ash (*Fraxinus pennsylvanica*), hackberry (*Celtis occidentalis*), sweet gum (*Liquidambar styriciflua*), box elder (*Acer negundo*) and red maple (*Acer rubrum*).

Below is a brief discussion of wetlands on each reservoir, giving their location and functions. Wetlands are labeled by reservoir and parcel number (i.e., CC -31 is Cedar Creek Parcel 31).

Bear Creek

Extensive areas of wetlands are not present on Bear Creek Reservoir. Small areas of wetlands do exist on three of the seven parcels of TVA land. These areas are generally PSS1A/PEM1A wetlands occurring in very narrow fringes at the backs of coves of Parcels 3, 5, and 7. These wetlands do provide wildlife habitat value, as well as shoreline stabilization, provision of plant community diversity, and limited water quality improvement functions.

Cedar Creek
Numerous small wetland areas exist on parcels in Cedar Creek Reservoir. These are generally very small fringes of PSS1A or PEM1A wetlands confined to a narrow strip of shoreline or located at the heads of coves where tributary streams enter the reservoir. These types of wetlands occur on Parcels 1-4, 6, 12-14, 16, 18-20, 29, 33, 38, 41, 45, 47, 48, 50, 51, 53, 55, and 56. These areas provide limited wetland functions, most notably shoreline stabilization, with some wildlife habitat and plant community diversity functions. Additional parcels containing more significant areas of wetlands are described below:

Wetland CC-9: Classified as PSS1C, this wetland extends as a narrow zone along the shoreline in the uppermost portion of the Hellum Mill Branch embayment. This section of Hellum Mill Branch also contains several acres of snags. Ecological functions include shoreline stabilization, wildlife habitat, and contaminant removal.

Wetland CC-31: This is an extensive mosaic of PSS1C and PFO1A wetlands that encompass a vast proportion of Parcel 31 along Cedar Creek. Open pasture occurs along segments of the wetland's western boundary. Wetland functions include contaminant removal and sediment retention, as well as ideal wildlife habitat and plant community diversity.

Wetland CC-32: Occurring as a narrow fringe along the north side of Cedar Creek Reservoir, this wetland is classified as PSS1C, indicating the presence of low growing trees, shrubs, and herbs. Functions include shoreline stabilization, plant community diversity, and potential contaminant removal. The estimated size of this wetland is 2.0 acres.

Wetland CC-35: Wetland CC-35 is classified as a PSS1C wetland represented by a narrow corridor along the uppermost portion of Camp Branch. The surrounding area is characterized by a mosaic of forests, fields, and pine plantations. Functions include wildlife habitat, sediment retention, and contaminant removal.

Wetland CC-44: Encompassing the uppermost portion of the Lost Creek embayment, Wetland CC-44 is classified as PSS1C. As much of the surrounding landscape is under active agricultural and residential use, this wetland serves as a buffer area against unforeseen impacts farther inland. Functions include wildlife habitat, plant community diversity, sediment retention, and contaminant removal.

Upper Bear Creek
Numerous small wetland areas exist on parcels in Upper Bear Creek Reservoir. These are generally very small fringes of PSS1A or PEM1A wetlands confined to a narrow strip of shoreline or located at the heads of coves where tributary streams enter the reservoir. These types of wetlands occur on Parcels 2, 3, 5-

8, 15, 17-19, 23, 26, 32-44, 48, 50, 53-60, 62, 66, and 69. These wetlands provide limited wetland functions, most notably shoreline stabilization, with some wildlife habitat and plant community diversity functions. Additional parcels containing more significant areas of wetland are described below:

Wetland UB-6: Represented by a combination of PSS1C and PEM1F wetlands, this system embraces the head of the State Branch embayment. While the majority of the wetland is comprised of low growing trees and shrubs, a narrow fringe of Uruguay seedbox (*Ludwigia uruguayensis*), a semiaquatic species, inhabits shallow water along most of the periphery. Wetland functions include wildlife habitat, plant community diversity, shoreline stabilization, sediment retention, and contaminant removal.

Wetland UB-14: Classified as PSS1C, Wetland 14 is represented as a narrow corridor along the lower portion of State Branch just upstream from its confluence with Bear Creek. The estimated size is 3.0 acres. Functions include wildlife habitat, shoreline stabilization, sediment retention, and a limited function of contaminant removal.

Wetland UB-15: Embracing the upper end of State Branch, Wetland UB-15 is classified as PSS1C. Also in this area are several acres of snags. The surrounding area is forested and provides minor functions of sediment retention, shoreline stabilization, and contaminant removal. Combined with the benefits from the area of snags, this wetland furnishes ideal wildlife habitat.

Wetland UB-45: Encompassing a small area, Wetland UB-45 is represented by a densely vegetated zone along the margin of Upper Bear Creek, thus being classified as a PSS1C wetland. The estimated size is less than 1.0 acre. Functions include wildlife habitat, provision of plant community diversity, shoreline stabilization, and sediment retention.

Wetland UB-64: This wetland is a narrowly defined PSS1C wetland occurring along both sides of Melton Branch in Parcels 62, 63, and 64. While roughly only 2.0 acres in size, this wetland provides valuable ecological functions such as retaining sediment and removing contaminants from surrounding areas, shoreline stabilization, and plant community diversity.

Little Bear Creek

Numerous small wetland areas exist on parcels in Little Bear Creek Reservoir. These are generally very small fringes of PSS1A or PEM1A wetlands located at the heads of coves where tributary streams enter the reservoir or are confined to a narrow strip of shoreline. These types of wetlands occur on Parcels 2-5, 7, 8, 11-15, 19, 21-24, 29, 32, 34, 35, and 37. These areas provide limited wetland functions, most notably shoreline stabilization, with some wildlife habitat and plant community diversity functions. Additional parcels containing more significant areas of wetlands are described below:

Wetland LB-20: A narrow fringe of wetland vegetation occurs at the shoreline of this parcel. A mix of buttonbush, black willow, rushes, and sedges, this small area was the only wetland discovered during the field survey of this reservoir. This area, while small, does have wildlife habitat functions, and some limited functions for sediment and nutrient retention. This parcel, however, is designated as committed and was not intensively surveyed.

Wetland LB-30: This parcel contains a PSS1A/PEM1A area of approximately 2.0 acres in the Dempsey Spring Branch embayment. The wetland is a mix of buttonbush, alder, and rushes along the shoreline. This parcel is designated as committed land and was not intensively surveyed. Like Wetland LB 20, this area also has wildlife habitat functions, and may function to retain nutrients and sediments. It also has some benefit for shoreline stabilization.

Wetland LB-31: A small fringe of wetland vegetation occurs at Carpenter Branch. Classified as a PSS1A/PEM1A, this small area occurs on a committed parcel and was not intensively surveyed. The fringe zone of buttonbush, alder, dogwood, and rushes does provide an important wildlife habitat function.

3.5.2 Environmental Consequences

In all, 86 parcels contain wetland areas within a portion of their area. Thirteen of these parcels (CC-9, CC-31, CC-32, CC-35, CC-44, UB-6, UB-14, UB-15, UB-45, UB-64, LB-20, LB-30, LB-31) contain functionally significant wetlands. All of the wetlands, whether they were determined to be functionally significant or not, would be protected from most direct impacts through compliance with federal mandates and legal requirements for protection of wetlands. Regulatory protection is extended to wetlands under Section 404 of the CWA , and TVA is subject to EO 11990, Protection of Wetlands, which mandates that federal agencies take such actions as may be necessary to "minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. . . ." Consistent with this requirement, TVA would, to the extent practicable, take measures to either avoid adverse impacts to wetlands or mitigate unavoidable effects to wetlands in disposing of land or during its Section 26a review of water-use facilities.

Alternative A - In all, 13 parcels contain significant wetland areas within a portion of their area. Under the No Action Alternative, all of these wetlands would be protected from most direct impacts through compliance with federal mandates and legal requirements for protection of wetlands.

If conditions of Section 404 or 26a permits did allow some wetland impacts based on site-specific circumstances, mitigation requirements would offset any long-term loss of wetland functions. However, even with mitigation, there would be some short-term loss of wetland functions in the time it would take for the mitigated wetlands to develop a mature stand of wetland vegetation.

Under Alternative A, smaller areas of fringe wetlands located on TVA land in the Bear Creek Project area would be subject to TVA NEPA review and also compliance with EO 11990. However, these wetlands could suffer indirect impacts to wetland functions due to site-specific impacts, mainly incremental clearing of vegetation, if allocated for development.

Alternative B - Under this alternative, 12 parcels containing significant wetlands would be categorized as Zone 3, Sensitive Resource Management, or Zone 4, Natural Resource Conservation. These zones would emphasize protection of sensitive natural resources, including wetlands, and would preserve wetland functions on these parcels. No water-use facilities would be permitted, and wetland areas would remain intact. One parcel would be in Zone 7 and would receive protection through the shoreline categorization provided under SMP.

Additional parcels containing small areas of wetlands on Upper Bear, Little Bear, and Cedar Creeks were allocated to Zones 6 or 7 (Developed Recreation or Residential Access). For any parcels allocated to Zones 6 or 7, wetlands present on these sites would be protected under federal law, and any potential impacts to wetlands would be regulated under these programs. In site-specific cases where some wetland impacts do occur, mitigation requirements would offset any long-term loss of wetland functions. There would be, however, some short-term loss of wetland functions during the time required for the mitigated wetland to mature. On parcels designated Zones 6 and 7, there may also be some incremental clearing of wetland vegetation by landowners resulting in some minor, cumulative loss of wetland function, primarily shoreline stabilization, wildlife habitat provision, and plant community diversity.

Under either Alternative A (No Action) or Alternative B (Action), wetlands would be protected from most direct impacts through compliance with federal mandates and legal requirements for wetland protection. However, under Alternative B, wetland areas with substantial ecological functions would be allocated to the Sensitive Resource Management Zone (Zone 3). This designation would allow for the development of management strategies to enhance the functions of wetland resources and provide a long-term beneficial effect to wetlands on TVA lands. With either alternative, there would be some minor, cumulative loss of wetland functions associated with an increase in residential, commercial, and recreational development, as small areas of wetlands are cleared of vegetation.

3.6 Recreation

3.6.1 Affected Environment

The Bear Creek Project consists of four reservoirs, a floodway, and a floatway within the Bear Creek watershed. Recreation facilities provided and maintained by TVA, BCDA, and one municipality within the project area include six formal campgrounds, 15 reservoir access areas, and five canoe access areas (see Table 3.6.1-1).

Bear Creek, located in Franklin County, has two developed campgrounds with 45 campsites operated by BCDA at Piney Point and Horseshoe Bend. Both have swimming beaches and reservoir access areas with paved parking areas and courtesy docks. There is also a lake access area at Scott Ford with a gravel parking lot. TVA operates a swimming beach and tailwater fishing area on the dam reservation. The BCEEC is located on Bear Creek Reservoir approximately at mile 79. It is owned by BCDA and leased by the Franklin County Board of Education in a cooperative agreement called the Bear Creek Education Project. Developments include group dormitories, kitchen and dining facilities, outdoor activity centers, a beach area with boat dock, restored cultural areas, and staff residences.

Cedar Creek, located in Franklin County, has one developed campground with 53 campsites operated by BCDA at Slickrock. Slickrock also has a boat ramp with paved parking and a courtesy pier, a swimming beach with pavilion and restroom facilities, and a developed play area. There are also reservoir access areas with paved parking and courtesy docks at Hellums Mill, Britton Bridge, and Lost Creek operated by BCDA. TVA maintains a reservoir access area with paved parking on the Cedar Creek Dam Reservation. There is a tailwater fishing area below the dam.

Upper Bear, located in Franklin, Marion, and Winston Counties, has one developed campground at Twin Forks which is under license to the town of Bear Creek by BCDA. It has campsites, playground facilities, ball fields, a pavilion, and a swimming beach. Adjacent to the licensed area, BCDA manages a boat ramp with a paved parking area and courtesy dock. Across the creek from the ramp, and also named Twin Forks, is a BCDA swimming beach and picnic pavilion with paved parking. There are three other reservoir access areas on Upper Bear at Batestown, Mon Dye, and Quarter Creek. All three have paved parking areas and a courtesy dock. Both Mon Dye and Quarter Creek have picnic pavilions.

Table 3.6.1-1. Public Recreation Sites on Bear Creek Lakes

County	Site	Camping	Bath House	Swimming	Boat Ramp	Picnic	Electric Hook-up	Concessions	Fish Pier	Pavilion
Upper Bear										
Marion	Twin Forks	X	X	X	X	X	X			X
Winston	Quarter Creek			X	X	X				X
Franklin	Batestown				X					
Franklin	Mon Dye		X	X	X	X				X
Cedar Creek										
Franklin	Cedar Creek Dam				X					
Franklin	Hellums Mill				X					
Franklin	Slickrock	X	X	X	X	X	X	X		X
Franklin	Britton Bridge				X					
Franklin	Lost Creek				X					
Little Bear										
Franklin	Elliott Branch	X	X	X	X	X	X	X	X	X
Franklin	McAfee Landing				X					
Franklin	Williams Hollow	X	X	X	X		X	X		
Franklin	Little Bear Dam								X	
Big Bear										
Franklin	Piney Point	X	X	X	X	X	X			
Franklin	Horseshoe Bend	X	X	X	X	X	X	X	X	X
Franklin	Scott Ford				X					

Little Bear, located in Franklin County, has two developed campgrounds at Elliott Branch and Williams Hollow providing 60 campsites. There are reservoir access areas at these campgrounds, as well as a lake access area at McAfee Landing. All three have paved parking areas and courtesy docks. Both Williams Hollow and Elliott Branch have developed swimming beaches. Elliott Branch has a picnic pavilion with a paved parking area. With the exception of a handicapped-accessible fishing pier on the dam reservation at Little Bear, maintained by TVA, all other recreation facilities on Little Bear are managed by BCDA.

The floatway, which extends from the tailwater of Upper Bear Creek Dam to the headwaters of Bear Creek Reservoir, has five access areas: at Highway 5 Bridge, Mill Creek, Rock Quarry, Military Bridge, and Scott Bridge. All except Scott Bridge have developed parking areas and access facilities. One commercial canoe outfitter has a licensed boat access area on the floatway upstream of the U.S. Highway 43 Bridge.

The developed campgrounds on the Bear Creek Reservoirs, with the exception of Williams Hollow, experience occupancy rates which are higher than the average public campground in the region. This is probably due to the fact that they are well maintained, and they are smaller than average. Sales of BCDA day-use permits have documented visitors from all 50 states and several foreign countries. In 1998, BCDA sold 37,808 day passes and 6,758 annual passes (required for visitors to BCDA facilities between the ages of 16 and 65), representing increases over 1997 of 10 percent and 7 percent, respectively. The BCEEC had 7,000 participants in the 1998-1999 operating year representing an increase of 16 percent from the previous year.

Parts of William B. Bankhead National Forest, administered by the U. S. Forest Service, are located on the upper end of the Bear Creek watershed in Lawrence and Winston Counties. The forest totals 179,000 acres, which includes the 12,726-acre Sipsey Wilderness Area. It is considered a multiple use area, including timber and wildlife management, recreation, wilderness, and water uses; however, hunting and timber harvesting are restricted in Sipsey Wilderness Area. The forest is scenic, providing primitive camping, hiking, and horse trails.

Recreation facilities on the 21,200-acre Lewis Smith Lake, located in portions of Winston, Walker, and Cullman Counties, include developed campgrounds, lodging facilities, facilities for boating, swimming, and full-service marinas.

The Natchez Trace Parkway (Parkway), a unit of the National Park Service (NPS), crosses Bear Creek on the lower end of the watershed. Picnic facilities are provided at the crossing. It was designated an All-American Road in 1996. In 1983, Congress designated the Parkway as the corridor for the Natchez Trace National Scenic Trail. The Parkway was established to commemorate the original Natchez Trace, a primitive trail stretching 500 miles through the wilderness from Natchez, Mississippi, to Nashville, Tennessee. The original trace followed old American Indian trails and was used by boatmen, traders, and explorers returning to the eastern U.S. after sailing down the Mississippi River, as a federal postal road, and for troop movements during the War of 1812. In 1934, the U.S. Congress commissioned the NPS to survey the old Indian trail known as Natchez Trace and plan a national road along this route. The Parkway was officially established in 1938 (NPS, 1987).

The Tennessee-Tombigbee Waterway (Waterway), located approximately 20 miles west of the watershed, provides opportunities for recreational boating and commercial barge traffic. The Waterway provides a direct route to the Gulf of Mexico from the upper Mississippi, Ohio, and Tennessee Rivers. Bay Springs Lake, a 6,600-acre reservoir on the Waterway provides fishing, camping, wildlife observation, and full-service marinas.

The Dismals is a private commercial scenic area in the watershed that has rental cabins and campsites located off-reservoir.

3.6.2 Environmental Consequences

Alternative A - Under this alternative, no comprehensive plan for developing recreation exists, and there are very little provisions for public input and needs analyses. BCDA would likely continue to manage its existing public use areas, and TVA would continue to manage the dam reservations and associated recreation facilities. Any expansion of existing facilities would likely occur on the currently developed parcels which have adequate space for expansion beyond this planning horizon. Decisions to expand would likely be made based upon demand for facilities at specific locations or specific reservoirs. The Twin Forks Public Use Area on Upper Bear would continue to be managed by the town of Bear Creek. TVA would respond to inquiries for new public recreation facilities on a case-by-case basis and would continue to partner with BCDA and other public entities to develop, manage, and maintain the facilities. It is anticipated that land allocated for developed public recreation would slightly increase over the next 10 years.

Alternative B - This alternative allocates land for concentrated, active recreation activities that require capital improvement and maintenance to Zone 6. Under this alternative, BCDA would likely continue to manage its existing public use areas and TVA would continue to manage the dam reservations and associated recreation facilities. Any expansion of existing facilities would likely occur on the currently developed parcels which have adequate space for expansion beyond this planning horizon. The Twin Forks Public Use Area on Upper Bear would continue to be managed by the town of Bear Creek. TVA would respond to inquiries for new public recreation facilities on a case-by-case basis and would continue to partner with BCDA and other public entities to develop, manage, and maintain the facilities.

Bear Creek
Under this alternative Parcel 4 (100.2 acres), which includes the shoreline around BCEEC, would provide for future growth of both formal facilities and informal activities.

Cedar Creek
Alternative B establishes Parcel 22 (80.3 acres) for future expansion of Slickrock Public Use Area (Parcel 23). Prior master plans for Slickrock included this as the future expansion direction. This alternative recognizes Parcel 36 as the location for an existing group camp activity, which has previously been operated under an agriculture use license, and Parcel 42 as the current location of back-lying commercial recreation activity and the historical location of special event activities such as boat races. The possibility of commercial use licenses at these sites would be explored with interested parties. In response to public comments for additional facilities, this alternative proposes Parcel 57 (17.6 acres) as a potential site for future commercial public recreation development. When combined with BCDA land, this site would offer a suitable location featuring accessibility to Highway 247 and adequate year-round water depth. If adequate market demand is identified, a request for expression of interest or request for development proposals would be publicized for this parcel.

Upper Bear
This alternative provides for future expansion of public recreation opportunities at Parcel 19 (15.5 acres), Quarter Creek Public Use Area. TVA and BCDA would continue to identify interested public entities which would be interested in and capable of developing and maintaining camping and related facilities. Parcel 54 (41.0 acres) provides for possible future expansion of recreation facilities at Batestown Reservoir access area, including day use and camping facilities.

Little Bear
While recognizing that there is adequate room for expansion of Williams Hollow (Parcel 14) and Elliott Branch (Parcel 2), this alternative provides for Parcel 5 (5.4 acres) as future commercial recreation potential and/or community dock facilities for Parcel 4 located immediately downstream and proposed for future residential development. If adequate market demand is identified, a request for expression of interest or request for development proposals would be publicized for this parcel. If BCDA proposes to develop residential lots back lying Parcel 4, this parcel would possibly be used for community dock facilities in lieu of private water-use facilities fronting each waterfront lot.

It is anticipated that the existing floatway access sites would be adequate for future use of the scenic area.

None of the four reservoirs have existing marina services. There are relatively few residential water-use facilities except in certain concentrated areas. Most of the water-use recreation activities are accessed by the existing developed public use areas as will be the case in the future. Future residential development as proposed by this Plan would not significantly affect the use and enjoyment of the reservoir areas by the general public.

The large acreage proposed for allocation to Zones 3 and 4 would be available to the public for natural resource activities, such as hunting, wildlife observation, and passive recreation activities while emphasizing protecting and enhancing the resources identified.

3.7 Water Quality

3.7.1 Affected Environment

Off-Reservoir Watershed Activities

Introduction

During the public scoping period, several comments were voiced regarding contamination of the Bear Creek Reservoirs by off-reservoir farming operations. While these lands are not a part of the current land planning effort, they are a valid and significant component to the health, development, and enjoyment of the lake waters and surrounding reservoir properties. The following issues are deemed important not only to the health of the watershed but also directly or indirectly impact the economy and quality of life in the watershed counties as well. The reservoirs are increasingly used for fishing, recreational boating, and swimming. They support several species of flora and fauna that are unique to the north Alabama area. Additionally, they provide an increasingly important role in municipal water supply systems. The Upper Bear water treatment plant has provided a source of water for residents in three counties for several years. In late 1999, the city of Russellville extended a water line from Elliott Lake to Cedar Creek Reservoir to supplement that source which was alarmingly low due to a prolonged drought. The Franklin County Water Authority is presently evaluating the feasibility of a new water treatment plant on Little Bear. TVA has attempted to identify a few of the issues concerning off-reservoir land use and the activities underway.

Issues

The Bear Creek watershed is a largely rural area that historically has been dominated mainly by agriculture and, to a lesser degree, mining and timber activities. One area of significance in the watershed has been the Bear Creek Floatway located immediately downstream of Upper Bear Creek Dam. This recreational floatway was developed with the impoundment of Upper Bear Creek Dam in the late 1970s. During the middle 1980s, high levels of bacteria forced its closure to recreation. Over a 4-year period, TVA, the United States Department of Agriculture (USDA), NRCS, and local landowners cooperatively invested funding and in-kind services of nearly $2 million to reduce pollution coming from mainly agriculture areas. By 1990, the floatway was reopened to recreational use.

With the contamination in the floatway reduced and similar pollution abatement projects being implemented by the NRCS in the other areas, the vast majority of agricultural pollutants in the watershed were well contained through proper waste handling practices. However, during the early 1990s, a shift in the commercial market resulted in a tremendous growth in agriculture in the Bear Creek watershed dominated primarily by the poultry industry. By 1996, the expanding poultry industry, coupled with expansions in cropping practices and the size of cattle operations, resulted in concerns being raised about possible biological contamination. These concerns were not only voiced by citizens and the state regulatory agency, but also from the farming community. Currently in Franklin County there are approximately 149 growers of poultry with an estimated 486 chicken houses. Each house averages an estimated 15,000-17,000 chickens. The majority of the houses in Franklin County are in the Bear Creek watershed and work in support of the Gold Kist processing plant east of Russellville. Gold Kist employs an estimated 1,890 people and processes an estimated 1.44 million chickens per week. Other houses in Lawrence, Winston, and Colbert Counties provide products for the operation. In addition, a large quantity of the feed grain is grown locally.

Presently, most agricultural operations in the Bear Creek watershed have various degrees of environmental problems associated with the day-to-day operations. For the livestock and poultry operations, the most critical problems are the lack of adequate waste management facilities, proper operation and maintenance of existing waste management facilities, and the ultimate disposal of the tremendous amount of waste produced at each site. Improper waste management practices result in possible environmental problems from over-applying waste to the land or applying during unsuitable periods (e.g., winter months, heavy rainfall periods). For farms that are predominantly cropland, the most critical problem is proper fertilizer/pesticide application and erosion/runoff control. As in the case of the livestock and poultry operators, these problems tie directly to proper techniques and economics.

Several thousand acres in the Bear Creek watershed, as well as surrounding areas, were formerly used in strip mining operations. This practice has ended; however, the problems associated with the abandoned mines continue. Problems associated with the mines include both water quality concerns as well as general public safety concerns. Common problems include dangerous piles or embankments, dangerous impoundments, dangerous high walls, spoiled areas, acid runoff, and polluted water. Many acres were reclaimed in the 1960s and 1970s through erosion control measures and tree-planting campaigns.

Timber harvesting and replacement have been significant elements in the watershed's economy for many years. Several thousand acres are owned by timber companies, while other timber is provided by private landowners. BCDA has historically provided timber management activities on both TVA and BCDA land within the watershed. Water quality is affected when timber harvesting without use of Best Management Practices (BMPs) result in erosion of the land and siltation accumulation in the reservoirs. Other problems result in the loss of animal habitat, destruction of sensitive ecological areas, and the loss of valuable scenic areas.

Other off-reservoir activities that have potential for affecting water quality on the Bear Creek Reservoirs include discharges from municipal and industrial wastewater treatment plants; commercial, industrial and residential development along feeder streams; and improperly installed or operated septic systems.

Activities

A number of federal and state agencies, local governments, industries and private landowners are conducting on-going programs and activities in support of sustaining the Bear Creek watershed. The Soil and Water Conservation Districts in Franklin, Marion, Winston, and Colbert Counties, and NRCS have initiated the Bear Creek Advisory Committee. The committee was formed to develop and implement water resource assessment and improvement activities. It involves a wide range of agencies, public and private entities, and special interest groups. During 1998-1999, this group hired a coordinator to facilitate the formation of the committee, assess site-specific agriculturally and nonagriculturally related environmental problems/needs in the watershed and initiate activities deemed necessary to improve or preserve proper resource management in the watershed. In August 1999, the Franklin County Soil and Water Conservation District conducted a Bear Creek watershed planning meeting in order to coordinate activities of all agencies and groups that are working on projects within the watershed. This was a successful meeting that informed participating agencies of on-going activities and created a "big picture" awareness.

In support of the above activities and in light of TVA's assumption from BCDA of management of agricultural licenses on TVA reservoir land, TVA is instituting a number of policies in support of protecting and enhancing public lands and improving water quality in the watershed. These policies include establishing a buffer of appropriate width between agricultural tracts and the reservoir and partnering with NRCS, Soil and Water Conservation Districts, and the license holders to develop and implement conservation plans with BMPs.

The Office of Surface Mining has an on-going program to identify and reclaim abandoned mine lands. In the Bear Creek watershed portion of Franklin, Marion, and Winston Counties, 24 sites have been identified. Twelve of the sites have been reclaimed, while 12 are proposed for treatment.

Another activity in support of the Bear Creek watershed is being initiated and implemented by a local stakeholder group called the Franklin County Earth Team Volunteers. They have begun the Little Bear Millennium Project (LBMP) whose goal is to improve water quality, shoreline aesthetics, and enhance fish and wildlife habitat on Little Bear Reservoir. Plans include involvement from BCDA, Alabama Game and Fish, Earth Team Volunteers, and other volunteers from school groups, scout troops, private citizens and sport clubs. Activities include planting trees and shrubs for fish and wildlife habitat, bioengineered shoreline stabilization projects, and seeding mud flats with annual wheat and ryegrass. If successful, the project will be extended to other Bear Creek Reservoirs.

Surface Waters

Within the Tennessee River drainage area, various subwatersheds have been divided into hydrologic units (HU). The Bear Creek Reservoirs are located in three HUs. Cedar Creek Reservoir is located in the lower end of the Cedar Creek HUC (AL 06030006-040). Little Bear Creek Reservoir is located near the middle of the Little Bear Creek HUC (AL 06030006-030). Upper Bear Creek and Bear Creek Reservoirs are both located in the Bear Creek HUC (AL 06030006-010). Upper Bear Creek Reservoir is located in the upper portion of the HUC, and Bear Creek Reservoir is located near the middle.

Water quality in the Bear Creek Project Reservoirs is influenced by the physical characteristics of the reservoirs, geology, land use, and inflow water quality. Each reservoir is operated for flood control and recreation. Upper Bear and Cedar Creek Reservoirs are also operated for water supply. Each reservoir is relatively deep with low average discharge, resulting in long average retention times in all but Bear Creek Reservoir. Average discharge is 380 cubic feet per second (cfs) for Bear Creek Reservoir, 101 cfs for Little Bear Creek Reservoir, 282 cfs for Cedar Creek Reservoir, and 200 cfs for Upper Bear Creek Reservoir. Retention time is 13 days for Bear Creek, 225 days for Little Bear, 282 days for Cedar and 85 days for Upper Bear (TVA, 1988; 1994; 1995; 1996; 1997; 1998). Discharges from Upper Bear Creek Reservoir fluctuate greatly during the summer canoeing season.

Weekend releases are usually around 250 cfs to provide sufficient water for recreational use on the Bear Creek Floatway, while weekday releases may be as low as 10-50 cfs (TVA, 1988).

Most of the drainage area for all four reservoirs lies within the western Highland Rim Physiographic Province. Underlying rock formations are primarily sandstone (Upper Bear) and limestone (Little Bear, Bear, and Cedar). Numerous limestone outcroppings occur throughout the drainage area, and are prevalent along many areas of shoreline for all but Upper Bear Creek Reservoir (TVA, 1994; 1995; 1996; 1997; 1998). Upper Bear Creek Reservoir is primarily surrounded by sandstone and shale. Many areas are laden with coal deposits (TVA, 1988). Presence of limestone and sandstone along shorelines provides a stable surface, and shoreline erosion is limited to only small areas throughout the reservoirs.

Land use throughout the four reservoirs' drainage areas consists primarily of forested lands and agriculture (TVA, 1994; 1995; 1996; 1997; 1998). Agricultural runoff could increase nutrient levels in the reservoirs; however, all except Bear Creek Reservoir are typically oligotropic (low production) due to naturally low nutrient levels of nitrogen and phosphorus in inflow waters. Chlorophyll levels during summer months are typically low, except in Bear Creek Reservoir (TVA, 1994; 1995; 1996; 1997; 1998). Phosphorus is probably limited in the natural runoffs of area lands, and may also be lost as it forms precipitants with metals (Angus and Marion, 1993). Nutrient levels could also be elevated in areas of lakeshore development if septic systems are not installed or operated properly.

Increased soil erosion from improperly managed forestry and agriculture practices could increase sediment load on all reservoirs. Runoff from poorly managed lands could increase nutrient loads, as well as turbidity. Poorly managed waterfront and adjacent properties could also contribute to increased soil erosion and, therefore, sediment loading in the reservoirs. Sedimentation has been found to be extensive in certain areas of Upper Bear Creek Reservoir, primarily due to improper mining activities immediately prior to completion of the dam (Carriker, 1981).

Russellville, in the upper Cedar Creek Reservoir drainage area, is the only major urban area. Smaller urban areas (and the nearby reservoir) include Hackleburg and Hodges (Bear Creek), Spruce Pine (Little Bear Creek), Bear Creek (Upper Bear and Bear Creeks), Phil Campbell (Upper Bear and Little Bear Creeks) and portions of Haleyville (Upper Bear Creek). Urban runoff could increase nutrient and toxic chemical loads on all reservoirs. Elevated levels of organic herbicides, pesticides, and other toxic chemicals have not been found in the sediments of Bear, Cedar, and Little Bear Creek Reservoirs (TVA, 1994; 1995; 1996; 1997; 1998). Sediments from Upper Bear Creek

Reservoir have not been sampled as part of TVA's routine reservoir monitoring program.

Residential development near the shores of these reservoirs requires on-site treatment of wastewaters (septic systems). Soils in many areas around the reservoirs are not suitable for conventional septic systems (TVA, 1987). Improper septic systems increase nutrient loading on the reservoirs, as well as provide a source of bacterial contamination, particularly fecal coliform bacteria. Bacterial contamination could adversely affect recreational uses of the reservoirs.

Scattered open pit and strip mines where iron and coal have been mined can be found throughout all drainage areas, but are especially common around Upper Bear Creek Reservoir. Runoff from abandoned mines have the potential of contaminating reservoir waters with unacceptable levels of toxic metals and decreasing pH. Most mine areas have been reclaimed to prevent additional surface runoff, erosion, and surface water contamination. Levels of toxic metals in sediments have not been found to exceed TVA and the EPA sediment quality guidelines in any reservoir sampled (Upper Bear Creek not sampled) (TVA, 1994; 1995; 1996; 1997; 1998). Elevated levels of toxic metals, particularly aluminum, iron, and manganese are found in deep water areas of Upper Bear Creek and Bear Creek Reservoirs (TVA, 1988; Angus and Marion, 1993).

Low inflow volumes combined with relatively deep waters and long retention times allow stratification of all the reservoirs during summer months. Stratification leads to anoxic conditions (i.e., little or no oxygen) throughout most of the reservoir volume as decomposition uses all available oxygen in the hypolimnion. All four reservoirs stratify by early summer, and oxygen levels in the hypolimnion are typically less than 2 milligrams per liter throughout the summer months. Typically, only the upper 3-5 meters (m) of water in each reservoir contain sufficient oxygen levels during summer months to support most aquatic life. Anoxic conditions allow reduction of iron and manganese compounds. Reduction causes these potentially toxic metals to become available in the water column. Sulfide compounds are also formed during the anoxic period and can lead to adverse effects on aquatic organisms. A combination of anoxia, toxic metals, and sulfides typically adversely affect most aquatic life. Benthic communities typically are not diverse and are comprised primarily of tolerant species such as dipteran larvae (TVA, 1994; 1995; 1996; 1997; 1998). TVA provides aeration at several sites in Upper Bear Creek Reservoir to minimize stratification and subsequent anoxia (TVA, 1988).

The waters of all reservoirs are typically soft with very low alkalinity. This allows poor buffering capacity for the acidic runoff from area mines (Marion, et al., 1991). The low hardness also provides little chelation of toxic metals.

Metal concentrations are typically high, especially in Upper Bear Creek and Bear Creek Reservoirs. Typically, aluminum, iron, and manganese are the primary problematic metals (Angus and Marion, 1993). High concentrations of metals combined with low hardness could cause problems for many aquatic organisms.

The usual pH for Bear Creek Reservoir is about 7.0. Upper Bear Creek has an average pH of 6.8. Historically, the pH in Upper Bear Creek Reservoir has been lower, probably due to surface mine runoff (Angus and Marion, 1993). Alabama Department of Environmental Management (ADEM) (1985) found values averaging 6.1-6.2. Little Bear Creek Reservoir has an average pH of 7.7 (Angus and Marion, 1993). Cedar Reservoir has an average pH of 7.7 (TVA data). Decreases in pH levels, particularly from surface mine runoffs, could cause increased metal toxicity to aquatic organisms. Poor buffering capacity due to low alkalinity and hardness could further exacerbate the problems of high metal concentrations and acidic inflow near surface mines.

As part the Vital Signs Monitoring Program initiated by TVA in 1990, each reservoir in the Bear Creek system, expect Upper Bear Creek, has been monitored for physical/chemical characteristics of water, physical/chemical characteristics of sediment, benthic macroinvertebrate, and fish community assemblages. One location on each reservoir has been sampled annually since 1993. After the 1997 sampling season, sites have been monitored on a biannual basis (i.e., no sampling in 1998). The overall health of Little Bear and Cedar Creek Reservoirs has been fair. Bear Creek Reservoir has been rated fair to poor each year.

Monitoring sites are located in the forebay region of each reservoir. Locations are Little Bear Creek Mile 12.5, Cedar Creek Mile 25.2, and Bear Creek Mile 75.0.

The primary water quality indicator of concern for these reservoirs is dissolved oxygen (DO). Each year DO levels have been sufficiently low to yield a poor rating in all three reservoirs. In 1993 and 1994, the Bear Creek Reservoir received poor sediment toxicity ratings. In 1994, Little Bear Creek Reservoir received poor sediment toxicity ratings. Each year, all reservoirs have produced fair or good ratings in chemical analyses of sediments, except for 1993. In 1993, sediment chemistry received a poor rating for Bear Creek Reservoir. Sediment toxicity was not monitored after 1994. Chlorophyll levels were fair to good in both Cedar Creek and Little Bear Creek Reservoirs each year. Levels in Bear Creek Reservoir were fair in 1994, but poor for all other years. A summary of monitoring results is included in Table 3.7.1-1.

Table 3.7.1-1. Water Quality Ratings, Vital Signs Monitoring Data

	Monitoring Years

	1993	1994	1995	1996	1997
Cedar					
Dissolved Oxygen	poor	poor	poor	poor	poor
Chlorophyll	fair	good	good	good	good
Sediment Chemistry	fair	good	good	good	good
Sediment Toxicity	fair	good	NS	NS	NS
Little Bear					
Dissolved Oxygen	poor	poor	poor	poor	poor
Chlorophyll	good	good	good	good	good
Sediment Chemistry	fair	good	good	good	good
Sediment Toxicity	fair	poor	NS	NS	NS
Bear					
Dissolved Oxygen	poor	poor	poor	poor	poor
Chlorophyll	poor	fair	poor	poor	poor
Sediment Chemistry	poor	good	good	good	good
Sediment Toxicity	poor	poor	NS	NS	NS

NS-Not Sampled

Groundwater, Geology, and Site Soils (Hydrogeology)
The Bear Creek Project area is located within three physiographic provinces. The vast majority of the project area is in the East Gulf Coastal Plain section of the Coastal Plain Province. This is the inner edge of the Coastal Plain which forms the western boundary of the Appalachian Plateaus. Locally, this district is referred to as the Fall Line Hills which regionally includes upland portions surrounding the Cedar, Little Bear, and Bear Creek Reservoirs. Topographically, this area is characterized by steep slopes and deeply incised stream channels. In the mideastern portion of Franklin County, the stream channel portions of Cedar Creek, and the reservoir reaches of Little Bear and Bear Creeks, are located in the Moulton Valley (rolling lowland) district of the Highland Rim (Interior Low Plateaus Province). The majority of Upper Bear Creek and the upper reaches of Little Bear and Bear Creeks are located in the Warrior Basin district of the Cumberland Plateau (Appalachian Plateaus Province). This eroded plateau is dissected and steeply sloped.

Geologic formations exposed in the project area range in age from Mississippian and Pennsylvanian consolidated rocks to late Cretaceous unconsolidated gravel. The formations of Mississippian age include the Hartselle Sandstone, Bangor Limestone, and Pennington Formation. The Mississippian rocks are overlain by the Pottsville Formation of Pennsylvanian age, and the Late Cretaceous Tuscaloosa Group. Gentle folds are the principal geologic structures that occur in the consolidated rocks, with strike trending northwest. Folding is most common in the Hartselle Sandstone, and to a lesser degree in the Pottsville Formation. Based on the altitude of the top of the

Hartselle Sandstone, bedrock strata possess a regional dip to the south at about 10.8 meters per kilometers (m/km) (Peace, 1963; 1964).

The Hartselle Sandstone outcrops primarily along the lower valley reaches of Cedar Creek. The Hartselle is generally a fine-grained quartzose sandstone that is thick-bedded to massive (Thomas, 1972). According to Peace (1964), the Hartselle Sandstone is a poor aquifer in this area, and wells developed in the formation generally yield less than 1.2 liters per minute (L/min). The Bangor Limestone overlies the Hartselle Sandstone and is exposed along Cedar, Little Bear, and Bear Creek valleys. The Bangor consists of medium crystalline to dense fossiliferous limestone (in parts cherty or silty), and basal calcareous shale. In the project area, the Bangor Limestone contains solutioned fractures and openings that can yield groundwater in excess of 60 L/min. Peace (1964) indicates that larger water supplies are developed where the Tuscaloosa Group immediately overlies the Bangor. This is due in part to groundwater storage within the overlying Tuscaloosa, and an artifact of pre-Cretaceous erosion in these areas that resulted in higher solution channel density and increased bedrock fracture interconnection. The Pennington Formation overlies the Bangor Limestone and crops out in the southwestern corner of Franklin County near Little Bear Creek along the base of the escarpment westward. The Pennington is composed of a sequence of shales, sandstones, and crinoidal limestone and is not considered an aquifer. The lower part of Pottsville Formation is exposed in the southeastern portion along Bear Creek (upper reaches) and Upper Bear Creeks and unconformably overlies the Pennington. The formation has been completely eroded from the central and northern portions of the project area. The Pottsville in the region is described as a series of alternating beds of massive coarse-grained sandstone and fissile to thin-bedded shale with thin coal beds of no commercial importance (Johnston, 1933; Peace, 1964). Groundwater in the Pottsville occurs in openings along joints, bedding planes, and fractures. The maturely eroded Tuscaloosa Group rests upon the southward-sloping bedrocks, capping all ridges and hills except in the southeastern corner of the project area. The formation consists of irregularly bedded sand, rounded gravel, and clay and is a source of sand and aggregate for construction. The thickness of the formation is highly variable due to erosion. Due to high permeability, groundwater from the Tuscaloosa supplies many domestic and farm needs through wells and springs, and numerous unused springs flow from sand and gravel beds in the formation (Peace, 1962).

The principal aquifers of this region are limestone aquifers in rocks of Mississippian age. The project area is underlain by the Bangor Aquifer and is bounded to the north and south by the Fort Payne-Tuscumbia and Pottsville Aquifers, respectively (Moore, 1998). The Pennington Formation is considered a confining unit in Franklin County.

Precipitation is the primary source of recharge in the project area. Most of the precipitation becomes overland runoff to streams, but some percolate downward through Tuscaloosa sediment and residuum to the underlying bedrock. Some water is stored in and moves through intergranular pore spaces in the Tuscaloosa Group and residuum. In the consolidated rocks, however, most of the water moves through and is discharged from secondary openings, such as joints, fractures, and bedding planes. In the carbonate rocks (e.g., the Bangor Limestone) fractures have been enlarged by solution activity. As a result, groundwater discharge from springs and seeps is common. For instance, Oglesby and Moore (1989) show the locations of five springs in Franklin County located along Cedar Creek. The springs issue from the Bangor Limestone and measured flow rates range from 25 to 95 L/min. Smaller magnitude springs also issue from outcrops of the Tuscaloosa Group and Pottsville Formation.

In general, the Bangor Limestone exhibits a higher degree of karst features (i.e., caves, sinkholes, springs, and sinking streams) relative to other bedrocks in the project area. The Tuscaloosa sediment has a tendency to mask karst features (e.g., sinkholes) where it overlies the Bangor Limestone across the project area (Stringfield et al., 1974). There are at least 19 reported accessible caves in the vicinity of the project. It is likely that the vast majority of these caves are developed within the Bangor Limestone.

3.7.2 Environmental Consequences

Surface Waters

The primary consequence of land use in the Bear Creek Reservoirs area is the increased nutrient loading on all reservoirs. Although all four reservoirs are considered oligotropic, they all suffer from hypolimnic anoxia due to low inflow and long retention times. Increased nutrient loading into the reservoirs would lead to increased primary production (algae) and the subsequent decomposition of the increased organic load would result in continued declines in DO levels.

Alternative A - Under the No Action Alternative, continued use of TVA property for residential access and agricultural practices could increase nutrient loading in all reservoirs. Current practices of shoreline lawn maintenance and vegetation removal prevents runoff waters from being filtered before entering the reservoirs. Nutrients from failing/inadequate septic systems and lawn chemical applications are washed into the reservoirs during each rainfall event. Agricultural practices that include farming/grazing near and to the shoreline also contribute to increased nutrient runoff.

Alternative B - The proposed Action Alternative would better control land use activities on TVA-owned properties surrounding each reservoir. Establishment of vegetative buffers on TVA lands will help filter nutrient runoff and prevent increased nutrient loading of the reservoirs. Vegetative buffers, as established by TVA's SMP, would help minimize water quality impacts of adjoining residential development. Designation of numerous tracts so that no shoreline development can occur will also prevent water quality impacts from adjoining, off-reservoir properties.

Although shoreline erosion is only a localized problem on these reservoirs due to the numerous rock outcroppings, establishment of vegetative shoreline practices will prevent problems in areas that are susceptible to erosion. Root systems of grass lawns are not sufficiently deep to prevent shoreline erosion due to wave action and rain runoff. Vegetative buffers also will help filter the soil runoff from adjoining properties. Vegetative buffers are especially important on lands designated for agriculture use. Prevention of excessive erosion of adjoining agricultural properties by use of buffers will prevent increased turbidity and nutrient loading in the reservoirs.

Groundwater, Geology, and Site Soils (Hydrogeology)
Potential impacts to groundwater in the vicinity of parcel sites may be generally divided into the following categories: (1) groundwater levels, flow rates, and subsidence; and (2) groundwater and surface water quality. Alteration of groundwater levels, flow rates, and directions can be produced by activities, such as grading and excavation associated with roads, residential development, and timber harvesting. The level of impact related to such activities is generally dependent on the scale of disturbance. However, changes in groundwater conditions of these types can potentially impact domestic wells, streams, and springs used as water supplies. Although rare, changes in ambient groundwater conditions can also produce subsidence or sinkhole collapse. In a broad sense, increased development of project lands may enhance the likelihood of contaminant releases to groundwater and surface water from ground-disturbing activities. The most acute contaminant releases to groundwater are most likely related to industrial operations and wastewater treatment facilities. Residential septic tank systems can also result in groundwater quality impacts if improperly designed, operated, and/or maintained.

At upland parcel locations, soils may be sufficiently thick to afford some amount of groundwater protection from contaminants that might result from human activities (e.g., industrial releases, fuel spills, and faulty septic tank systems). However, where bedrock aquifers are overlain by thin soils and receive relatively direct recharge, the natural systems may not be adequate to attenuate pollutant loads. This is especially true along the steep slopes bounding portions of reservoirs and in karst terrain. Therefore, at most parcels, some quantity of a hypothetical contaminant entering the bedrock groundwater system adjacent to the reservoir might eventually be discharged to the reservoir. Potential groundwater impacts, therefore, might conceivably translate to surface water impacts. Potential contaminants of a transient nature might include fuels, oils, solvents used for operation and maintenance of construction vehicles and equipment; and spills or over-applications of herbicides and pesticides. Additionally, typical contaminants that might be found in the area include those related to improperly designed and/or operated wastewater treatment systems or septic tanks (nutrients, pathogens, and other chemicals), and undefined industrial releases.

Increased development, construction, and associated activities in the project area might also impact groundwater quality through changes in nutrient budgets, organic loads, mineral solute loads, pH, and DO. Because these types of impacts are usually associated with erosion from construction activities, their likelihood of occurrence increases with the intensity of development undertaken in the project area. Adherence to standards in the SMI ROD would help buffer the reservoir from these erosion and contamination problems.

Low population densities and unfavorable hydrogeologic conditions (e.g., shallow bedrock and steep/rugged topography) substantially increase the costs of conventional sewer systems and can result in the installation of numerous residential septic tanks. The majority of properties bordering project reservoirs are underlain by the permeable Tuscaloosa Group and outcrops of the karstic Bangor limestone. The hydrogeologic characteristics of these formations make them poor candidates for installation of septic tank systems. Hence, septic tanks surrounding project reservoirs may pose the greatest risk related to cumulative impacts to groundwater. Alternative collection systems for domestic wastewater (Harkins, 1993) could reduce the risks associated with septic tanks on non-TVA property. With respect to TVA property, the SMI allows no septic tanks on TVA land fronting residential subdivisions.

Subsidence sometimes occurs due to changes in subsurface drainage patterns and groundwater elevations, and alteration of geologic formations. These changes may appear during or after construction as a result of excavation, filling, groundwater pumping, and foundation loading. A slight potential might also exist for altering groundwater flow rates to domestic wells, streams, and springs used for water supplies. Areas that are the most susceptible to these potential problems are generally underlain by soluble carbonate rocks (i.e., Bangor limestone) and exhibit karst features. Because of the presence of karst features, geotechnical investigations conducted by developers prior to development under either of the alternatives would help minimize impacts to groundwater and surface waters in the area.

Alternative A - Under Alternative A, additional development will continue to occur under the guidance of TVA policies and the SMP. However, TVA property would not be allocated into appropriate uses based on existing conditions, foreseeable needs, and environmental review of the land base. The potential impacts to groundwater resources under this alternative would depend on the outcome of case-by-case reviews conducted by TVA, BCDA, and/or other responsible regulatory agencies. Without careful geotechnical investigations, the likelihood of groundwater impacts from development of project lands surrounding the reservoir, as well as cumulative effects from development of project lands added to other ongoing development, would increase with time under this alternative.

Alternative B - Under Alternative B, TVA property has been allocated into categories that emphasize resource management and conservation. Relative to Alternative A, this balance of development and conservation would afford enhanced groundwater protection in the project area due to the commitment of approximately 88 percent of project lands to sensitive resource protection, natural resource conservation, and recreation, all of which would tend to protect groundwater resources. The proposed land allocation of Alternative B would result in insignificant impacts to groundwater resources in the area and is the preferred alternative. In order to ensure protection of groundwater resources, state and local permitting agencies would require appropriate geotechnical investigations prior to development.

3.8 Aquatic Ecology

3.8.1 Affected Environment

Aquatic habitat in the near shore (littoral) zone is greatly influenced by back-lying land use and topography. In areas characterized by residential development, habitat includes man-made features, such as seawalls and docks. Undeveloped shoreline is typically wooded, so trees and brush provide woody cover in these areas. Shoreline topography for the affected reservoirs varies from moderately deep with stretches of bluff along the main channels to typically shallow in embayments and coves. Rock is an important constituent of habitat over most of the reservoirs, either in the form of bedrock outcrops, a mixture of rubble and cobble, or gravel along main channel shorelines. Cove substrate is typically soil and gravel with scattered cobble.

TVA began a program to systematically monitor the ecological condition of its reservoirs in 1990. Objectives of the monitoring is to provide information on the "health" or integrity of the aquatic ecosystems in major Tennessee River tributaries and reservoirs and to provide screening level information for describing how well these water resources meet the "fishable" and "swimmable" goals of the CWA. This information is used here to describe the aquatic communities of the affected reservoirs.

Fish are included in aquatic monitoring programs because they are important to the aquatic food chain and because they have a long life cycle which allows them to reflect conditions over time. Fish are also important to the public for aesthetic, recreational, and commercial reasons. Samples are collected with gill netting and electrofishing gear. The fish community rating is based primarily on fish community structure and function. Also considered in the rating is the percentage of the sample represented by omnivores and insectivores, overall number of fish collected, and the occurrence of fish with anomalies such as diseases, lesions, parasites, deformities, etc. (TVA, 1999b).

Benthic macroinvertebrates (i.e., small bottom-dwelling animals) are included in aquatic monitoring programs because of their importance to the aquatic food chain, and because they have limited capability of movement, thereby preventing them from avoiding undesirable conditions. Sampling and data analyses were based on seven parameters (eight parameters prior to 1995) that indicate species diversity, abundance of selected species that are indicative of good (and poor) water quality, total abundance of all species except those indicative of poor water quality, and proportion of samples with no organisms present. Collection methods and rating criteria were different prior to 1994, so those results are not compared directly to samples taken using current methods (TVA, 1999b).

Bear Creek Reservoir

TVA rotenone sampling at Bear Creek resulted in the capture of 25-33 species from 1974 through 1978. TVA's gill net and electrofishing sampling in this reservoir in 1997 collected 24 species of fish, with gizzard shad (*Dorosoma cepedianum*) being the most numerous followed by spotted sucker (*Minytrema melanops*), bluegill (*Lepomis macrochirus*), threadfin shad (*Dorosoma petenense*), and largemouth bass (*Micropterus salmoides*) (TVA, 1998). This indicates that the fisheries community has remained fairly stable over the 20-year period. Overall, compared to the other Bear Creek Project Reservoirs and other TVA reservoirs in the Interior Plateau ecoregion (e.g., Tims Ford and Normandy) the fish community rating has been good in all years sampled, except for the fair rating in 1995 (Table 3.8.1-1).

Table 3.8.1-1. Fish Community Ratings, TVA Vital Signs Monitoring

	Monitoring Year					
Reservoir	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Bear Creek	good	good	good	fair	good	good
Cedar Creek	good	good	good	good	good	excellent
Upper Bear Creek	poor	fair	NS	NS	NS	NS
Little Bear Creek	good	good	good	good	good	excellent

NS-Not Sampled.

TVA's benthic samples taken from Bear Creek Reservoir in 1997 included seven species, with oligochaetes (aquatic worms) and chironomids (midge larvae) being the most numerous groups. Fingernail clams were the only mollusks collected.

As shown in Table 3.8.1-2, the benthic community in Bear Creek has rated from fair to poor since 1993. Chlorophyll levels and DO content are two water quality parameters that have rated poor throughout the sampling period that would have a negative impact on both the benthic and fish communities.

Table 3.8.1-2. Benthic Community Ratings, TVA Vital Signs Monitoring

	Monitoring Year*				
Reservoir	**1994**	**1995**	**1996**	**1997**	**1998**
Bear Creek	fair	fair	fair	poor	NS
Cedar Creek	good	very poor	poor	poor	NS
Little Bear Creek	poor	poor	poor	very poor	NS

*Samples taken prior to 1994 are not directly comparable to subsequent years; no samples taken in 1998.
NS-Not Sampled.

Cedar Creek Reservoir

In 1997, 24 species of fish were collected at Cedar Creek Reservoir in TVA's most recent sampling with gill nets and electrofishing gear. The most numerous species was logperch, followed by spotted bass (*Micropterus punctulatus*), gizzard shad, and bluegill. Overall, the 1997 results indicated an excellent fish community; it had rated good in previous years (Table 3.8.1-1). Only two groups of benthic organisms were collected, with Chironomids and Oligochaetes being the most numerous. The benthic community in Cedar Creek Reservoir has generally rated poor in recent years (Table 3.8.1-2).

Upper Bear Creek Reservoir
TVA monitoring samples have not been taken in this reservoir in recent years, but those taken in 1993 included 14 species of fish, with bluegill being the most numerous followed by channel catfish (*Ictalurus punctatus*), largemouth bass, and gizzard shad. Overall, the 1993 sample rated only fair; it had rated poor in 1992. Studies conducted by the biology department of the University of Alabama at Birmingham in 1991 indicated that the largemouth bass population in Upper Bear Creek Reservoir was in poor condition due to (1) a scarcity of suitable forage fish, or (2) effects of chronic stress from poor water quality (Angus and Marion, 1993). Benthic samples have not been taken from this reservoir as part of TVA's monitoring program.

Little Bear Creek Reservoir
Gill net and electrofishing sampling in Little Bear Creek Reservoir in 1997 collected 21 species, and indicated an excellent fish community. Spotted sucker were the most numerous species, followed by largemouth bass, whitetail shiner (*Cyprinella galactura*), and rosefin shiner (*Lythrurus fasceolaris*). The Little Bear Creek Reservoir fish sample had rated good in previous years' sampling (Table 3.8.1-1). Historic cove rotenone samples had showed a range of 26 to 31 species in 1976-1978. Vital signs monitoring in Little Bear Creek Reservoir has shown a trend of a declining benthic community, rating very poor in 1997 and poor in previous years. Combined with consistently poor levels of DO, this may be limiting the fish community from further improvement.

3.8.2 Environmental Consequences

The potential for impacts to aquatic resources depends, to a large extent, on the amount of alteration to a natural shoreline condition that would occur under the two alternatives. These alterations include impacts to shoreline vegetation, vegetation on back-lying lots, and changes in land uses. Shoreline vegetation (particularly trees) provides shade, organic matter (which is a food source for benthic macroinvertebrates), and shoreline stabilization, and trees provide aquatic habitat (cover) as they fall into the reservoir. Shoreline vegetation and vegetation on back-lying land provide a buffer zone which functions to filter nutrients, soil erosion, and other pollutants from surface runoff while stabilizing erodible soils.

Preservation of a natural shoreline condition, to the extent possible, is particularly important on reservoirs such as Bear Creek Project Reservoirs. Shoreline development can greatly modify the physical characteristics of adjacent fish and aquatic invertebrate habitats, which can result in dramatic changes in the quality of the fish community. One of the most detrimental effects of shoreline development is the removal of riparian zone vegetation. Removal of this vegetation can result in loss of fish cover and shade (which elevates water temperatures). Fish spawning habitat, such as gravel and woody cover, can be rendered unsuitable by excessive siltation and erosion, which can occur when riparian vegetation is cleared. Waste treatment facilities on back-lying lots can cause pollution either in the form of excessive nutrient loading, or fecal coliform bacteria if they are not properly constructed and maintained. Also, lawn fertilization can contribute to nutrification of the reservoir if buffer zones are not maintained.

Alternative A - Under this alternative, TVA would use SMP and other TVA policies to manage its lands. Past BCDA policies and practices have been used in such a way that numerous water-use facilities have been approved where the landowners/developers had no waterfront rights. This policy results in land uses that are not environmentally sound and do not coincide with the preferred use as indicated in the public meetings. These practices also promote land uses that result in erosion, buffer zones being removed, and construction of waste treatment facilities in areas that are not capable of handling such facilities. This alternative would result in negative aquatic impacts that would increase over time as more areas of buffer zones and vegetative cover were removed.

Alternative B - This alternative would use the proposed Bear Creek Project Reservoirs' Land Management Plan. Protection and conservation of natural resources would be an important factor in deciding the type and degree of shoreline development. This alternative would provide protection of large stretches of littoral (near shore) aquatic habitat, which is the most productive region of a reservoir. Important fish species utilize such shorelines because of their spawning requirements, the presence of submerged cover, (i.e., rocks, logs brush, etc.), and the availability of aquatic invertebrates and small fish as a food source. Developments, such as docks, fills, bridges, outfalls, water intakes, and riprap in designated areas would require TVA review and approval of plans before they are constructed. Impacts resulting from such activities would be minimized through requirements included in Section 26a permits and land use agreements to use BMPs for protection of aquatic habitats. Selection of this alternative would likely result in insignificant adverse impacts overall, with beneficial impacts to aquatic resources in areas where a natural shoreline condition is preserved and is preferred.

<u>Bear Creek Reservoir</u>
This reservoir was built specifically for flood control and recreation; therefore, no residential or industrial development will be allowed on this reservoir. Selection of either Alternative A or B should not have a significant impact on the aquatic resources of the reservoir. Potential impacts from any new recreational facilities, such as marinas or camping areas, would be minimized through requirements included in Section 26a permits and land use agreements relating to the use of BMPs that protect aquatic habitats.

<u>Cedar Creek Reservoir</u>
Alternative A - Operation of Cedar Creek Reservoir under this alternative would provide for continued development, both commercial and residential, as

the demand arose. Because of the extent to which Cedar Creek would likely be developed in the future due to its location, impacts resulting from Alternative A would likely be more apparent here than on the other Bear Creek Project Reservoirs. Water quality, fisheries habitat, and invertebrate habitat would be negatively impacted as a result of these changes.

Alternative B - Areas designated Sensitive Resource Management and Natural Resource Conservation would be protected from further development, and impacts to aquatic resources would be generally less than under Alternative A. Potential impacts from any new development would be minimized through requirements included in Section 26a permits and land use agreements relating to the use of BMPs that protect aquatic habitats.

Upper Bear Creek

Alternative A - This alternative could result in additional aquatic impacts due to the cumulative nature of future impacts in association with negative impacts that have already occurred as a result of past surface coal mining in the watershed. Alternative A would allow the continued development of residential and commercial facilities which would mean more removal of vegetation, erosion and siltation during construction, and more nutrient loading resulting from improperly installed or maintained waste treatment systems. Continued erosion and siltation from existing mining areas would also be more detrimental to the aquatic habitat if buffer zones are removed around the shoreline due to new development.

Alternative B - Areas of important aquatic habitat (i.e., spawning areas, nursery, and resting areas) would be protected from further impacts resulting from development, erosion, and nutrient loading. Areas designated for Natural Resource Conservation and Sensitive Resource Management would receive little if any new development that could impact the aquatic habitat, and development in the other zones would be controlled by TVA technical staff to minimize impacts through requirements included in Section 26a permits and land use agreements relating to the use of BMPs that protect aquatic habitats.

Little Bear Creek

Alternative A - Continued development of residential and commercial facilities on the reservoir could result in adverse impacts to the aquatic habitat due to erosion and siltation during construction, and removal of the vegetative buffer along the shoreline. Improper installation and maintenance of septic systems could increase nutrient levels in the reservoir, thus putting more stress on aquatic organisms. In addition, residential development would mean more runoff of nutrients and chemicals from lawns.

Alternative B - This alternative would protect areas designated as Natural Resource Conservation and Sensitive Resource Management from unsuitable new development. Development in the other zones would be controlled by

TVA technical staff to minimize impacts through requirements included in Section 26a permits and land use agreements relating to the use of BMPs that protect aquatic habitats.

3.9 Socioeconomics

3.9.1 Affected Environment

The Bear Creek Project lies in Franklin, Marion, and Winston Counties in northwest Alabama, south of the Florence metropolitan area and near the Alabama-Mississippi state line.

Population

The 1998 population of the three counties in the Bear Creek area is estimated by the U. S. Bureau of the Census to be 84,825, a 6.4 percent increase over the 1990 population of 79,697 (Table 3.9.1-1). This growth rate is slower than that of the state, which is estimated to have grown by 7.7 percent, and the nation, which is estimated to have grown by 8.7 percent.

The Bear Creek counties have a labor market area (LMA) that includes the Florence metropolitan area to the north, the Decatur metropolitan area to the east, and part of the Birmingham metropolitan area to the south, as well as two Mississippi counties to the west. The LMA has an estimated 1998 population of over 1.2 million, a 3.6 percent increase over 1990. By the year 2020, the Bear Creek area is projected to have a population of over 88,000, while the population of the LMA is projected to be almost 1.4 million.

Table 3.9.1-1. Population and Population Projections, 1980-2020

County	1980	1990	1998	2010	2020
Franklin	28,350	27,814	29,682	29,716	30,403
Marion	30,041	29,830	30,986	32,075	32,773
Winston	21,953	22,053	24,157	24,462	24,938
Area Total	80,344	79,697	84,825	86,253	88,113
Rest of LMA					
Colbert	54,519	51,666	52,946	59,799	64,065
Cullman	61,642	67,613	74,994	81,782	88,117
Fayette	18,809	17,962	18,133	19,315	19,750
Jefferson	671,324	651,520	659,524	706,823	732,507
Lamar	16,453	15,715	15,731	16,410	16,495
Lauderdale	80,546	79,661	84,325	85,335	88,284
Lawrence	30,170	31,513	33,447	34,420	35,940
Morgan	90,231	100,043	109,369	122,323	131,574
Walker	68,660	67,670	71,027	76,003	79,997
Itawamba, MS	20,518	20,017	21,072	22,949	24,258
Tishomingo, MS	18,434	17,683	18,654	20,277	21,395
LMA Total	1,211,650	1,200,760	1,244,047	1,331,689	1,390,495
Alabama	3,893,888	4,040,389	4,351,999	4,808,302	5,166,507
United States (000)	226,546	248,765	270,299	297,716	322,742
Percent Change In Population					
	1980-1990	**1990-1998**	**1998-2010**	**2010-2020**	**1998-2020**
Franklin	-1.9	6.7	0.1	2.3	2.4
Marion	-0.7	3.9	3.5	2.2	5.8
Winston	0.5	9.5	1.3	1.9	3.2
Area Total	-0.8	6.4	1.7	2.2	3.9
LMA Total	-0.9	3.6	7.0	4.4	11.8
Alabama	3.8	7.7	10.5	7.4	18.7
United States (000)	9.8	8.7	10.1	8.4	19.4

Source: Historical data from U.S. Bureau of the Census, Census of Population; projections for Alabama from State Data Center, University of Alabama (extended from 2015 to 2020 by TVA); projections for U.S. from U. S. Bureau of the Census (middle series); projections for Mississippi by TVA, using linear trend of historical data.

Labor Force and Unemployment

In 1998 the civilian labor force of the Bear Creek area was 46,250, as shown in Table 3.9.1-2. Of those, 3,065 were unemployed, for an unemployment rate of 6.6 percent. Unemployment rates ranged from 5.6 percent in Winston County to 7.2 in Franklin, with Marion County at 6.9 percent. All of these rates were above the state rate of 4.2 percent and the national rate of 4.5 percent. In the LMA as a whole, the civilian labor force totaled almost 634,000, with an unemployment rate of 4.3 percent, about the same as the state and the nation. However, the unemployment rate varied greatly within the LMA, ranging from 3.1 percent in Jefferson County (Birmingham) to 11.4 percent in Tishomingo County, Mississippi.

Table 3.9.1-2. Labor Force Data, Residents of Bear Creek Area, 1998 Annual Average

County	Civilian Labor Force	Employment	Unemployment	Unemployment Rate
Franklin	17,347	16,103	1,244	7.2
Marion	16,237	15,123	1,114	6.9
Winston	12,666	11,959	707	5.6
Subtotal	46,250	43,185	3,065	6.6
Colbert, AL	26,463	24,437	2,026	7.7
Cullman, AL	39,095	37,753	1,342	3.4
Fayette, AL	8,360	7,776	584	7.0
Jefferson, AL	340,350	329,882	10,468	3.1
Lamar, AL	7,748	7,153	595	7.7
Lauderdale, AL	42,352	39,547	2,805	6.6
Lawrence, AL	16,497	15,628	869	5.3
Morgan, AL	56,405	54,251	2,154	3.8
Walker, AL	29,926	28,249	1,677	5.6
Itawamba, MS	11,190	10,590	600	5.4
Tishomingo, MS	9,220	8,170	1,050	11.4
LMA total	633,856	606,621	27,235	4.3
Alabama	2,152,645	2,061,869	90,776	4.2
United States (000)	137,673	131,463	6,210	4.5

Source: State employment security departments; U.S. Bureau of Labor Statistics.

Jobs

As is common in rural areas of the Tennessee Valley, the Bear Creek area is more dependent on manufacturing jobs than the state as a whole. In 1997, about 40 percent of all jobs in the Bear Creek area were in manufacturing industries, compared to about 17 percent statewide. Conversely, the area had a smaller share of jobs in services, not quite 17 percent compared to over 25 percent statewide. In the area, manufacturing's share of total jobs actually increased by about one percentage point in 1997, compared to 1989 data, while the state followed the national pattern of decline in the manufacturing share of jobs during the same time period. Both the state and the area, however, experienced an increase in the share of total jobs that are in the service sector. See Table 3.9.1-3.

Table 3.9.1-3. Employment Data, Residents of Bear Creek Area, 1997 Annual Average

County	Total Jobs	Manufacturing	Services	Other
1997:				
Franklin	15,924	5,337	3,222	7,365
Marion	16,011	6,756	2,668	6,587
Winston	15,354	6,961	2,055	6,338
Total	47,289	19,054	7,945	20,290
Alabama	2,325,305	393,122	586,810	1,345,373
1989:				
Franklin	12,230	3,609	2,048	6,573
Marion	14,098	6,453	2,008	5,637
Winston	11,837	4,883	1,417	5,537
Total	38,165	14,945	5,473	17,747
Alabama	2,019,508	396,527	437,150	1,185,831

Source: U. S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System.

Occupation Patterns

As seen in Table 3.9.1-4, all three Bear Creek counties have a much lower share of their workers employed in managerial and professional jobs and in technical, sales, and administrative jobs than in the state overall. Reflecting the relative importance of manufacturing, these counties have more workers in the so called blue-collar jobs. Both the generally higher-paying categories of precision production, craft, and repair jobs and the service, farm operators, fabricators, and laborers categories are relatively more important in these counties. Almost 23 percent of Alabama workers are employed in managerial and professional jobs, while the share is around 14 percent in the Bear Creek counties. Similarly, technical, sales, and administrative jobs constitute over 29 percent of the total statewide, but about 21 percent in the area counties. Among blue-collar jobs, the area counties have from about three percentage points more of its workers employed in the precision production, craft, and repair categories and about 14 percentage points more in the service, farm, operators, and laborers categories.

Table 3.9.1-4. Occupation of Workers, 1990 (percent distribution)

Occupation	Franklin County	Marion County	Winston County	Alabama
Managerial and Professional	14.4	13.4	13.0	22.7
Technical, Sales, and Administrative	22.6	21.2	19.6	29.4
Precision Production, Craft, and Repair	16.7	17.1	15.4	13.0
Service, Farm, Operators, Fabricators, and Laborers	46.3	48.3	51.9	34.9

Source: U. S. Bureau of the Census, Census of Population, 1990.

Income

Per capita, personal income in the Bear Creek counties increased faster from 1989 to 1997 than in the state or the nation. Increases (in real terms) ranged from about 16 percent in Franklin County to over 19 percent in Marion County, while Alabama's per capita increased 12 percent and the nation's 7.6 percent. However, the average income level in the Bear Creek area remains well below the national and state averages. In the Bear Creek counties, average income ranges from 68 to 74 percent of the national average, while the Alabama average is 82 percent of the national average.

The manufacturing sector generates a large share of the earnings generated in the Bear Creek counties, 39 percent in Franklin County and 51 percent in both Marion and Winston Counties. This is much greater than the 22 percent in the state and 18 percent nationally. See Table 3.9.1-5.

Table 3.9.1-5. Income and Earnings Data

	Franklin County	Marion County	Winston County	Alabama	United States
1997					
Per Capita Personal Income	17,775	17,301	18,696	20,672	25,288
Earnings (%):					
Manufacturing	39.1	51.3	50.8	21.6	17.7
Services	18.3	13.4	11.1	23.2	28.5
Government	14.9	11.0	8.7	18.0	14.8
Other	27.7	24.3	29.4	37.2	39.0
1989					
Per Capita Personal Income (1997$)	15,314	14,488	15,759	18,465	23,496
Earnings (%):					
Manufacturing	35.1	54.3	42.8	24.6	20.2
Services	16.0	10.9	7.6	19.8	25.1
Government	17.1	12.6	11.3	19.3	15.7
Other	31.8	22.3	38.3	36.3	39.0

Source: U. S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System.

Environmental Justice

The three Bear Creek area counties have relatively small minority populations, particularly in the areas immediately around the Bear Creek Reservoirs. As of 1990, the population of the state of Alabama was 26.7 percent minority (nonwhite plus the white population of Hispanic origin). However, the Bear Creek counties have much smaller minority populations, with the largest percentage in Franklin County at 5.2 percent in 1990. The parts of the counties immediately around the reservoirs have even smaller minority populations, as shown by census tract data. Census tracts are subcounty areas used by the U. S. Census Bureau in taking the decennial census and for which census data are reported. The various census tracts in which the reservoirs are located are listed in Table 3.9.1-6. All of these census tracts had very small minority populations in 1990, ranging from 0.5 percent to 1.9 percent. More recent estimates for 1998 show increases in the minority population and the minority share of total population, especially the Hispanic white population, in Alabama and in the three Bear Creek counties (these estimates are not available for census tracts). Using these estimates, the percent minority in 1998 was 27.8 in the state of Alabama, 5.9 in Franklin County, 4.4 in Marion County, and 1.2 in Winston County. However, these estimates are still in a developmental stage and may not be accurate, especially for small populations and for the Hispanic population (U. S. Census Bureau).

On the other hand, poverty rates are somewhat higher in the three counties than in the state, as well as in several of the census tracts. The state poverty rate in 1989 was 18.3, while the Bear Creek counties have poverty rates that range from 19.1 to 20.7 percent. Within the census tracts, poverty rates range from 9.9 percent to 24.3 percent.

Table 3.9.1-6. Minority and Poverty Data

	Total Population	Nonwhite Population	Hispanic White Population	Percent Minority	Percent Persons Below Poverty Level
Franklin County	27,814	1,351	88	5.2	20.7
Census Tract 9731	2,220	7	7	0.6	17.3
Census Tract 9734	2,802	49	3	1.9	24.3
Census Tract 9735	2,443	28	7	1.4	9.9
Census Tract 9736	1,779	2	16	1.0	20.9
Census Tract 9737	5,532	39	13	0.9	21.6
Marion County	29,830	1,071	51	3.8	19.1
Census Tract 9840	4,642	12	9	0.5	19.0
Winston County	22,053	128	54	0.8	19.8
Census Tract 9957	4,678	30	15	1.0	14.0
Alabama	4,040,587	1,064,790	15,630	26.7	18.3

Source: U. S. Bureau of the Census, Census of Population 1990.

3.9.2 Environmental Consequences

Direct socioeconomic impacts would result from use of the TVA lands for industrial, commercial, recreation, or residential uses, or to facilitate or make possible such uses on back-lying properties. Likely socioeconomic impacts from such uses are discussed below for each of the alternatives.

Alternative A - Under this alternative, land use decisions would be made on a case-by-case basis. While it is likely that little, if any, land would be used for industrial or nonrecreation commercial uses, such uses could occur. Should this happen, there could be beneficial socioeconomic impacts to the area.

Use of lands for commercial recreation purposes could also have beneficial socioeconomic impacts on the area. Some such facilities could draw users from outside the immediate area, thus increasing income and employment in the area. More passive uses or small-scale development would have lesser impact on the local economy.

Some of the TVA lands probably would be used to provide water access for residential developments. Such uses would attract more residential development to the area immediately surrounding the reservoirs and most likely would lead to some population growth that would not otherwise occur in the Bear Creek counties.

Decisions that allow major industrial, commercial, commercial recreation, or residential developments would be likely to accelerate the population growth rates projected for the Bear Creek counties, as shown in Table 3.9.1-1.

Alternative B - There is one parcel allocated for Industrial/Commercial (other than commercial recreation) use under the proposed land use plan. Therefore, there would be insignificant socioeconomic impacts from industrial or nonrecreation commercial use of the TVA properties.

Almost 600 acres of TVA land is allocated under the proposed plan for recreation development. Depending on the type of development that occurs, there could be beneficial socioeconomic impacts to the Bear Creek counties. Extensive recreation development could attract users from outside the area, thereby increasing income and employment in the Bear Creek area.

241 acres of TVA land is allocated for Residential Access under the proposed plan, allowing possibly extensive water-related residential development on back-lying properties. Such uses would attract more residential development to the area immediately surrounding the reservoirs and most likely would lead to some population growth that would not otherwise occur in the Bear Creek counties. Depending on the specific development plans, considerable residential growth could occur in the area.

Decisions that allow major commercial recreation or residential developments would be likely to accelerate the population growth rates projected for the Bear Creek counties, as shown in Table 3.9.1-1.

3.10 Navigation

3.10.1 Affected Environment

There is no commercial navigation on the four reservoirs that are part of the Bear Creek Project. The reservoir for the Bear Creek Project is 12 miles long, the reservoir for the Cedar Creek Project is 9 miles long, and the Little Bear Creek Project Reservoir is 6 miles long. The reservoir for the Upper Bear Creek Project consists of two arms, each 7 miles long, and has a total length of

14 miles. Due to the short lengths of the four reservoirs, TVA has not installed navigation aids on land surrounding the reservoirs to assist recreational boaters.

3.10.2 Environmental Consequences

Under either alternative, there should be no significant impact on navigation by recreational boaters. The construction of water-use structures associated with residential development or marinas would have the greatest potential for impacting navigation on the reservoirs. Requests for marinas, docks, boathouses, fishing piers, and launching ramps will be reviewed as part of TVA's Section 26a permitting process. The Section 26a process would ensure that water-use structures constructed along the shoreline will not impact recreational navigation. Commercial developments that do not involve the placement of structures in the reservoir would have no impact on navigation.

Increased residential and recreational development would marginally increase the number of recreational boats and personal watercraft on the reservoirs. This small increase would have insignificant effects on recreational boating and navigation. TVA does not regulate the number of boats that can be operated on TVA reservoirs. The Alabama Game and Fish Commission is responsible for enforcement of boating safety regulations in the state of Alabama, including the Bear Creek Project Reservoirs.

3.11 Other Issues

3.11.1 Floodplains

Affected Environment

Bear Creek Reservoir

The 100-year floodplain on Bear Creek Reservoir is the area below elevation 609.5 feet mean sea level (msl). The 500-year or "critical action" floodplain on Bear Creek Reservoir is the area below elevation 610.3 feet msl.

Cedar Creek Reservoir

The 100-year floodplain on Cedar Creek Reservoir is the area below elevation 589.0 feet msl. The 500-year or "critical action" floodplain on Cedar Creek Reservoir is the area below elevation 590.2 feet msl.

Upper Bear Creek Reservoir

The 100-year floodplain on Upper Bear Creek Reservoir is the area below elevation 804.0 feet msl. The 500-year or "critical action" floodplain on Upper Bear Creek Reservoir is the area below elevation 805.0 feet msl.

Little Bear Creek Reservoir
The 100-year floodplain on Little Bear Creek Reservoir is the area below elevation 628.0 feet msl. The 500-year or "critical action" floodplain on Little Bear Creek Reservoir is the area below elevation 629.3 feet msl.

Environmental Consequences
For either alternative, any development proposed within the 100-year floodplain would be subject to the requirements of EO 11988 (Floodplain Management). The first step in the review process would be to determine if the activity is covered under TVA's "Class Review of Certain Repetitive Actions in the 100-Year Floodplain." As a result of this review, TVA determined there were no practicable alternatives to several actions that would avoid siting in the 100-year floodplain. Examples of actions frequently undertaken by applicants that are within the Class Review include water-use facilities, water intakes, boat ramps, picnic tables, benches and grills, and retaining walls and riprap. A set of review criteria were also established to ensure natural and beneficial floodplain values are not significantly affected. If these criteria are followed, adverse floodplain impacts should be minimized.

If an activity is proposed that is not considered to be a repetitive action in the 100-year floodplain, EO 11988 requires the applicant to evaluate alternatives to the floodplain siting which would either identify a better option or support and document a determination by TVA on a case-by-case basis of "no practicable alternative" to siting within the 100-year floodplain. If this determination can be made, adverse floodplain impacts would be minimized.

All development on the Bear Creek Project Reservoirs subject to flood damage would be located above the 500-year flood elevation. Any fill material placed between the January 1st winter level and the 500-year flood elevation would be subject to the requirements of the TVA Flood Control Storage Loss Guideline (TVA, 1999c).

Under Alternative A, the allocation, development, and/or management of properties would be made on a case-by-case basis, and evaluations would be done individually to ensure compliance with EO 11988. Potential development would generally consist of water-use facilities and other repetitive actions in the floodplain that should result in minor floodplain impacts. Under Alternative B, the potential adverse impacts to natural and beneficial floodplain values would be less than those under Alternative A because a substantial portion of the available land would be allocated for Resource Management and conservation activities. Under either alternative, impacts to floodplain values would be insignificant.

3.11.2 Air Quality

Affected Environment

Air quality is an environmental resource value that is considered important to most people. Through its passage of the Clean Air Act (CAA), Congress has mandated the protection and enhancement of our nation's air quality resources. National Ambient Air Quality Standards for six criteria pollutants [sulfur dioxide (SO_2), ozone (O_3), nitrogen dioxide (NO_2), particulate matter (PM_{10}-particles smaller than or equal to 10 micrometers, and $PM_{2.5}$-particles smaller than or equal to 2.5 micrometers), carbon monoxide (CO), and lead (Pb)] have been set to protect the public health and welfare. Prevention of Significant Deterioration (PSD) regulations have been established to ensure that areas with good air quality do not lose this desirable status. A listing of the national air quality standards is given in Table 3.11.2.-1.

National standards, other than annual standards, are not to be exceeded more than once per year (except where noted). Units are parts per million (ppm) by volume of air except for PM which is expressed in micrograms per cubic meter ($\mu g/m^3$). Attainment statuses for the new 8-hour O_3 standard and the $PM_{2.5}$ standard for any site have yet to be determined. The timeline for these new standards require monitors being put in place nationwide between 1998 and 2000 and data collection taking place between 1998 and 2003. Assessment of attainment status for these new standards will only be possible after 3 years of data have been collected. The results of ambient air monitoring at three sites are discussed in paragraphs that follow. Although no applicable data for Pb were found for the three sites, past air quality monitoring for all locations sampled in the Valley has shown Pb to be far below the 1.5 $\mu g/m^3$ quarterly mean limit.

Table 3.11.2-1. National Ambient Air Quality Standards

Pollutant	Primary[a]	Secondary[b]
Sulfur Dioxide	0.14 ppm (365 μg/m³) maximum 24-hour concentration not to be exceeded more than once per year. 0.03 ppm (80 μg/m³) annual arithmetic mean.	0.5 ppm (1,300 μg/m³) maximum 3-hour concentration not to be exceeded more than once per year.
Ozone (Existing)[c]	0.12 ppm maximum 1-hour concentration with an expected exceedance of no more than one day per year based upon a 3-year average.	Same as primary standard
Ozone (New)	0.08 ppm based on the average of the fourth-highest daily maximum 8-hour concentration during each ozone season (currently April 1-October 31) for each of 3 consecutive years.	Same as primary standard
Nitrogen Dioxide	0.053 ppm (100 μg/m³) annual arithmetic mean.	Same as primary standard
Carbon Monoxide	35 ppm (40 mg/m³) maximum 1-hour concentration not to be exceeded more than once per year. 9 ppm (10 mg/m³) maximum 8-hour concentration not to be exceeded more than once per year.	None
$PM_{2.5}$ (New Standard)	15 μg/m³ annual average.	50 μg/m³ (24-hour average)
PM_{10}	150 μg/m³ maximum 24-hour concentration with an expected exceedance of no more than one per year based upon a 3-year average. 50 μg/m³ annual arithmetic mean.	Same as primary standard
Lead	1.5 μg/m³ maximum quarterly arithmetic mean.	Same as primary standard

a - Standards set to protect public health.
b - Standards set to protect public welfare.
c - Only applicable in areas not attaining the standard prior to September 16, 1997.

The feasibility of locating a commercial or industrial facility on a given site may be affected by several air quality considerations. Among the factors are dispersion conditions (nearby high terrain, frequency of air stagnation) and regulatory status (attainment of air quality standards, proximity to PSD Class I area). Regulatory constraints that may influence siting decisions are embodied in the New Source Review provisions of the CAA and in EPA's PSD regulations (EPA, 1998).

PSD rules restrict the amount by which ambient levels may increase due to emissions from major new sources or the modification of existing sources, and require the use of best available control technology on such sources. A facility will be a major source if it emits more than 100 tons per year of any criteria pollutant. A memorandum listing pollutants currently subject to PSD review was published in the April 28, 1992, *Federal Register* (EPA, 1992). Generally, dispersion modeling is required to demonstrate that pollution levels do not increase beyond the allowable increments. For the sites considered in this EA, ambient air quality data necessary for PSD purposes are available.

More stringent PSD increments apply for sources affecting specially protected areas (Class I) such as national parks and wilderness areas. Dispersion analyses are generally required for sources subject to PSD review that are within 100 kilometers of such an area. The Sipsey National Wilderness Class I Area is within this distance to the east of the Bear Creek Land Plan area.

Table 3.11.2-2 gives the results of ambient air quality monitoring of criteria pollutants in the vicinity of the Bear Creek site. The Bear Creek area is currently in attainment for PM_{10}, NO_2, CO, SO_2, Pb, and the 1-hour O_3 standards. The attainment status of the site for the new $PM_{2.5}$ standard cannot be determined until field data are collected. Based on 1996-98 monitoring data, the area should be in attainment for the new 8-hour O_3 standard.

The $PM_{2.5}$ data presented in Table 3.11.2-2 are representative of urban (Nashville, Tennessee) and rural (Lawrence County, Tennessee) environments. The Nashville $PM_{2.5}$ data were collected from a location in downtown Nashville, so the use of these data for the Bear Creek area may not be appropriate. However, it can be seen that even at a rural site, such as Lawrence County, Tennessee, monitoring indicates levels are within 10 percent of the new EPA annual $PM_{2.5}$ standard.

Table 3.11.2-2. Ambient Concentrations of Criteria Air Pollutants Compared With Air Quality Standards

		One-Year Maximum or Mean[a]	
Pollutant	**Level of Standard (ppm)[b]**	**Concentration (ppm)[b]**	**Percent of Standard (%)**
Ozone (Existing Standard)[c] Ozone (New Standard)[e]	Max. 1-hr Avg. (0.12) 4th Highest 8-hr Avg. (0.08)	0.134 (0.104)[d] 0.079 (-)	116 (86) 99 (-)
Sulfur Dioxide	Max. 3-hr Avg. (0.5) Max. 24-hr Avg. (0.14) Annual Mean (0.030)	0.18 (0.097) 0.006 (0.023) 0.002 (0.003)	4 (19) 4 (16) 6 (10)
Nitrogen Dioxide	Annual Mean (0.053)	0.01 (0.004)	8
Carbon Monoxide	Max. 1-hr Avg. (35) Max. 8-hr Avg. (9)	no data no data	no data no data
PM_{10} (Existing Standard) $PM_{2.5}$ (New Standard)	(μg/m³) Max. 24-hr Avg. (150) Annual Mean (50) Annual (15) 24-hr (50)	(μg/m³) 93 18 18.4 (13.7)[f] no data	 29 36 122 (91) no data
Lead	(μg/m³) Quarterly Mean (1.5)	no data	no data

a - SO_2 values for Colbert Fossil Plant, January 1, 1996, through December 31, 1997. Numbers in parenthesis are Dickson, Tennessee. Other pollutant values, except for PM, are from Dickson, Tennessee, for March 1, 1995, through September 30, 1995.
b - ppm unless otherwise noted.
c - Concentration must be 0.125 ppm or higher to be considered above the level of the standard (0.120).
d - First entry for Tupelo, Mississippi, PSD site from January 1997 through December 1997 and number in parenthesis from Mulberry Creek, Alabama (April 1, 1994, through March 31, 1995).
e - Fourth-highest concentration must be 0.084 ppm to be considered above the level of the standard (0.08 ppm).
f - First entry from Nashville, Tennessee, and value in parenthesis from Lawrence County, Tennessee. Both sites operated by TVA from April 22, 1997, through April 23, 1998.

Environmental Consequences

Alternative A - This No Action Alternative would continue the policy of case-by-case review of development requests. However, the anticipated requests for available land would be for residential or recreational purposes. Any impacts on the ambient air quality from this alternative would be minor. The details of these possible impacts are the same as those discussed in the paragraphs describing the consequences of Alternative B.

Alternative B - Air resources in the Bear Creek Land Management Plan area will not be significantly affected by implementation of this Plan. The only tracts that would be involved in any disturbance of ambient air quality are those designated for recreation or residential purposes. However, any impacts on the air quality would be minor, and some would be transitory.

Land preparation and construction associated with development of residential and recreation tracts may generate dust from earth disturbance and would generate combustion emissions from fuel-burning vehicles and equipment and any open burning of vegetation cleared from a development location. Chemical vapors from paint, solvents, fuels, and other materials associated with construction would also be emitted. These pollutants would have minor and transitory effects on air quality.

After development of homes and recreational facilities, emissions from vehicles and other fossil fuel-burning equipment, fireplaces and stoves that burn wood, and various maintenance activities can be expected. These impacts will be minor and intermittent, and some would be seasonal.

Conclusion - Both alternatives would have insignificant effects on air quality. However, Alternative B, which would effectively preclude future industrial/commercial development on the TVA-controlled land, would likely be more favorable for air quality in the long run.

3.11.3 Transportation

Affected Environment

The Bear Creek Project lands lie within Franklin, Marion, and Winston Counties in Alabama. Upper Bear, Little Bear, and Cedar Creek Reservoirs have plans for future shoreline development. Cedar Creek Dam is located 14 miles west of Russellville; Upper Bear Creek is located 16 miles southwest of Russellville; and Little Bear Creek is located 15 miles west of Russellville. Primary access to these project lands is via U.S. Highway 72 from the north. U.S. Highway 72 is primarily a four-lane, principal-divided highway which runs in an east-west direction through North Alabama. U.S. Highway 72 provides access to Florence, Alabama, which is located approximately 20 miles north of Russellville, Alabama. Access south to the project area from Florence is via U.S. Highway 43 which is a four-lane, principal-divided highway and runs from U.S. Highway 72 to Russellville and continues southward. Approximately 9 miles south of Russellville, U.S. Highway 43 becomes a two-lane facility. The nearest interstate highway is Interstate Highway 65 which runs north-south between Birmingham, Alabama, and Nashville, Tennessee, and is located almost 50 miles east of Russellville. Refer to Figure 1.2-1 for a map of the area.

Several roads traverse the Plan area south of U.S. Highway 72, including State Routes 17, 24, 247, 19, 187, 172, 13, 237, 241, and 243. These roads serve as connector and feeder routes to the primary access roads. State Route 17, or U.S. Highway 43, is a four-lane divided highway about 2 miles north of Phil Campbell, Alabama. Route 17, in the vicinity of Phil Campbell, and Route 24 are high quality two-lane routes with good shoulder width, lane width, alignment, and sight distance in rural areas. Routes 247, 19, 172, 13, and 243 are high- to mid-quality two-lane secondary roads with some paved shoulders, good lane width, and some passing zones. Routes 187, 237, and 241 are two-lane secondary roads with more narrow lane widths, limited sight distance, and little to no shoulder width. Numerous smaller county roads lead from these connector roads to the individual lands and parcels.

The latest available daily traffic (ADT) counts provided by the Alabama Department of Transportation for the primary and connector roads are shown in Table 3.11.3-1.

Table 3.11.3-1. Average Daily Traffic Increases for Roads Surrounding and Traversing Plan Area

Road	Existing ADT	Predicted ADT	Existing Levels of Service* (LOS)	Predicted LOS
State Route 24	2,630	5,293	C	D
State Route 247	1,340	2,281	B	B
State Route 172 (E)	1,060	1,188	B	B
State Route 172 (W)	2,020	2,104	B	B
State Route 187	330	697	A	A
State Route 13	5,820	6,903	D	E
State Route 237	570	642	A	A
State Route 241	840	840	A	A
State Route 243	1,530	2,050	B	B
U.S. Hwy 72	10,330	11,118	A	A
U.S. Hwy 43/SR 17 (N)	18,130	19,173	B	B
U.S. Hwy 43/SR 17 (S)	8,910	9,553	A	A

E - East W - West SR - State Route
N - North S - South
*LOS designations: A-F (A=best conditions; F=worst conditions)

Environmental Consequences
The plans for the Bear Creek Project land will include a wide range of possible land uses in the development of the area. The parcels allocate land use zones to include industrial and commercial development, developed recreation, and residential development, as well as resource management and conservation. These types of development will result in the generation of additional traffic on the adjacent roadway network. The methodology (Institute of Transportation Engineers, 1998) used to determine the additional trip generation estimates is based on an independent variable (acreage) for each particular land use for a specified day or time period (weekday). Based on several field studies of existing recreational homes, marinas, parks, golf courses, light industry, manufacturing, industrial parks, and warehousing, estimates of vehicle trip ends or vehicles per day were used to determine how the existing traffic would be affected. The Plan areas were divided into sectors using existing population

and ADT data to determine traffic flow direction of the expected new generators.

The methodology (Transportation Research Board, 1994) was used to identify possible traffic flow problem areas. The manual provides a qualitative method to measure the operational conditions within a traffic stream and their perception by motorists. This method takes into account lane widths, shoulder effects, average highway speed, alignment, etc. Six levels of service (LOS) are defined and given letter designations, from A to F, with LOS-A representing the best conditions and LOS-F the worst. At several representative points, the LOS provided to the existing traffic was compared to the LOS to the sum of the existing traffic and the projected additional traffic.

The additional traffic due to the proposed alternatives would result in increases in ADT as shown in Table 3.11.3-1. The existing LOS was compared to the predicted LOS. This level of analysis provides a broad overview of the predicted impact. The state multilane highways (U.S. Highway 72 and U.S. Highway 43/State Route 17) would provide higher capacity levels, and an increase in traffic would tend to be less noticeable. The state routes, primarily two-lane highways, would show varying increases in traffic, with only two noticeable decreases in LOS. State Route 24 would still experience stable traffic flow, but would become susceptible to congestion due to turning traffic and slow-moving vehicles. State Route 13, between Phil Campbell and Haleyville, would experience the most notable degradation of service, often experiencing slowdown of traffic. However, the existing conditions for this route are less than desirable, with the result that further slowdowns may not be all that noticeable. Plans are underway by the Alabama Department of Transportation to relocate State Route 5 (State Route 13) in this area. This will decrease the impact to State Route 13 and most likely reduce the traffic impact to State Route 243. Although some of the percentage increases in ADT are rather high, the roads in this area are generally underutilized, with the exception of the two aforementioned state routes, and an increase in traffic will not result in a major change to the existing service levels of the local roads.

The numerous smaller county roads that lead to the connector roads will experience large increases in traffic volume, but are fully capable of absorbing the additional traffic load. Also, some parcels to be developed do not have access. The roads which lead to the connector roads may have to be upgraded, and new roads may have to be developed for the traffic conditions expected. Over a long period of time, there is a natural progression to improve the quality of the local roadway network. Therefore, as traffic increases, roadway networks will also improve. Also, the increases in traffic will occur slowly over a long span of time, so that traffic conditions will not change suddenly and will not be perceived by the user as a significant change. In addition, users of the local roadway network tend to be multiusers of the entire Bear Creek

Project land area. Therefore, total vehicle trip ends are reduced as trips can be made internally without using the off-site road system.

Possible mitigative efforts that could be made to improve traffic will likely be made over time by the appropriate county highway departments. Physical improvements to increase road capacity could include intersection redesign, construction of additional vehicle lanes throughout road segments, construction of passing lanes in certain locations, realignment to eliminate some of the no-passing zones, increased shoulder width, etc. Any new roads that will be constructed for access that lead to the secondary connector roads should be designed based on detailed field studies to assure adequate traffic conditions.

3.12 Cumulative Impacts

This EA tiers off of the SMI EIS for the cumulative impacts of residential development activities on this and other reservoirs in the TVA system.

Under the original intent, all land capable (not necessarily suitable) of development was to be eventually developed either for recreation or residential purposes. The developable BCDA land is estimated to be 2,751 acres, not including Bear Creek and not including Zone 6, Recreation land. TVA land fronting BCDA contains 699 acres along 56 miles of shoreline. Implementation of Alternative B would provide for five TVA parcels fronting BCDA to be eventually developed. This represents approximately 56 acres and 5 miles of shoreline. There are approximately 340 BCDA acres behind these five parcels.

Implementation of either alternative could change the land use of individual sites on the Bear Creek Project Reservoirs. However, the impacts of these changes would be minor compared to the continuing development on non-TVA lands surrounding the reservoirs. The Bear Creek Project allocations would not affect the larger trends in resources occurring on non-TVA land around the reservoirs. Residential development of private property in the area is expected to continue, regardless of the method TVA uses to manage reservoir lands. Likewise, increased demand for the use of the reservoir and adjacent TVA lands for all types of human activities is likely to continue with the projected rise in population. Accompanied with this increased use will be increased air pollution from vehicles and heating units; more water runoff from roads and structures; larger volumes of solid waste and sewage; increased traffic; and increased need for support infrastructure. However, TVA's decisions regarding allocations of Bear Creek Project lands would have only minor or negligible effects on these growth-related environmental impacts.

3.13 Proposed Commitments

1. Cultural resources review. TVA will comply with terms and conditions of a Programmatic Agreement with the State Historic Preservation Officer for identification, evaluation, and treatment of historic properties that are eligible for inclusion in the National Register of Historic Places.

2. Karst features. The integrity of two caves located on the Little Bear Creek Reservoir area would be protected by establishing a 200-foot vegetation protection buffer zone around the opening of these caves.

3. Habitat protection areas. Populations of rare plants and animals, and uncommon habitats identified during field surveys would be established as TVA Habitat Protection Areas (Appendix E, Table E-6).

4. Small wild area. A mature upland hardwood forest with a series of low limestone outcrops located on Parcel 37 on Little Bear Creek Reservoir would be established as a TVA Small Wild Area.

5. Agricultural licenses. Future agricultural licenses and renewal of existing agricultural licenses would continue to include requirements addressing establishment of a buffer between agricultural tracts and the reservoir and the use of agricultural BMPs.

4. SUPPORTING INFORMATION

4.1 List of TVA Preparers and Contributors

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Position: Zoologists, TVA Watershed Technical Services
Education: M.S., Zoology
Experience: 8 years experience in monitoring terrestrial endangered species

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Education: M.A., Anthropology
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Experience: 25 years experience with TVA in fisheries and aquatic ecology impact assessment

Charles R. Tichy
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Experience: 32 years experience in historic preservation and historic restoration

4.2 List of Agencies and Persons Consulted

The draft EA/EIS was distributed to the following federal, state, and local agencies. Copies were provided to three local libraries and the TVA Pickwick watershed office for the public to review.

Federal Agencies
U.S. Fish and Wildlife Service, Decatur and Daphne, Alabama
U.S. Army Corps of Engineers, Nashville District
U.S. Department of Agriculture, Forest Service, National Forests in Alabama

State Agencies
Alabama Dept. of Agriculture and Industries, Montgomery, AL 36109-0336
Alabama Dept. of Conservation & Natural Resources, Montgomery, AL 36130
Alabama Dept. of Economic & Community Affairs, Montgomery, AL 36130
Alabama Dept. of Environmental Management, Montgomery, AL 36130-1463
Alabama Dept. of Transportation, Tuscumbia, AL 35674
Alabama Historical Commission, Montgomery, AL 36130-0900
Alabama State Historic Preservation Officer, Montgomery, AL 36130-0900
Alabama Development Office, Montgomery, AL 36130-4106
Alabama Forestry Commission, Double Springs, AL 35553
Alabama Forestry Commission, Florence, AL 35630
Alabama Forestry Commission, Russellville, AL 35653
Bear Creek Development Authority, Russellville, AL 35653
Office of Archaeological Services, Moundville, AL 35474
Natural Resources Conservation Service, Hamilton, AL 35570
Natural Resources Conservation Service, Russellville, AL 35653

Local Agencies
Northwest Alabama Council of Local Governments, Muscle Shoals, AL 35661

Persons Consulted
Alabama Environmental Council, Birmingham, AL 35233
Alabama Mountain Lakes Assoc., Mooresville, AL 35649
Alabama Power, Haleyville, AL 35565
Alabama Trails Association, Birmingham, AL 35237-1162
Alabama Water Watch Program, Auburn, AL 36849
Alabama Waterfowl Association, Guntersville, AL 35976
Bear Creek Canoe Run, Hackleburg, AL 35564
Bear Creek Education Center, Hodges, AL 35571
Champion International, Russellville, AL 35653
First Metro Bank, Muscle Shoals, AL 35561
Franklin County Education Supt., Russellville, AL 35653
Franklin County Sheriff, Russellville, AL 35653
Franklin Electric Cooperative, Russellville, AL 35653
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Williams, Danny M., Russellville, AL 35653
Williams, Jack, Russellville, AL 35654
Williams, Jr., Robert, Phil Campbell, AL 35581
Willingham, Floyd, Russellville, AL 35653
Winslow, L. J., Mayor, Town of Lynn, Lynn, AL 35575
Witt, W. D., Russellville, AL 35653
Woods, Ryan, Russellville, AL 35653
Yocom, Ray, Sheffield, AL 35660

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Appendix A – Responses to Public Comments to the Draft

The draft Environmental Assessment and Land Management Plan was issued on April 7, 2000; the comment period closed May 31, 2000. The draft was available at public libraries and city halls in the Bear Creek watershed. Approximately 450 copies of the documents were mailed to individuals, agencies and organizations requesting copies. Public meetings were held at the Phil Campbell, Alabama, Community Center on April 27, 2000, and at the Belgreen, Alabama, High School on May 9, 2000. At these open house style public meetings, TVA staff members representing various disciplines were available to discuss the plan. The public was encouraged to submit comments either in writing, or verbally to a court stenographer for transcription. An additional open house was conducted on January 9, 2001, at the Russellville City Hall to allow the public to view changes that were made to the draft.

After public comments were received, changes in the draft EA and Plan were made that reflect response to public input. Three of six Zone 7 (Residential Access) properties fronting undeveloped BCDA property were changed to Zone 4 (Natural Resource Conservation) based upon a recommendation by the BCDA Board of Directors. The board is comprised of nine publicly elected officials, four members appointed by county commissions in the watershed, and one member appointed by the governor. BCDA has indicated that they wish to concentrate on public recreation benefits of the reservoirs and have no desire to develop additional residential subdivisions. This decision is based primarily upon opposition the BCDA board has received as a result of past residential developments and comments regarding proposed future developments. This change affects three parcels—one each on Upper Bear, Little Bear, and Cedar Creek Reservoirs—involving 3.9 miles of shoreline and 43.9 TVA acres.

Private landowners (both potential subdivision developers and single-family landowners) back lying some Zone 3 and 4 properties where no water-use facilities presently exist requested changing parts of the Zone 3 and 4 properties to Zone 7 so they could request docks in the future, as could be done by property owners back-lying Zone 7 properties. The Pickwick Watershed Team recommends against changing these parcels to residential access for the following reasons:

- Many public responses in the scoping effort and written comment period reflect an opposition to opening up new shoreline areas for residential access.
- These Zone 3 and 4 properties are currently undeveloped shoreline with no existing water-use facilities.
- The undeveloped shoreline provides protection to water quality by filtering sediment and pollutants before they reach the reservoir.
- The width of TVA land fronting many of these back-lying tracts would represent a large conversion of public land to land dedicated to private residential use.
- There are no deeded land rights for water-use facilities on these parcels.

Several written comments were received from back-lying property owners requesting changing from Zone 3 or 4 to Zone 7 areas where existing private water-use facilities have been grandfathered. Approximately 31 individuals wrote letters requesting single-family docks. Sixteen parcels on three reservoirs would be affected by these requests. The watershed team identified three Zone 3 or 4 parcels with at least five existing BCDA-permitted water-use facilities. These parcels affecting at least 15 individuals were changed to Zone 7. The Pickwick Watershed Team recommends against splitting additional Zone 3 parcels into Zone 7 parcels in order to accommodate the dock requests for the following reasons:

- The planning process indicated sensitive resources on these parcels.
- There are no deeded land rights for water-use facilities on these parcels.
- There are approximately 55 grandfathered private water-use facilities involving 33 parcels on three reservoirs that have neighbors who could make the same request.
- This would encourage development in areas where little development currently exists. A majority of respondents to the initial public scoping efforts wished for undeveloped areas to remain undeveloped.

The watershed team attempted to identify defensible criteria for responsibly permitting new docks in the areas identified above. The team recommends that existing grandfathered dock permit holders be encouraged to make application on behalf of and with their neighbors for modified multiple-slip facilities to accommodate their neighbors' watercrafts. TVA approval would be based upon existing 26a procedures. In addition, TVA will work with BCDA to provide public boat slips in existing recreation areas. This will help accommodate back-lying property owners who wish to leave their boats in the water during the summer recreation season.

The watershed team attempted another approach to consider other requested revisions after the above two major groupings of requests were considered. It was thought that criteria for allowing additional residential development could possibly be identified. The watershed team rejected additional development in all parcels in Zones 2, 3, 5, and 6. Zone 7 was rejected since residential access is already allowed there. Only Zone 4 parcels remained. The team then eliminated parcels with no existing private water-use facilities and all parcels where BCDA is the back-lying property owner. This left seven Zone 4 parcels on two reservoirs. Several requests to change from Zone 4 to Zone 7 had been received concerning two of the seven parcels. Three of the parcels had existing agricultural licenses with associated private water-use facilities that had been permitted by BCDA (one of whom has requested revisions to allow future subdivision development). The remaining two parcels include wide strips of TVA land (as much as 1,500 feet) that are near a municipal water intake. The team could not identify defensible criteria for revising the plan to accommodate additional water-use facilities in these areas.

The primary emphasis of the Pickwick Team, in partnership with BCDA and other stakeholders, will be twofold: maximize the public recreation benefits of the four reservoirs and sustain the reservoirs for current and future water supply sources. Through this, a high level of economic activity can be achieved that will benefit the entire watershed while protecting the natural resources that are valued. With this emphasis the public land around the reservoirs will remain public.

Individual written comments are listed below, as well as comments given to recorders at public meetings. In some cases, comments were edited for brevity and to focus on the main issues raised related to the plan. Copies of complete letters received are on file at the Pickwick Watershed Team office. Most are addressed by the watershed team decisions explained above. Other pertinent responses are placed following each comment.

Written Comments

Mrs. Roy G. McCleese, Russellville, AL
I feel like in view of the effort we've took to preserve natural vegetation, the TVA should meet us (the ten families that own land on our loop) halfway and let one of us have one dock, and one beach area for our kids to swim. We've planted vegetation to beautify and preserve the land and to enhance wildlife. We would like TVA to see our side and let us live as good as the public land across the creek. Make sure that highway doesn't ruin our land get-away.

Water-use facility request addressed above. Future highway construction will be reviewed under TVA's 26a/land use request procedures. TVA has not received a 26a application from the Alabama Department of Transportation for proposed bridge crossings on Upper Bear Reservoir. However, they have been notified that sensitive resources exist in the area of the proposed bridges.

Mrs. Roy McCleese, Russellville, AL
Also, if there is poison oak/ivy growing on the buffer, we should be able to remove it so that everyone can enjoy the land and water as it was intended. I would like to see the landowners behind the buffer be able to maintain it (after approval) for a small fee and take more responsibility for its upkeep and litter removal. When you say it belongs to everyone, not everyone respects it. Giving us more rights to it could improve it.

Back-lying landowners can request vegetation management permits through the Pickwick Watershed Team.

Leland Sharpe, Phil Campbell, AL
I would like to do whatever it takes to help TVA and help the homeowners be happy with our problems. I know we should be able to satisfy everyone.

Comment noted.

Paul Cochrun, Bear Creek, AL
I am concerned about putting in a dock and what vegetation needs to be planted. I purchased my flotation services approximately 18 months ago, but I could not get any one to build it. So I didn't get my permit when I talked with the TVA man.

Water-use facility request addressed above.

H. Frank Tidwell, Hamilton, AL
Please consider from the black line above area 57 south to next black line be considered as Residential. Change from Zone 3 to Zone 7. There are existing property owners at this location that paid water-use prices for the property. Please at least meet us halfway and allow just a pier right! Frank Tidwell. Chris Williams

Water-use facility request addressed above.

Zack McNutt, Phil Campbell, AL
I, Zack McNutt, fully concur with all the meeting, and everyone was real nice, and, seemingly, everyone is in accord with the meetings.

Comment noted.

Richele Habada	Ellis Nix
Wynndy Sampson	Dorothy Nix
Gail Nix	Zack McNutt
Kristy Habada	Joe Evett and Judy Evett
Thomas F. Nix	Larry Sandusky
Hershel Nix	Lisa Sandusky
Gary Vandiver	Freddie Saint
Mark Sampson	Leland Sharpe

Area #58, 59, and 38 should be changed to Zone 7 instead of Zone 4. Because a large portion of the land in these areas are developed and where developed under BCDA rule and were approved.

Parcel 58 has been expanded to reflect back-lying existing subdivision boundaries. It has been changed to Zone-Residential Access to reflect the five BCDA-permitted water-use facilities.

Donald and Shelie Cooper, Phil Campbell, AL
I would like you to keep in mind that Upper Bear is not like the other lakes, because of the Floatway, the water drops in the summer and up in the winter.

Comment noted.

Allen Grissom, Jr., Russellville, AL
Everyone is interested in the land and water conservation. We were informed the lakes were constructed for the public to use; if not, why have the lakes at all? Let the people around the lakes construct piers and upgrade the shorelines. The lakes covered the Indian burial grounds, this is OK. Let's be reasonable and let the people use the lakes and shorelines, as long as they take care of them and keep them clean.

Water-use facility request addressed above. Certain shoreline activities (i.e., vegetation management) can be permitted through the Pickwick Watershed Team.

Curtis Swinney, Hodges, AL
No more hardwood timber cut. No more new housing district developed. We need water treatment plants, also industrial development. We need expansion of picnic areas and more parking space. We need improvement of boat access areas.

TVA conducts timber management under certain conditions on suitable tracts. These are conducted under the direction of TVA's professional staff to ensure that any adverse impacts are minimized or mitigated. Recreational development is addressed above.

Olen Barr, Muscle Shoals, AL
I have owned and lived on this property for the past 45 years. I am retired now and hope to still be able to have access to the water as I have in the past. It is a beautiful place, and we hope to be able to keep it that way.

Comments noted.

Brenda S. Goebel, Pensacola, FL
I own 12 acres (with near 400' of water frontage) adjacent to Little Bear Creek in Franklin County. I have interest in building piers in the future. I grew up in Colbert County and have lived in Michigan and Florida in order to earn my livelihood. For all of my life, I have returned to Colbert and Franklin Counties for vacations and have enjoyed the beauty and peace of Little Bear Creek several times each year.

I cannot attend your May 9th meeting at Belgreen High School. But I must tell you that I am gravely concerned about "guidelines being developed regarding land use for property owners who DO NOT already have an existing pier." As I understand from other property owner with piers on Little Bear Creek, guidelines being developed are unfair. I have heard that Horace Cleveland and BCDA, who do not currently have piers, will be allowed to have piers in the future. I want the same right. I have owned land adjacent to Little Bear for 16 years. Just because my husband died and I was unable to build a pier years ago, am I to be prohibited from having a pier when I finally am able to retire? Please see that guidelines which limit me and give to the Horace Clevelands and BCDA is NOT fair.

Please hear my plea that I want to be able to build piers in the future.

Water-use facility request addressed above.

Herbert and Esne Butler, Russellville, Alabama
As per previous conversations, you are aware that this area has been proposed as Sensitive Resource Management zoning. This is of great concern to us and to all of the landowners in the Williams Hollow Community especially since this is one of the oldest established residential areas on all of the lakes.

We personally own five platted lots adjoining your lands which we hope to sell in the future for proposed home sites. As you proposed, we are pleased to build community piers as opposed to individual piers to accommodate these lots.

Please schedule a meeting for the purpose of discussing the rezoning of our area to Residential Access and for your suggestions on how we might continue to preserve the existing conditions.

Thank you for your kind attention to this matter and your many efforts in the past.

Water-use facility request addressed above.

Neal Hargett, Russellville, AL
As you are aware, I own certain real property which adjoins the TVA severance property in Parcel on Little Bear Creek Lake. I am enclosing a copy of the TVA map with my real property "highlighted" for your benefit.

Under the preliminary land use plan, the TVA property is designated Zone 3, Sensitive Resource Management, thereby effectively preventing my future utilization of the same in conjunction with the development of my real property. From a review of the proposed plan, it is my understanding that this designation is subject to review, and I would appreciate you and/or other TVA personnel contacting me regarding a change in the land use designation of these, or a portion of these parcels.

Reasons for not changing the zoning of specific sites are discussed above.

Sam and Janet Stokes, Russellville, AL
We live adjacent to Parcels 31 and 32 on the Cedar Creek Reservoir. The land in this area has not been greatly developed and does not seem too damaged. We believe that allowing people in this area to build a pier would have little if any effect on the shoreline. We believe existing landowners should have the opportunity to build a pier for personal use. These areas were farmed each year without any significant damage. A few piers in this area, under your guidelines for existing piers, would not be a great difference.

When my father had the land bought from our family, by TVA for BCDA, we were not allowed to keep access to the water. My father offered to allow them to flood anything—if we could retain land ownership. They insisted the land be purchased to the high flood line. As a result, part of our front yard literally belongs to TVA. I wonder, with all TVA's new regulations, if soon we will be told not to mow our yard. When the land was purchased, we were told it would benefit our children and grandchildren. We were assured that we could get permits for piers. However, you have changed everything, and our children will not be able to get a pier permit. When they inherit the land and select a place to live they will not be allowed to build a pier. Yet, BCDA is allowed to sell lots and give access to people from anywhere. We believe you are discriminating against the former property owners and their heirs by refusing their children and grandchildren access for new piers. BCDA should have given these property owners a chance to obtain pier permits before returning the ownership to TVA.

The value of the archaeological sites in these areas was not great enough to prevent the flooding of the bottomland, but they provide a convenient excuse not to issue permits for piers. A controlled number of piers in the water above these sites should not damage these sites more than TVA putting water above them damaged them.

We ask you to consider giving the existing property owners without piers an opportunity to have a pier.

Parcel 32 has been changed to Zone 7-Residential Access. The parcel will be managed according to the categorization of residential shoreline as provided in the Shoreline Management Policy Record of Decision.

Vic Nix, Phil Campbell, AL
I purchased a 1 acre lot on Little Bear Lake near Williams Hollow Camp area, thinking I could have access to the lake and a pier. I met Mr. Don Sibley at the lake, and we walked over my lot. He gave me the location I could build a pier if the land had a suitable perk rate. I had the land perked and a permit to install a septic tank issued by the Health Department. Then, I found out Don Sibley was no longer employed by BCDA, and TVA had taken control.

I contacted Danny Johnson and was told that TVA was in the process of writing new rules. I have been waiting for the new rules and have just found out that the area my lot is in may be zoned "sensitive." I contacted Jim Shedd, with TVA, and was told I needed to submit this letter.

I purchased the land only after I was told I could have a pier by Don Sibley and BCDA. I did the required perk test, built a road, and leveled an area on the lot. I have invested a lot of money and have waited over a year for permission to build a pier.

I would like to meet with a TVA representative and get permission to build a pier. I understand that you are grandfathering existing piers, and I believe under the circumstances, I should be grandfathered in. I am looking forward to hearing from you.

Water-use facility request addressed above.

Graton Hester, Russellville, AL
I own land joining several parcels on the Cedar Creek Reservoir, including Parcels 31 and 32. These parcels do not have a problem with erosion on our side of the reservoir. I think that you should allow people who own land and do not have a pier to get a pier permit. At least the people with homes already built should be able to get a pier permit.

When you bought the land from me for BCDA I was told that we would have the use of the land by getting permits for piers. The possibility of TVA control was never mentioned. I was assured that my children and grandchildren would have the continued use of the land. Now they will not be able to have their own pier.

I think you need to give the people who own land an opportunity to have a pier for their use. It won't do anymore harm now than it did when BCDA issued permits. BCDA could have avoided the problem by giving us this chance before giving the land back to

TVA. I think you should find a way to give people a chance to get a pier permit that own land and do not have one. Anything you could do to help with this problem would be very helpful.

Parcel 32 has been changed to Zone 7-Residential Access. The parcel will be managed according to the categorization of residential shoreline as provided in the Shoreline Management Policy Record of Decision.

Vic Nix, Phil Campbell, AL
Alternative A is the best active for BCDA lakes. Using the laws already in existence will protect the lakes from pollution and over development. Under the State Health rules and BCDA rules, before a lot can be built on, the land must be perked and a suitable system installed. Most land around the lakes cannot be developed under these rules, which will provide sufficient underdeveloped lands. By using the subdivision rules of the state, all subdivisions would be designed to protect the environment from pollution and drainage. We have sufficient laws to protect the scenic and environmental values of our lakes.

Comment noted.

Albert Hester, Russellville, AL
My family and I own land next to Parcels 31 and 32 of the Cedar Creek Reservoir. The land in this area does not have a damage or erosion problem. I feel that we should be allowed to have a pier in this area.

When TVA bought the land from my father, we were not allowed to keep access to the water. They insisted on buying to the high floodline. I think you are discriminating against the former property owners and their heirs. You are allowing BCDA to sell lots and give access to strangers. However, you are refusing the children and grandchildren of the original owners access for new piers. This decision is unfair and I think you need to reconsider your position.

Parcel 32 has been changed to Zone 7-Residential Access. The parcel will be managed according to the categorization of residential shoreline as provided in the Shoreline Management Policy Record of Decision.

Neal Hargett, Russellville, AL
Please consider reevaluating the shoreline status of <u>not all</u> but some portions of my property on Little Bear Lake. I will be sending detailed maps and comments soon. Thanks.

Reasons for not changing the zoning of specific sites are discussed above.

Jerry and Deborah Phillips, Bear Creek, AL
I am in favor of Alternative A, or the "no-action" alternative plan. I think Alternative B restricts landowners but gives TVA and BCDA unfair competitive advantages in developing their lands. I want the option to build piers or docks and picnic tables on land Parcel 67. I also want access road and utilities easement starting approximately 400'

from the west end of the metal guardrail of the bridge, and from this point on Highway 79 going north approximately 275' to our property line. I feel like we were under no timetable for the development or use of the shoreline until TVA began the environmental assessment studies.

Map isn't drawn true. TVA has narrow frontage on new road to bridge. People are mud-riding in big pickup trucks; there is a significant amount of garbage (sofa, mattress, bottles, etc.) that has been thrown there. Four wheelers have eroded land on banks on both sides of Highway 79 at the new bridge.

Water-use facility request addressed above.

Form Letter From:
Kathryn Gardner, Bear Creek, AL
Alton Romine
Tony Bishop, Haleyville, AL
Becky and Donald Tittle, Phil Campbell, AL
Heath Bishop, Phil Campbell, AL
Daniel and Norma McCarley, Bear Creek, AL
Curthal Hightower
Gary Rushing, Haleyville, AL
Deborah Bishop, Phil Campbell, AL
J. W. and Daisy Pike, Phil Campbell, AL
Donald and Johnnie Poe, Phil Campbell, AL
Dewey and Mildred McCarley
Fran Bishop, Haleyville, AL
Allen Pike
The original purpose of the taking of land by TVA/BCDA was for public use; the creation of the Bear Creek Lakes. The subsequent BCDA developments, Tanglewood and Lick Creek Cove, then took this same "public use land" and put it into private hands. It was wrong then, and it is wrong now. It was unnecessary in the beginning to take land that was not needed (above the high water mark) from private landowners for a small amount of money and in turn sell this land for a large profit.

The following parcels are designated as proposed residential for the development of new subdivisions on TVA's draft Land Management Plan:

#26 & #28 - Upper Bear Creek Reservoir
#19 & #54 - Cedar Creek Reservoir
#4 & #30 - Little Bear Creek Reservoir

We DO NOT want these parcels, nor any other parcels, developed for subdivisions.

If TVA is concerned about water quality and preserving the shoreline in a natural state, then WHY propose development of more land? ZERO TOLERANCE for all developments, including TVA and BCDA, should be the Land Management Plan!

Designating specific tracts of shoreline as "Residential Access" zones allows back-lying property owners various rights to use of the shoreline. Development on private land or BCDA land back lying specified tracts is possible under either alternative. As discussed above, however, BCDA has reconsidered development of some of its property, which will result in a reduction of subdivision development on BCDA lands and a reduction in requests for water-use facilities in the future. Parcels 28 Upper Bear; 19 Cedar; and 30 Little Bear have been changed to Zone 4-Natural Resource Conservation.

Montez Hester, Dallas, TX
I am VERY MUCH opposed to you building a subdivision on Little Bear Creek Lake. My grandfather didn't sell this land for subdivision purposes; he sold it to TVA for flood control, clean water, and recreation.

I think if you have any land left over, you should return it to the rightful owners. What's wrong with preserving nature? Why are you building a subdivision when you're going to put a water plant there for the whole county to get water out of that lake? That means there will be raw sewage going out into the lake. How healthy is that for people?

This is land that has been passed down from generation to generation. I'd like to have my share back. As far as I'm concerned, you should leave this land alone. What's happening to environment preservation?

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands. The proposed water treatment plant is for withdrawing water from the reservoir for potable water supply. There will be no raw sewage dumping in the reservoir as a result of this facility.

Mazelle Hardin, Vina, AL
My family and I understand that TVA and/or Bear Creek Watershed Association is planning for subdivisions on Little Bear Creek Lake. My father, the late James Floyd Hardin, did not sell his land for that purpose. He was told that the land would be used for wildlife and recreation.

We would like that his wishes be respected.

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands.

Wayne Phillips, Bear Creek, AL
A large part of my family's farm went into the Upper Bear Creek Dam site, splitting the property into two halves. A deed was written granting a 25-foot right-of-way between the two blocks of property. I own blocks of land that was designed to be connected by this land. If any change in land use of this property occurs (such as any related to the school) this right-of-way much be considered first.

Rights-of-way recorded on deeds are considered in land use decisions. No changes in land use are proposed under this plan for the Upper Bear Creek Dam Reservation.

Darlene Hester, Russellville, AL
I'm very much against any subdivision on any of the four TVA lakes. You took my father's land on Little Bear for flood control and recreation. Please leave the timber alone, and just let it grow. Why did you take more land than you needed anyway? Why not return the land not needed back to the people you took it from? You should have been visionary enough to see what you were taking from us, and I think you did know. You could see how much you would gain from it and that's all you cared about.

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands. Return of property to previous landowners or their heirs is not within the scope of the EA or Land Use Plan.

Darlene Hardin Hester, Russellville, AL
I'm writing to you concerning the subdivision you are thinking of starting on Little Bear Lake. I'm very much opposed to this. You bought the land from my father for flood control and recreation purposes only. Please leave it alone, and let the timber grow. Just let nature alone. If you have more land than you need why not return it back to the original owner?
Why would you want to start a subdivision where you are planning to build a water system for the whole county to get their water from?

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands. Return of property to previous landowners or their heirs is not within the scope of the EA or Land Use Plan.

Glenda Thompkins
Tobias Neal Tompkins
Jessica Ann Tompkins
Charles Neal Tompkins
Russellville, AL
You purchased our property on Cedar Creek at a minimal price. You took away our source of income (farmland). Then you tell us we can buy it back at auction. How do you justify this comment when you have taken our way of making a living; taken away our heritage and our children's inheritance? How can we afford to pay $30K per lot when you only gave $168.00 per acre? My son and daughter are becoming adults now; my son is getting married this August and has no property to start a home; we were left 4 acres of 106 with a large part of this in ditches and gullies. Our children are still in college and cannot pay excessive amounts for property that should be theirs anyway. How would you feel if someone took your home away and sold it for an excessive amount at auction then told you it was best for you and your family.

When I was in college at UAB and my family was at home for a year, I came home on weekends. One weekend I was walking with my son and daughter ages 9 & 11, on the property that we previously owned. One of BCDA's park rangers drove by and asked for our permits. I told him we were just walking and did not have one. It was too cold to swim and we were not even in a picnic area, and had no food with us. He threatened to take me to jail if I did not sign the ticket he was writing me. I refused and told him to take me and my two children if he must. He eventually got in his truck and left as we walked home. This is just one of many experiences we have had over the years as have many other families. Please sell us our property back at the price you paid us for it or leave it alone. We don't want it subdivided. If we wanted neighbors we would move to the city. As it is now we have many sleepless nights due to the parties that occur in Lick Creek Subdivision which adjoins our property on three sides. We have notified BCDA, TVA, and our sheriff department but they cannot cover this consistently, they can't even cover their usual routine areas, our county is too large.

Please, again, I ask you to sell our property back that has not been purchased by other individuals already at the price you gave us for it.

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands. Return of property to previous landowners or their heirs is not within the scope of the EA or Land Use Plan.

Don Lord, Phil Campbell, AL
In this assessment, you speak of soil erosion, but not on a lake-by-lake comparison. Bear Creek Reservoir has no names, yet you do have soil erosion. Bear Creek Lake and Upper Bear Creek Lake are both much too narrow for the "bass boat" horsepowers that are allowed. The narrowness of these two lakes allows the wakes to break sharply on the shores. In-water vegetation would 1) create a strong wake buffer, 2) create more DO, 3) create more cover for the food chain.

The state DOT is operating under a 1990 road plan—has TVA reviewed the lakeside ground that the DOT wants to cross?

The preferred alternative would better allow control of shoreline erosion, regardless of the cause, by encouraging the establishment and preservation of vegetated shorelines. TVA does not regulate the horsepower of boats on its reservoirs. Future highway construction will be reviewed under TVA's 26a/land use request procedures. ADOT has been notified that sensitive resources exist in the areas of the proposed bridges.

Frank Bishop, Russellville, AL
According to the Upper Bear Creek Reservoir draft allocation map, Area 16 (Zone 4) and Area 18 (Zone 3), it is my understanding from the data mailed to me and the meeting held to discuss the zoning, these areas can't be used for residential recreational use. I purchased a ½ acre lot with 150' of frontage joining the TVA property line for the future purpose of building a vacation/weekend home in a location where these two areas meet. I purchased the property over 5 years ago and was waiting until the property was paid off to develop for personal use. Again, it is my understanding that no future dock permits will be issued in the areas and an access corridor will not be granted if a dock is not already on the property.

I would like to ask that these areas be reconsidered in zoning in order that residential access/recreation along with future dock permits be allowed in the area.

Water-use facility request addressed above.

Frank Bishop, Russellville, AL
According to the Cedar Creek Reservoir draft allocation map, Area 43, Lost Creek Area, (Zone 4) Natural Resource Management, my understanding from the data mailed to me and the meeting held to discuss the zoning, this areas isn't a Residential Access area. I think I understand that we may use this property (TVA) or a corridor on this property to access our dock due to a dock permit being already issued for this location. I purchased this property adjoining the TVA property several years ago along with an existing dwelling which was present prior to the lake being built. The property has been used as residential access from the time the lake developed.

It is my concern that in years to come that due to the present proposed zoning of this area, the powers that be at the time, may turn down any improvements, repairs, or replacements of the existing docks and relinquish any access to the lake.

I would like to ask that these areas be considered in zoning to a Zone 7, Residential Access, as are many of the residential developed areas and the BCDA areas along the banks of Cedar Creek Lake.

Reasons for not changing the zoning of specific sites are discussed above. Existing water-use facilities will be grandfathered, and will be permitted to remain as long as they meet TVA guidelines.

Jerry McKinney, Red Bay, AL
It is very sad to listen to the lies of TVA after so many years of the same things. I stood on the porch of my grandmother's home in the '60s when TVA lied to her. They said you can't have any land on the water because we don't want any sewage going into the water. Now TVA is selling lots through the name of BCDA. The county is planning a water plant for all of the county's water and TVA plans a subdivision on that same lake. TVA is sorry from beginning to end.

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands and fewer requests for residential water-use facilities.

Esta McKinney, Red Bay, AL
I think TVA is still lying to the public. The public meeting showed that no one wanted any subdivision on the lake and that the public wants it left in its natural state. No more tree cutting. Why would I want a subdivision on the lake where I get drinking water. Too much damage has already been done to landowners and the lakes. I hope TVA never gets another tax dollar from the government.

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands.

Eddie Britton, Russellville, AL
My family owns land along approximately 1 mile of shoreline in Parcels 28 and 29 on Cedar Creek Reservoir. We have cooperated fully with TVA (Jim Shedd and Doug Murphy) by removing existing fences and planting over 100 trees you provided.

Please give us permission to construct water-use facilities at some point in the future on these parcels (grandfather in) before the Land Management Plan is implemented. Otherwise, please rezone Parcels 28 and 29 where additional water-use facilities will be considered in the future.

Thank you for your consideration in this matter.

Water-use facility request addressed above.

Theresa Hester Mays, Laguna Niguel, CA
It is my understanding that land controlled and governed by Tennessee Valley Authority and/or Bear Creek Development Authority may be approved for sale for residential use. This land is located in Franklin County, Alabama, surrounding Little Bear Lake and three other area lakes. I am opposed to this land being sold for that purpose. I ask that you carefully review the rules under which the government obtained this land and the purpose for which it was obtained.

My deceased maternal grandfather, Floyd Hardin, was forced to sell 146 acres of his land to TVA in 1968 for $16,900. My grandfather grieved after having to sell his land, but was told by TVA authorities that he had no other option. He was also told by TVA authorities that the land was to be used solely for flood control purposes and recreation. The only comfort my grandfather could find in being forced to sell his land was the belief that his land would be used for flood control purposes and that others in the community would benefit from his sacrifice. In 1968 I was only 15 years old, but I can still remember how painful this was for him.

Now, my mother has informed me that the land my family gave up will probably be sold off in lots for $35,000 to $40,000 each. It is not fair the government takes a family's coveted land and then breaches the word and spirit of the original agreement by selling the land at a profit for a purpose very different from the original agreement. This violation of trust applies to not just my family, but all the families that relied on the word of the TVA.

Please kindly reply as to whether TVA will reconsider its position and abide by the original agreement.

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands.

Marty Berry, Russellville, AL

After looking over the Upper Bear Creek Reservoir draft allocation map, Area 16 (Zone 4) and Area 18 (Zone 3), the best I can understand, these areas can't be used for residential recreational purposes. I purchased a lot with frontage joining the TVA property line a few years ago in this area for future use. I can't tell exactly which area it is located but somewhere around where these two areas meet. It is my understanding that no future dock permits will be issued in these areas and an access corridor will not be granted if a dock is not already on the property.

I would like to ask that these areas be reconsidered in zoning in order that residential access/recreation along with future dock permits be allowed in this area.

Water-use facility request addressed above.

Herbert and Esne Butler, Russellville, AL
We are the owners of property located at #16, along with several landowners who are all concerned that we will be deprived of any benefit of use of the shoreline.

Please consider the rezoning of this small area to Residential Access so that we might enjoy the lake as other zoned areas are allowed to do.

As for the entire lake, we believe that with the limited number of accessible tracts of land owned by individuals; with a few exceptions, that landowners should have access to the lakes from their property. Most landowners are very good stewards of the lakes and certainly would be required to perform within reasonable guidelines.

Thank you for your kind attention to this matter.

Little Bear Parcel 16 has been changed to Zone 7-Residential Access. The parcel will be managed according to the categorization of residential shoreline as provided in the Shoreline Management Policy Record of Decision. All of the public are encouraged to responsibly use the shoreline for informal public recreation uses.

Brenda Goebel, Pensacola, FL
For years I have owned property adjoining TVA shoreline labeled Section 36 on TVA maps in Franklin County, Alabama. TVA is proposing unfair zoning changes. I have written to TVA to express my opposition and to ask to be on a mailing list and as of yet I have heard nothing from TVA. I would like to solicit your support for two actions:

- My land and all adjoining TVA shoreline be zoned Residential Access (Zone 7) with the same lake use privileges as Bear Creek Development Authority (BCDA) is affording others.

- That an advisory board consisting of landowners from each of the four lakes be instituted for the purpose of meeting on a regular basis with TVA representatives, thereby apprising the communities of any development of interest.

Thank you for your support.

Rezoning requests addressed above. TVA staff attends quarterly public meetings of the BCDA Board of Directors who are responsible for initiating development projects on the Bear Creek Reservoirs. TVA also meets regularly with the Little Bear Millennium Group and other stakeholders around the reservoirs. We encourage the organization and development of landowner groups.

Donald M. James, Birmingham, AL
I am submitting these comments in response to the draft Bear Creek Environmental Assessment and draft Bear Creek Reservoir Land Management Plan. I applaud the efforts of TVA to protect and enhance the environmental quality of the four Bear Creek lakes, as I am a landowner and part-time resident on Cedar Creek Lake. My house and boathouse were built in 1981-1982 and have been used continuously as a lake house since that date. My property fronts your Parcel 32 and essentially begins on the northwest boundary of Parcel 32 and continues along your setback line for approximately 1,100 feet. In your draft Plan, all of the lake frontage adjacent to my lake house is designated as Zone 3, Sensitive Resource Management. I note from your map that virtually all of the other areas of Cedar Creek Lake that have established lake house developments have been designated as Zone 7 ,Residential Access. I also note that lots owned by TVA or BCDA that have not yet been developed are all designated as Zone 7, Residential Access.

Your Executive Summary of the draft Plan properly states that "A basic premise of the reservoir land planning process is that land currently committed to a specific use would be allocated to that current use unless these is an overriding need to change that use." You also state that in preferred Alternative B, "This Plan grandfathers previous land use commitments..." The TVA lands adjacent to my property described above have been utilized for residential access to the lake for almost twenty years. I ask that you change the zone description for Parcel 32 to Zone 7, Residential Access, to reflect its historical and current use as residential access. Your Executive Summary also states that "The largest category of existing acreage is undeveloped. The majority of this undeveloped acreage would be placed in Sensitive Resource Management in Alternative B." The BCDA/TVA land adjacent to my property is far from undeveloped, having been utilized continuously for almost twenty years as access to the lake for my residence and boathouse. There are seven houses that front the lake in Parcel 32, and your draft Plan appears to treat them differently than all of the other established residential areas around the lake, including the undeveloped lots owned by TVA or BCDA.

You should also be aware of the prior litigation between my predecessors in interest to my property and BCDA, the United States of America, and TVA. These Court Orders from the Circuit Court of Franklin County, Alabama, are in Case Nos. 81-100 and 84-106. As a result of these Court Orders, my predecessors in interest and I have paid BCDA and TVA a $500 annual user's fee every year since 1983 for the use of the BCDA and TVA property adjacent to my property on the lake. I request that before you change the designation of the property that is subject of these Court Orders from Residential Access to Sensitive Resource Management, you review the history of the use of this property.

I also note from your Executive Summary that 6,950.1 acres of shoreline are proposed to be dedicated to Zone 3, Sensitive Resource Management, while 236.8 acres are designated as Zone 7, Residential Access. All of Parcel 32 is only 17 acres, and that portion of Parcel 32 adjacent to my property appears to be only about 5 acres.

As I indicated, I applaud the efforts of TVA to protect and enhance the environmental quality of Cedar Creek Lake. I would be pleased to work with TVA personnel to establish plantings of native plants along the shoreline adjacent to my property.

In my view, one of the greatest failings in environmental management of Cedar Creek Lake is the persistent problem of users of the lake throwing trash into the lake. My family and I spend many hours every year picking up cans, bottles, Styrofoam and assorted trash from the shorelines of the lake and floating in the lake itself. I urge TVA to implement a public awareness campaign to encourage lake users to remove their trash when they leave the lake and to provide adequate and well maintained trash receptacles at the public facilities around the lake. In addition, publicizing appropriate fines for littering the lake and enforcing those fines would be extremely helpful.

I would also propose that TVA work with lake residents and users to establish an annual or semi-annual lake clean-up day to emphasize the need to keep the lake clean. Other communities have had great success in volunteer clean-up programs for streams and lakes.

Parcel 32 has been changed to Zone 7-Residential Access. The parcel will be managed according to the categorization of residential shoreline as provided in the Shoreline Management Policy Record of Decision. As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands. Pickwick Watershed Team members can recommend native vegetation that is suitable for planting for shoreline stabilization. TVA encourages the formation of lake user groups and will assist in clean-up programs.

Jarel L. Hilton, The Nature Conservancy, Montgomery, AL
I wanted you to know how much we appreciate the planning effort made by TVA in the Bear Creek Project and its contribution to conservation. From our involvement we saw that an extreme effort was made to conduct a thorough biological inventory so that planning decisions could be based on sound science. TVA clearly placed protection of the natural resource as a high priority.

Data collected from this project was valuable to our program in both building the database and assessing biologically significant lands. The Nature Conservancy is currently undergoing a nationwide conservation planning initiative by identified natural ecoregions of which Alabama shares five. The Bear Creek Project area is included in the Cumberland Southern Ridge and Valley ecoregion, and planning is currently underway. Significant natural areas identified during this project will be incorporated into the overall ecoregional plan. Bear Creek represents an important area of the Southern Appalachians including several endemic plants with global rarity. Long-term protection of these lands is an important contribution to the overall conservation of this rich and diverse system.

Again, I want to acknowledge the professionalism and dedication of you and other TVA staff involved with this project. I look forward to our continued involvement and support for natural resource protection and conservation on TVA land.

Comment noted.

Patricia A. Thorpe, Spruce Pine, AL
I would like to comment on your response to my question, "Why homeowners in Parcel 6 that is Cleveland Circle on Little Bear Creek have been allocated as Residential Access while other home owners in 18, 16, and 15 have been included in the Sensitive Resource Management area?"

When we bought our property it was adjacent to BCDA land. As responsible law-abiding citizens we tried to abide by the rules established by BCDA. Obviously, the homeowners in Cleveland Circle did not. If the BCDA land that fronts Cleveland Circle had sensitive plant and/or animal resources, historic, or prehistoric archaeological resources, they are long gone now.

Since the homeowners in Cleveland Circle did not abide by BCDA rules, and continued to build stairs and cement walkways down to their piers, plus added structures such as gazebos, any hint of natural resources has been removed along with any significant visual areas.

I guess it's old fashioned to expect that people would get punished for breaking the rules instead of getting rewarded. I've often wondered how the homeowners avoided being prosecuted by BCDA when what they were doing was a clear violation of the rules. Maybe you can explain that to me. If the rules were changed, no one bothered to notify me, or I would have steps down to my pier also.

If you are going to give them a pass by allocating them as Residential Access, then everyone on all the Bear Creek Lakes who currently have a pier permit should be allocated as Residential Access. I have no problem with the Sensitive Resource Management Areas, except where there is a current adjacent homeowner in residence with a pier permit. All such circumstances should be allocated as Residential Access. If not, make the homeowners in Cleveland Circle tear down their stairs and gazebos, so everyone on all the lakes will be living under the same rules and conditions!

Rezoning requests addressed above. Little Bear Parcel 16 has been changed to Zone 7-Residential Access. The parcel will be managed according to the categorization of residential shoreline as provided in the Shoreline Management Policy Record of Decision. All BCDA-permitted water-use facilities have been grandfathered.

Cynthia Forsythe, Russellville, AL
Allow homeowners who were not able to receive a BCDA permit for clearing and pier construction to be grandfathered and allow the same residential zoning and privileges afforded to BCDA-developed communities. (I constructed my home between April of 1999 and October 1999—when I requested a permit TVA had not taken over, but new permits were not being issued.)

Parcel 32 has a preexisting subdivision (Cedar Shores Subdivision) which was established in the late '80s. This should be a residential area on the map.

I am willing to work with you and your organization to plant vegetation to help fight erosion.

Parcel 32 has been changed to Zone 7-Residential Access. The parcel will be managed according to the categorization of residential shoreline as provided in the Shoreline Management Policy Record of Decision. The Pickwick Watershed Team can provide guidance on what types of vegetation or other measures in combination with vegetation can best control erosion.

Gay E. King, Russellville, AL

(1) Against additional subdivisions.
(2) Against any additional timber cutting.
(3) Leave land as is—no industrial/commercial development—if you are truly concerned with clean water, then no additional development will be done to run in lakes since land (most) will not perk. Additional commercial development destroys natural wildlife, and for generations to come there will be no nature as God intended for our future relations

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands. TVA conducts timber management under certain conditions on suitable tracts. These are conducted under the direction of TVA's professional staff to ensure that any adverse impacts are minimized or mitigated. One parcel, the proposed water treatment plant on Little Bear Dam, is zoned for Industrial/Commercial uses under this plan.

Mary L. Borden, Leighton, AL
My husband and I own two lots in the Cedar Shores Subdivision, which have been declared sensitive. We purchased these lots with the understanding that we would be allowed to do some clearing, build a pier, and build a home on these lots. We knew there were a few restrictions regarding which trees and plants could be removed, but that was the only restrictions we were aware of at the time. Some lots in this area already have piers. We are requesting the right to put a pier at these two lots. Declaring these lots a sensitive area and not allowing us to build a pier will basically make this land useless for us. We feel that since there are other lots with piers in this area we should be allowed to build a pier also. Please reconsider allowing piers at these lots.

Water-use facility request addressed above.

Keith Grissom, Spruce Pine, AL
I am writing this letter in reference to the conversation that we had approximately a month ago concerning property that I own on Cedar Lake. As per your request I will present here a brief account of the events as they transpired.

Approximately five years ago I had in my possession approximately 5-6 parcels of land that contained timber. In mid 1995, I entered into an agreement with Champion to cut the timber from this property. At that same time, Champion officials indicated an interest in purchasing one section of this property because it provided them with a road access to the highway. In order to gain possession of this property, Champion offered me a land swap deal that included the property that I now own on Cedar Lake. Before making a firm commitment on the swap I felt that it was in my best interest to ensure that I could use the property in the way that I intended. In late 1995, BCDA was in charge of overseeing the lakes, which included Cedar, and I met with the director at that time, Mr. Don Sibley. The focus of these meetings was to ensure that any potential buyers of the lake lots that I proposed to sell could secure access to the lakes by way of pier permits. Without the right to purchase access to the water, the land would be of little value to me and my decision to acquire the land in the swap hinged on being able to purchase the pier permits.

During my meetings with Mr. Sibley, specifically during our meeting in December, 1996, Mr. Sibley circled on a map of the property the right for me to secure permits for piers that began with number 3-13 and ended with number 3-13G. There were two areas that were excluded in the agreement. One of these areas included a fish habitat and the other involved the main body of water. These areas were designated on the map and Mr. Sibley signed the map verifying this agreement. Mr. Sibley also agreed that the property could be managed according to the BCDA standard handbook that specifies what can and cannot be done on the property.

It was with this assurance I entered into the final agreement with Champion and the deeds were signed on February 14, 1997. Over the course of the next months I had the land surveyed and had percolation tests done on the soil in preparation for sale of the lots at a future date. In November of 1997, city water lines were run to the property at my expense.

As you are aware, in 1998, TVA took control of the management of the lakes from the BCDA. The land that I have in my possession includes land that adjoins this body of water. As you also know, TVA immediately put a hold on all pier permits while they conducted a study of the lake and adjoining land. Approximately one month ago TVA released a document that classified the lakes and surrounding areas. The land that I own was classified as a Natural Resource which means pier permits are not allowed.

I feel that this decision was not fair because when I purchased this property it was in good faith and with the assurance of the then governing body that I would have access rights to the water through the issuance of pier permits. I have enclosed a sworn statement from Mr. Sibley that verifies that the agreement was in good standing at the time that TVA took control of the lakes from the BCDA. Since the BCDA was the only body with the authority to issue such an agreement, that agreement should be honored in spite of the change of command that has occurred since that time.

Your timely consideration in this matter will be greatly appreciated.

Water-use facility and rezoning requests addressed above. Based upon a deposition of the former BCDA administrator and documents signed by BCDA, TVA will honor BCDA's commitments to Mr. Grissom. This is considered a grandfathered facility within a Zone 4-Natural Resource Conservation not a change to Zone 7-Residential Access.

Statements
TVA Minutes of Meeting
May 9, 2000
Belgreen High School
Belgreen, Alabama
Before: Margaret Lynch, Commissioner

Bobby Sumerell
I've got 28 acres on Big Bear Creek Lake Reservoir that there is an old county road running to it and it crosses BCDA and TVA land and I need access to it. I have always used that road, but I need access to that land. I was told that they were going to put gates up and I couldn't go through there. Larry W. McDonald, I talked to him about it. The road crosses Bullock Branch. B-U-L-L-O-C-K. See, you turn in off of 187 on they call it Avery Road now and there's two houses there and I come down by them. All right. Then that little checkered mark, see that used to be the old county road that went through there, but it's just a small road that was abandoned. And I keep it up from right here to where it comes into my property. And my friend owned all of this property, but BCDA and TVA owns right along that branch.

The road that I'm on it used to be the old Ball Rock School House Road, it shows on the map, but it's called Avery Road now. And there's them houses. That's all I can go by. See I show it on that map here it crosses that's branch. I used to be told not to worry about it but times and things change. It's in Section 22. It would be Section 22, but I can't read all of that. Section 22 and then 03. I've just always crossed, it's just a branch crossing and the road comes right and it always went all the way through to this Ball Rock School over on this other highway. And somebody said, "Well, why don't you go in this way?" Well, all of that is private land and I'd have about six gates of private places to go through plus I'd have to go ten or fifteen miles all the way around in there when I could just go right in there. And so, I need a starting place somewhere. Thank you.

Comment noted and situation discussed with respondent during open house.

Patricia Thorpe, Spruce Spine, AL
I'm Patricia Thorpe on Little Bear Creek. TVA has not been consistent in the way it's handled current homeowners in its Bear Creek Land Management Plan. For example, current homeowners in Parcel 6 which is Cleveland Circle on Little Bear Creek have been allocated as residential access while other homeowners as in Parcels 18, 16, and 15 have

been included in the Sensitive Resource Management areas. Why?

My phone number is (number given).

Can you tell me specifically what defines the 2.3 acres in Parcel 18 on Little Bear Creek a Sensitive Resource Management Area? Why was my land included in the 2.3 acres in Parcel 18 Sensitive Resource Management Area instead of being grandfathered in and designated as residential access since my home has been on this site for over 10 years? Please confirm that the 24.7 acres in Parcel 30 on Little Bear Creek allocated as Residential Access will be eligible for our 26A permit for a boat dock or fishing pier. Please confirm that the 1,843.5 acres in Zone 3 Sensitive Resource Management Area on Little Bear Creek will not be eligible for a 26A Permit or have any future development including boat docks or fishing piers.

BCDA currently has signs posted in several different areas on Little Bear Creek that warn boaters to slow down due to underwater stumps. These signs have not been maintained; that is, painted, kept visible by cutting back the foliage, etc.. Will TVA keep these signs posted and maintain them as well as enforce the boater's speed with tickets? Also, since shoreline erosion seems to be TVA's major concern, will no wake signs be posted in the sloughs to help prevent the erosion?

Will TVA marine police or BCDA personnel police the Bear Creek lakes? Since septic tanks surrounding project reservoirs may pose the most significant problem pertaining to accumulative impact to groundwater, why are TVA and BCDA planning for future residential development on BCDA property surrounding the lakes? Since waste treatment facilities on back-lying lots can cause pollution either in the form of excessive nutrient loading or fecal coliform bacteria if they are not properly constructed and maintained, will the Franklin Health Department and adjacent health departments inspect all waste treatment facilities residential before issuing a permit and will the requirements be stricter for property adjacent to TVA land than formal requirements?

The following response was mailed May 30 to Ms. Thorpe:
"...current homeowners in Parcel 6 which is Cleveland Circle on Little Bear Creek have been allocated as residential access while other homeowners as in 18, 16, and 15 have been included in the Sensitive Resource Management areas. Why?"

Response: Parcels 18, 16, and 15 were allocated to Sensitive Resource Management category because of the presence of sensitive plant and/or animal resources, historic or prehistoric archaeological resources, and/or significant visual areas. These resources were not observed on Parcel 6. (Subsequent to this response, Parcel 16 was reallocated to Zone 7-Residential Access due to the presence of five or more BCDA-permitted water-use facilities. Sensitive resources will be managed according to the Shoreline Categorization as provided for in the Shoreline Management Policy Record of Decision.)

"Can you tell me specifically what defines the 2.3 acres in Parcel 18 on Little Bear Creek a Sensitive Resource Management Area?"

Response: Sensitive plant and archaeological resources were observed on this parcel.

"Why was my land included in the 2.3 acres in Parcel 18 Sensitive Resource Management Area instead of being grandfathered in and designated as residential access since my home has been on this site for over 10 years?"

Response: The 2.3 acres does not include your land. This is public land titled to the U.S. Government. Existing private docks on this parcel which were permitted by BCDA have been grandfathered. TVA is required by law to protect the sensitive resources in this area.

"Please confirm that the 24.7 acres in Parcel 30 on Little Bear Creek allocated as residential access will be eligible for our 26a permit for a boat dock or fishing pier."

Response: If Parcel 30 remains in a Zone 7, Residential Access category, and if BCDA decides to develop the back-lying parcel in the future, TVA will consider requests for water-use facilities, subject to environmental review and 26a and Shoreline Management Zone regulations.

"Please confirm that the 1,843.5 acres in Zone 3 Sensitive Resource Management Area on Little Bear Creek will not be eligible for a 26a permit or have any future development including boat docks or fishing piers."

Response: 816.6 acres on Little Bear Reservoir have been allocated to Zone 3, Sensitive Resource Management, in the draft Plan. While natural resource activities such as hunting, wildlife observation, and hiking may occur in this zone, the overriding management purpose is protecting the sensitive resources.

"Will TVA keep these signs (slow down due to underwater stumps) posted and maintain them as well as enforce the boater's speed with tickets? Also, since shoreline erosion seems to be TVA's major concern, will no wake signs be posted in the sloughs to help prevent the erosion? Will TVA marine police or BCDA personnel police the Bear Creek lakes?"

Response: TVA will continue to partner with BCDA and other state and federal agencies as well as other stakeholders to protect the resources of the Bear Creek Project. We are only successful if there is cooperation among the users of these resources.

"Since septic tanks surrounding project reservoirs may pose the most significant problem pertaining to accumulative impact to groundwater, why are TVA and BCDA planning for future residential development on BCDA property surrounding the lakes? Since waste treatment facilities on back-lying lots can cause pollution either in the form of excessive nutrient loading or fecal coliform bacteria if they are not properly constructed and maintained, will the Franklin Health Department and adjacent health departments inspect all waste treatment facilities residential before issuing a permit and will the requirements be stricter for property adjacent to TVA land than formal requirements?"

Response: BCDA will be required to meet National Environmental Policy Act requirements on any residential developments. This is in addition to obtaining all state *and local permits. Private developers of back-lying land must obtain appropriate state and local permits.*

As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands. Parcel 30 has been allocated to Zone 4, Natural Resource Conservation, as a result of public comment and a recommendation by the BCDA Board of Directors.

Thomas W. Murray, Spruce Pine, AL
Per instructions from Tennessee Valley Authority employees, the following will serve as my written statement regarding their proposal on the Bear Creek Lakes in Alabama.

I'm firmly against TVA offering more public land for sale to be used for residential development. I've lived on Little Bear Creek Lake for sixteen months, so I began with an unbiased perspective. I have attended four meetings and learned about the history of the lakes development and the current proposal. I've never seen a situation where a community has the amount of distrust shown for TVA. This community is made up of honest and hard working people who only want to be treated fairly. The means by which TVA acquired this land was not executed in an equitable manner, and this proposal for development is continuing this tradition of unfairness.

I've not heard one person state at these meetings that they wish TVA would sell additional property around the lakes. I have heard numerous taxpayers say they do not want more land sold. TVA personnel have given the impression at these meetings that they will carry out what the community wants. The community has said, "No." Will TVA respond to the community interest or their own interest? Please show me how the sale of additional land will be good for the community. And that's all I have.

TVA has not proposed the sale of TVA property for residential development under either alternative of this EA or the Land Use Plan. As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands.

Herschel Nix, Phil Campbell, AL
The way they've got it drawed up right now as far as the restrictions for the docks and the permits is unfair. And I feel the one that doesn't have any natural resource restrictions should be on permit, people make application and then have them come out and check it or if it meets their criteria they should be allowed to build a dock.

And also they are restricting the development of Franklin County, Marion County especially because it's bringing money and stuff into the communities that need it. By doing what they're doing it is keeping it from happening.

Water-use facility requests addressed above. By balancing development of public lands and recreational use of the reservoirs, while maintaining a clean reliable source of water, TVA hopes to encourage a high level of economic activity that will benefit the entire watershed while protecting the natural resources that are valued by many stakeholders.

Edward Lawhead, Russellville, AL
I support what Mr. Nix is saying. I also think they should do the same thing on Cedar Creek Reservoir. Also, I think that the landowner should be allowed to lease the property from their land down to the water similar to what they're doing with the Bear Creek Development Authority. Bear Creek Development Authority is subdividing the property that was taken from the landowners and they' re developing it. They're selling the lots for $30-35,000 and giving the people that are buying those lots from them the use of the property all the way down to the water. And while I own property that joins the TVA property, I don't expect them to sell me their property down to the water but I would like as a landowner to pay a fee of whatever kind so that I could lease the property between my land and the water and have some ownership rights of that. And I understand that they want to protect it for the public, that's fine with me. I just think that it would be better if we had more rights being the landowner right next to the property than what we have right now.

I also agree with Mr. Nix that some of the plans that they've got where they've restricted Upper Bear like they have does impair development. I work for a local bank in Franklin County. I've been there for twenty-five years, and we are the dominant mortgage financiers for all of the Franklin County area. We're the largest independent bank in the county. We've been there since 1906 and we finance a lot of the development that's on the lakes when people are building homes. And you've got the multiple effect of dollars being spent. If somebody goes down there you've got employment. It's providing development of the lakes. It's providing employment through the contractors that are building. The electricians, plumbers, builders are having to buy wood from the suppliers from the people that are working that have businesses in the county. You've got this tremendous multiplier effect plus you've got people that are there building on the lakes that are paying higher taxes than if the land was vacant. There's all kinds of multiple effects of these dollars that are being impeded by restricting the development. Franklin and Marion County are two of the poorest counties in Alabama like Mr. Nix was saying, and I think too much restriction on the lakes is detrimental. Where I agree with TVA's idea that we need to protect the environment, I also agree with Mr. Nix that the landowners down there are very responsible for the most part. They do more to protect the environment. Anything could happen if it was just vacant property. If you see a landowner there that is not protecting the environment then they need to take action against them like they would anyone else.

Water-use facility requests and reasons for not changing the zoning of specific sites are discussed above. By balancing development of public lands and recreational use of the reservoirs, while maintaining a clean reliable source of water, TVA hopes to encourage a high level of economic activity that will benefit the entire watershed while protecting the natural resources that are valued by many stakeholders.

Herschel Nix, Phil Campbell, AL
I would like to add something. Parcel 57, 58, and 59 should be residential. And I really don't understand how you can make a residential area a part of the lake where there's no docks and no houses, so somebody needs to really understand that one when they go to developing and go to their community meetings on Upper Bear.

Parcel 58 has been expanded to reflect back-lying existing subdivision boundaries. It has been changed to Zone 7-Residential Access to reflect the five BCDA-permitted water-use facilities present. As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands.

Edward Lawhead, Russellville, AL
I'm fortunate enough to be in a residential area and I don't have a dock. But there's two docks, one on either side of my property. I don't need a dock to tie a boat up. I just want a place to put my boat so I can get off on my property. So, I'm in a fortunate area where I don't have the problem that some of the landowners have, but I see where the residential should be expanded on Upper Bear in my opinion.

Water-use facility requests addressed above. Reasons for not changing the zoning of specific sites are discussed above.

Herschel Nix, Phil Campbell, AL
I wouldn't have been here, I wouldn't have been in Alabama, I wouldn't have been in Franklin County, if I hadn't been able to build on the lakes because I retired from Michigan and that's why I came back because we felt we found a great place to build a home and to relax and live on the lake.

Edward Lawhead, Russellville, AL
And you've got the same situation with him, he's got his house on the lake, I don't. I've got an option to buy the house next door to my lot and I'm trying to do this for my sons and my grandchildren just like Mr. Nix is. He has land that he was hoping that his sons or his grandchildren would build on next to where his house is, so we're talking about the future of Franklin County right now and not just something that's happening on May the 9th. It's affecting a lot of people, a lot of families, and lot of future build up and growth for the county. I thank them for coming and building the lakes in the first place. I am from the south side of Chicago. If you see trees like you have in Alabama you have to go to a forest preserve, so I'm all behind the conservation that TVA asks, but at the same time, I think we need to develop it too. But I really appreciate them building the lakes. And sometimes I forget to say thank you.

TVA intends to work with landowners with grandfathered water-use facilities in areas where no additional facilities will be permitted. Within existing 26a permitting guidelines, including environmental reviews, TVA will encourage the expansion of existing piers to accommodate adjacent landowners. TVA will also work with BCDA to provide public boat slips in existing recreation areas during the summer recreation season.

Keith Grissom, Spruce Pine, AL
What I done, I acquired some land on Cedar Creek Lake and I began this process in 1995 with a third-party swap, Champion Paper Company. And this process took, really probably, it went on into '96 which I met with BCDA several times during that period to make sure that I was doing the proper things and everything right. It went on until, probably, in December of '96 I got a letter of intent from Champion which is a paper really stating that all parties has come together and agreed, the three parties, that the figures and all is okay. So, at that time I went back to BCDA, met with them, making sure, I said, now, I do not want to have the amount of money that I'm going to have tied up in this property unless I can get pier permits for this parcel of land. And at that time the man of BCDA he said, "Well give me a couple of weeks, and I will call you." So, I left him my number. And in ten days, two weeks, he gave me a phone call and asked him to come to his office and I did. And when I got there he said, I mean, he had a map actually and he told me that it was okay for pier permits from a certain point here, which is I don't know the exact place, and he said that was okay. I originally asked for pier permits around this point, but he told me that that would be protruding out into the main channel body of water and it was a fish habitat over on this side and he wouldn't let me have pier permits for there and I said, "Well, that's fine." What he agreed to. That's fine. He gave me a document stating, you know, a signed document stating where I could have a pier permit on Cedar Creek Lake. Now, that would have been in probably December of '96. So, I went back and signed a letter of intent with Champion, sent it in. They started the process on getting the deeds prepared. We signed the deeds in March of '97. And at that time, I had a place over on Cedar in another area. So, it rocked on and in November of '97 I sold the place that I had which I had a pier on it but I sold it to build me a place over on this other property. So, during that time this TVA thing come up and all of it. Of course, my property that I've got is marked Parcel 4 which is marked natural resource reservation. So, that's kindly at the point that I'm at now is I want to talk to somebody. I've talked to Jim here.

See response to Keith Grissom above.

Herschel Nix
I bought 7 acres of land next to my house and it's on a lake. And I talked to Sibley which at that time worked for BCDA about getting permits and he said there shouldn't be any problem. We'd have to go through the application period just like we did with the rest of them and we should be able to get docks for them. When my kids retire that's what I bought the land for, so they could come down and retire and build a house. And I was told that needs to be part of the record. They said anything that BCDA has told us, I didn't realize to tell you I have nothing in writing, just his word that I could do that.

Reasons for not changing the zoning of specific sites are discussed above. TVA intends to work with landowners with grandfathered water-use facilities in areas where no additional facilities will be permitted. Within existing 26a permitting guidelines, including environmental reviews, TVA will encourage the expansion of existing piers to accommodate adjacent landowners. TVA will also work with BCDA to provide public boat slips in existing recreation areas during the summer recreation season.

Chris Williams, Phil Campbell, AL
I live adjacent to Parcel 57. I have a house and a dock. And my concern is that it was zoned 3 which is Sensitive Resource Management, I think, and everything I read from that is that I'm not going to have the same rights that the area is doing zoned Residential. And what I would like to have is my house and the area in front of my house zoned is Residential. What that means to me is no gazebo which is something that BCDA told me that there would be no problem with building. No improvements to the dock, and also different land use practices. I don't have in writing that BCDA told me that they would allow me to have a gazebo, but the fellow that ran BCDA is still alive and I'm sure he'll remember the conversation. And I think we would be backtracking on previous policy if we change and zone it Residential even since I've got a house and dock. there. The other thing is I have another lot adjacent to my house that is not zoned Residential. It's also zoned 3 for Sensitive Resource, and I would not be able to have any access permit or anything for that lot of which I was already told by BCDA that I would be able to get a dock permit, gazebo, and everything for that lot. And now I'm being told that it's not going to be allowed. So, I also want that one changed to Residential. Also, I would like for everybody at TVA to know that there's a lot of property owners that didn't get zoned Residential, and we're all willing to stick together and ride this through until we can get some changes made. Thank you.

Reasons for not changing the zoning of specific sites are discussed above.

James O. Powell, M. D., Birmingham, AL
Your efforts to conserve the water quality and ensure a healthy shoreline environment of the Bear Creek Lakes are commendable. I am all for it!

I have a house on Little Bear Creek Lane Zone 15, 16, 18 on your map. It is in the oldest residential area on the lake. Two of the houses (Don and Louie Ezzell's) predate the lake by many years. The other few houses were built in the late '70s or early '80s. Your designating our area as a Sensitive Resource Management one does not bother me. However, why allow BCDA to develop a residential area? Also what about Horace Cleveland? I understand he owns some 55 lots on Little Bear Creek Lake. He has already sold about half of them. His only interest in the lake is how much money he can make selling lots. Every time he sells a lot, and someone builds a house, two or three bad things happen. First, they cut trees which increases erosion. Second, they install a septic tank which pollutes the lake. Finally, they cause noise pollution with their boats and/or wave runners. Speaking of wave runners, I wish TVA would outlaw the damn things on the Bear Creek Lakes.

As to what you mean by Sensitive Resource Management, I have heard all sorts of rumors. On page 13 of your booklet, Bear Creek Reservoirs Land Management Plan, you state it means protection from further development. It so happens that I own a lot adjacent to my house (Little Bear Creek Zone 15, 16, 18). I have no plans to sell it in the near future, but someday I may wish to do so. Should I sell, the buyer would likely build a house. If so, it follows that said buyer would wish to build a pier. That would be possible I assume, since those presently buying lots from Horace Cleveland are building houses, piers, gazebos, etc., etc. Since it is likely that I have paid more taxes than he ever has, you would not treat us differently, would you?

In summary, your alternative B plan would remove about 47 miles of shoreline and 2,000 plus acres from future residential development. Good! Just go one step further and disallow all future house building, especially Horace Cleveland and BCDA's planned residential development.

Parcel 16 has been changed to Zone 7-Residential Access. The parcel will be managed according to the categorization of residential shoreline as provided in the Shoreline Management Policy Record of Decision. As discussed above, BCDA has reconsidered development of some of its property, which will likely result in a reduction of subdivision development on BCDA lands.

Mary DeLoach
We the community of Williams Hollow at Little Bear Lake which includes area 15, 16, and 18, are greatly concerned that our neighborhood has been zoned "Sensitive Resource Management" as opposed to "Residential" zoning.

Our neighborhood is the oldest established community on all of the lakes. We have been good stewards of the lakes; therefore, we expect to be granted "Residential" zoning with all the privileges afforded to all other residential zoned properties along with continual responsibility.

I recommend for the lake use on all of the lakes that landowners be allowed "Residential" zoning until there is evidence of shoreline abuse. Hope this helps. We have a house and a vacant lot on the lake. This is where we plan to retire.

You might wish to note that we are sending copies to the local congressional representatives.

Parcel 16 has been changed to Zone 7-Residential Access. The parcel will be managed according to the categorization of residential shoreline as provided in the Shoreline Management Policy Record of Decision. Water-use facility and rezoning requests addressed above.

Statements
TVA Minutes of Meeting
April 27, 2000
4:00 p.m.
Phil Campbell Community Center
Phil Campbell, Alabama

Royce Massey, Spruce Pine, AL
I'm Royce Massey. I live at Spruce Pine, Alabama, and it better known as the Nauvoo Community on the Little Bear Creek Reservoir.

My request is that I have a pier in Section 28 listed on Little Bear Creek Reservoir draft allocation map, and currently—the current location puts BCDA property or controlled area between me and the TVA property that the pier is located.

Under the current plan, it is my understanding that that pier could be grandfathered. What I'm asking or my request is that I have permission to maintain my grandfathered status and move that to area 29—actually about 500 feet would be the total distance that the pier would be moved. It would be moved in an eastwardly direction from Section 28 to Section 29 on the same side of the reservoir that it currently exists.

I'm talking to TVA representatives tonight—which is April 27, 2000, at Phil Campbell Community Center. They showed some hesitation in being able to approve this request due to Section 29 having some environmental protective—for some reason. My contention of why it should be allowed to do this and remain in a grandfathered status is that with my knowledge of Section 30—which is approved for residential access backed up by proposed residential area developed by BCDA—I just—I would like to know the specific reasons how that area could qualify for residential access and Section 29 cannot if I am denied my request.

Parcels 28 and 29 are both zoned Sensitive Resource Management. We have identified the water-use facility on Parcel 28 for grandfathering. To allow another facility on Parcel 29 where there are no existing facilities would involve clearing and development which is not compatible with Zone 3 designation.

Chris Williams, Phil Campbell, AL
I heard a lot of things in the first meeting stating that people that had dock permits were going to be grandfathered and have residential access to the lake, and I'm still hearing those things now, but on the new map people that had docks—including myself which is Parcel 58 {sic}—in a lot of cases those areas were not zoned as Residential Access. They were zoned as Conservative Resources and other things, but I'm being told at this meeting that that will be treated the same as Residential Access, because we were grandfathered. But what I need to see is something in writing or something on the map that zones my area as Residential Access or something in writing that says because I was grandfathered that I will have residential access, and I have yet to see anything like that. And I want to make sure that my land use practices are the same as those other people that have been grandfathered that the map shows them as Residential Access. And that's what is

important to me and a lot of other folks that are here at this meeting. Thank you.

Reasons for not changing the zoning of specific sites are discussed above. Pickwick watershed staff members are working with holders of BCDA water-use facility permits to put in place the proper documentation for "grandfathering." There are over 180 permits to be processed, and permit holders are asked to be patient.

COPY OF LETTER FROM ALABAMA HISTORICAL COMMISSION, WITH THE FOLLOWING RESPONSE:

Any required Phase II testing, as well as archaeological monitoring, will be coordinated in accordance with the provisions of the Programmatic Agreement, as finalized with the Alabama Historical Commission.

COPY OF LETTER FROM CORPS OF ENGINEERS; NO RESPONSE NEEDED

COPY OF LETTER FROM USFWS; NO RESPONSE NEEDED

APPENDIX B – PLANNING TEAM MEMBERS

Allsbrooks, Donald, Pickwick Watershed Team, Regional Wildlife Biologist
Cornhill, Ronnie, Pickwick Watershed Team, Regional Forester
Crosby, Buff, Pickwick Watershed Team, Manager
Gabel, Merry, Pickwick Watershed Team, Clerk
Hunt, Carolyn, Pickwick Watershed Team, Engineering Associate - Civil
Johnson, Danny, Pickwick Watershed Team Land Use Specialist
McDonald, Larry, Pickwick Watershed Team, Land Use Specialist
Murphy, Doug, Pickwick Watershed Team, Senior Field Representative
Pflueger, Richard, Pickwick Watershed Team, Regional Land Use Specialist
Shedd, Jim, Pickwick Watershed Team, Land Use Specialist
Simbeck, Damien, Pickwick Watershed Team, Biologist
Stalcup, Berry, Pickwick Watershed Team Biologist

APPENDIX C – CRITERIA FOR PARCEL RATING AND RANKING

Criteria for Recreation

Natural Resource Conservation Zone 4	Land Ownership	Aesthetics
River Corridor	H. >5 miles public land ownership M. 3-5 miles of uninterrupted public land L. <3 miles public land ownership	H. visual appeal very pleasing M. visual appeal slightly distracted L. visual appeal very poor

Natural Resource Conservation Zone 4	Land Base	Shoreline	Land Use
Informal Recreation (Recreation pursuits on undeveloped land)	H. >5 acres; <15% slope M. 2-5 acres; 15-20% slope L. <5 acres; >20% slope	H. easy access; use capability diverse M. fair access; use capability limited L. poor access and use capability	H. adjoining land use compatible M. adjoining land use questionable L. adjoining land use detracts

Recreation Zone 6	Land Base	Forestation	Shoreline	Harbor Area	Reservoir Drawdown	Location	Road Access	Outside Interest
Public Parks (Local, state, or federal parks)	H. >20 acres; 1-10% slope M. 10-20 acres; 10-15% slope L. <5 acres; >15% slope	H. >50% cover M. 25-50% cover L. <25% cover	H. <15% slope underwater; no water hazards M. 15-20% slope underwater; correctable hazards L. >20% slope underwater; prohibitive hazards	Not applicable	H. minimal visual aesthetic impact M. moderate visual aesthetic impact L. major visual aesthetic impact	H. major area of need M. may be needed L. duplicates or is questionable	H. road to the site M. road within ½ mile L. road >½ mile away	H. Use requested M. Potential exists L. Unlikely
Commercial (Campgrounds & marinas & resorts)	H. >10 acres; 1-5% slope M. 5-10 acres; 5-10% slope L. minimum 5 acres; >10% slope	H. <25% cover M. 25-50% cover L. >50% cover	H. <15% slope underwater; no water hazards M. 15-20% slope underwater; correctable hazards L. >20% slope underwater; prohibitive hazards	H. >10 acres; wind-protected M. 5-10 acres; partial protection L. <5 acres; no natural protection	H. minimal visual aesthetic impact M. moderate visual aesthetic impact L. major visual aesthetic impact	H. major area of need M. may be needed L. duplicates or is questionable	H. road to the site M. road within ½ mile L. road >½ mile away	H. Use requested M. Potential exists L. Unlikely
Water Access (Lake or river access sites)	H. >3 acres M. 1-3 acres L. <1 acre	Not applicable	H. <15% slope underwater; no water hazards M. 15-20% slope underwater; correctable hazards L. >20% slope underwater; prohibitive hazards	Not applicable	Not applicable	H. major area of need M. may be needed L duplicates or is questionable	H. road to the site M. road within ½ mile L. road >½ mile away	H. Use requested M. Potential exists L. Unlikely

Rating Categories: H. = high; M. = medium; L. = low.

Criteria for Industrial Development

Capability	Land Base	Land Slope	Shape	Height Above Water	Flooding	Barge Accessibility	Miles To Major State or Federal Highway	Miles To Railroad	Availability of Utilities	Road Access
Industrial Site	H. >100 acres M. 25 to 100 acres L. <25 acres	H. 1 to 5 percent M. 5 to 10 percent L. >10 percent	H. .fairly rectangular M. square L. irregular	H. <20 feet M. 20 to 40 feet L. >40 feet	H. majority above structure profile M. 50 percent above structure profile L. majority below structure profile	H. minor or no dredging required M. some dredging required L. major dredging required or no barge available	H. <2 M. 2 to 5 L. >5	H. <1 M. 1 to 2 L. >2	H. all utilities available M. some utilities available L. no utilities available	H. road to the site M. road within ½ mile L. road >½ mile away
Industrial Access	H. >10 acres M. 5 to 10 acres L. minimum of 5 acres	H. 1 to 5 percent M. 5 to 10 percent L. >10 percent	H. 5 to 15 percent M. 15 to 20 percent L. >20 or <5 percent	H. <20 feet M. 20 to 40 feet L. >40 feet	H. majority above structure profile M. 50 percent above structure profile L. majority below structure profile	H. minor or no dredging required M. some dredging required L. major dredging required or no barge available	H. <2 M. 2 to 5 L. >5	H. <1 M. 1 to 2 L. >2	H. all utilities available M. some utilities available L. no utilities available	H. road to the site M. road within ½ mile L. road >½ away

Rating Categories: H. = high; M. = medium; L. = low.

Criteria for Natural Resource Stewardship

Overland Access	Ecological Diversity	Habitat Management	Cost Recovery	Compatibility of Adjacent Land Use	Multiple Use Potential	Intensity of Current Use	Natural Resources Partnerships
Existing Road Network	>5 Ecological Communities Or Successional Stages	Easily Managed	High	Adjacent Land Use Would Have No Effect On Management Decisions	3 To 5 Potential Uses	N/A	N/A
Overland Access Possible	3 To 5 Ecological Communities Or Successional Stages	Could Be Managed	Medium	Adjacent Land Use Could Preclude Some Management Options	1 To 3 Potential Uses	N/A	N/A
Overland Access Unavailable	1 To 3 Ecological Communities Or Successional Stages	Difficult To Manage	Low	Adjacent Land Use Could Prevent Resource Management/Utilization	Single Use Potential	N/A	N/A
Existing Road Network	N/A	N/A	High	Adjacent Land Use Would Have No Effect On Management Decisions	3 To 5 Potential Uses	Year-round Use	N/A
Overland Access Possible	N/A	N/A	Medium	Adjacent Land Use Could Preclude Some Management Options	1 To 3 Potential Uses	2 or 3 Season Uses	N/A
Overland Access Unavailable	N/A	N/A	Low	Adjacent Land Use Could Prevent Resource Management/Utilization	Single Use Potential	<2 Season Uses	N/A
Existing Road Network	N/A	Easily Managed	High	Adjacent Land Use Would Have No Effect On Management Decisions	3 To 5 Potential Uses	N/A	2 or More Potential Partners; or 2 or More Partnerships in Place
Overland Access Possible	N/A	Could Be Managed	Medium	Adjacent Land Use Could Preclude Some Management Decisions	1 To 3 Potential Uses	N/A	1 or 2 Potential Partners or 1 or 2 Partnerships in Place
Overland Access Unavailable	N/A	Difficult To Manage	Low	Adjacent Land Use Could Prevent Resource Management/Utilization	Single Use Potential	N/A	No Potential for Partnerships; and No Partnerships in Place
>$5000	N/A	>2 Prior Investors	High	N/A	N/A	N/A	2 Or More Partners Have Invested
$0 to $5000	N/A	1 To 2 Prior Investors	Medium	N/A	N/A	N/A	1 To 2 Partners Have Invested
No Prior Investment	N/A	No Prior Investors	Low	N/A	N/A	N/A	No Prior Investments

N/A = Not Applicable

DEFINITIONS FOR NATURAL RESOURCES CAPABILITY/SUITABILITY CRITERIA

- **List of Primary Land Use/Ecological Community Types Used For Determining Level Of Diversity.**

  Managed Open Lands
  - Cropland
  - Pasture or Hay
  - Orchards/Groves/Vineyards
  - Maintained Early Successional (includes Old Field, Scrub/Shrub)

  Forest Lands*
  - Deciduous Forest
  - Evergreen (Coniferous) Forest
  - Mixed (i.e., Deciduous/Evergreen) Forest

  *Age/size class modifiers (i.e., seedling/sapling, pole, saw timber, and late successional) may be applied to better define stand development/condition.

  Wetland and Riparian Communities
  - Forested Wetlands
  - Scrub/Shrub Wetlands
  - Emergent Wetlands
  - Forested Riparian Zones

- **Multiple Use Categories**

  - Small Game Lands
  - Big Game Lands
  - Waterfowl Areas
  - Songbird Observation Areas
  - Waterfowl Observation Areas
  - Raptor Observation Areas
  - Large Mammal Observation Areas
  - Small Mammal Observation Areas
  - Amphibian/Reptile Breeding/Observation Areas
  - Forest Production Areas

- **Investment Types**

  - Forestry Research Activities
  - Wildlife Habitat Improvements
  - Wildlife Research Activities
  - Forest Management Investments/Activities
  - Present/Future Resource Value (i.e., Net Worth)

- **Potential Partnership Groups**

Educational Institutions
Nongovernmental Organizations
State Agencies
Other Federal Agencies

APPENDIX D – ALLOCATION OF COMMITTED LAND ON BEAR CREEK RESERVOIRS

Table D-1. Committed Project Lands

Parcel	Committed Land	Acres	Land Use Zone
Little Bear			
1	Dam Reservation	225.1	Zone 2, TVA Project Operations
2	Elliott Branch Public Use Area	51.6	Zone 6, Recreation
7	Sensitive Resources	11.3	Zone 3, Sensitive Resource Management
9	Sensitive Resources	16.9	Zone 3, Sensitive Resource Management
11	Sensitive Resources	15.6	Zone 3, Sensitive Resource Management
13	Sensitive Resources	271.1	Zone 3, Sensitive Resource Management
14	Williams Hollow Public Use Area	11.3	Zone 6, Recreation
19	Sensitive Resources	25.5	Zone 3, Sensitive Resource Management
21	Sensitive Resources	11.3	Zone 3, Sensitive Resource Management
25	McAfee Public Use Area	2.5	Zone 6, Recreation
29	Sensitive Resources	186.8	Zone 3, Sensitive Resource Management
32	Sensitive Resources	19.2	Zone 3, Sensitive Resource Management
34	Sensitive Resources	67.5	Zone 3, Sensitive Resource Management
		915.7	
Cedar Creek			
1	Dam Reservation	277.6	Zone 2, TVA Project Operations
3	Sensitive Resources	121.9	Zone 3, Sensitive Resource Management
11	Hellums Mill Public Use Area	8.7	Zone 6, Recreation
20 (partial)	Sensitive Resources	65.3	Zone 3, Sensitive Resource Management
21	Sensitive Resources	48.4	Zone 3, Sensitive Resource Management
22	Slickrock Public Use Area	80.3	Zone 6, Recreation
23	Slickrock Public Use Area	73.3	Zone 6, Recreation
25	Lick Creek Cove Subdivision	26.4	Zone 7, Residential Access
40	Lost Creek Public Use Area	9.7	Zone 6, Recreation
		711.6	

Upper

Table D-1. Committed Project Lands

Parcel	Committed Land	Acres	Land Use Zone
Bear			
1	Dam Reservation	192.0	Zone 2, TVA Project Operations
10	Sensitive Resources	73.8	Zone 3, Sensitive Resource Management
15	Sensitive Resources	50.9	Zone 3, Sensitive Resource Management
17	Sensitive Resources	513.4	Zone 3, Sensitive Resource Management
19	Quarter Creek Public Use Area	15.5	Zone 6, Recreation
27	Tanglewood Subdivision	1.3	Zone 7, Residential Access
31	Twin Forks Public Use Area	17.1	Zone 6, Recreation
43	Sensitive Resources	111.7	Zone 3, Sensitive Resource Management
46	Sensitive Resources	25.8	Zone 3, Sensitive Resource Management
49	Mon Dye Public Use Area	6.2	Zone 6, Recreation
50	Sensitive Resources	101.2	Zone 3, Sensitive Resource Management
53	Sensitive Resources	10.7	Zone 3, Sensitive Resource Management
54	Batestown Public Use Area	41.1	Zone 6, Recreation
56	Sensitive Resources	31.1	Zone 3, Sensitive Resource Management
60	Sensitive Resources	27.4	Zone 3, Sensitive Resource Management
		1,219.2	
Bear Creek			
1	Dam Reservation	170.4	Zone 2, TVA Project Operations
2	Piney Point Public Use Area	67.2	Zone 6, Recreation
3	Sensitive Resources	225.0	Zone 3, Sensitive Resource Management
4	Bear Creek Environmental Education Center	100.2	Zone 6, Recreation
5	Sensitive Resources	1,177.1	Zone 3, Sensitive Resource Management
6	Horseshoe Bend Public Use Area	68.8	Zone 6, Recreation
7	Sensitive Resources	486.9	Zone 3, Sensitive Resource Management
		2,295.6	

APPENDIX E – SUPPORTING TECHNICAL INFORMATION FOR THE AFFECTED ENVIRONMENT

THREATENED AND ENDANGERED SPECIES

TERRESTRIAL ECOLOGY

UNCOMMON COMMUNITIES

THREATENED AND ENDANGERED SPECIES

Table E-1. Listed Plant Species Potentially Occurring on Bear Creek Project Land Parcels, but Known From Franklin, Marion, and Winston Counties, Alabama, Based on Review of Alabama and TVA Natural Heritage Project Databases Prior to 1999 Field Survey

Common Name	Scientific Name	Federal Status	Alabama State Status
Alabama streak-sorus fern	*Thelypteris pilosa var. alabamensis*	LT	
Lyre-leaf bladderpod	*Lesquerella lyrata*	LT	
Prairie clover	*Dalea foliosa*	LE	
Yellow-eyed grass	*Xyris tennesseensis*	LE	
Alabama glade-cress	*Leavenworthia alabamica*		S2S3
Alabama larkspur	*Delphinium alabamicum*		S2
Allegheny spurge	*Pachysandra procumbens*		S2S3
Butler quillwort	*Isoetes butleri*		S2
Dwarf filmy-fern	*Trichomanes petersii*		S2
Fame-flower	*Talinum mengesii*		S2S3
Gattinger prairie clover	*Dalea gattingeri*		S3
Harper umbrella plant	*Eriogonium longifolium var. harperi*		S2
Jamesianthus	*Jamesianthus alabamensis*		S3
Limestone fame-flower	*Talinum calcaricum*		S2
Mountain camellia	*Stewartia ovata*		S2S3
Nestronia	*Nestronia umbellula*		S2
Pale umbrella-wort	*Mirabilis albida*		S2
Rock clubmoss	*Huperzia porophila*		
Riddell's Spikemoss	*Selaginella arenicola* ssp. *riddellii*		S2
Tuberous scurfpea	*Pediomelum subacaulis*		S2
Wall-rue spleenwort	*Asplenium ruta-muraria*		S2

Federal Rank:
LT: Listed Threatened
LE: Listed Endangered
State Rank:
S2 represents imperiled in the state because of rarity (6 to 20 occurrences) or because of some factor(s) making it very vulnerable to extirpation from Alabama.
S3 represents rare or uncommon in Alabama (21 to 100 occurrences).

Table E-2. State-Listed Plant Species Known From Upper Bear Creek, Little Bear Creek, and Cedar Creek Reservoir Lands, Based on 1999 Field Survey

Common Name	Scientific Name	Federal Status	Alabama State Status	Reservoir
Allegheny spurge	*Pachysandra procumbens*	-	S2S3	Little Bear, Upper Bear
Goldenseal	*Hydrastis canadensis*	-	S2	Little Bear
Gorge filmy fern	*Hymenophyllum tayloriae*	-	S1	Upper Bear
Green gentian	*Frasera caroliniensis*	-	S1S2	Little Bear
Harper's dodder	*Cuscuta harperi*	-	S2	Upper Bear
Horse-gentian	*Triosteum angustifolium*	-	S1	Little Bear
Jamesianthus	*Jamesianthus alabamensis*	-	S3	Cedar Creek
Little Mountain Meadow-rue	*Thalictrum mirabile*	-	S1	Upper Bear
Menge's Fame-flower	*Talinum mengesii*	-	S2S3	Upper Bear
Mountain camellia	*Stewartia ovata*	-	S2S3	Upper Bear
Muhly-grass	*Muhlenbergia sobolifera*	-	S1	Little Bear, Cedar Creek
Prairie trillium	*Trillium recurvatum*	-	S2	Little Bear
Riddell's Spikemoss	*Selaginella arenicola* ssp. *riddellii*	-	S2	Upper Bear
Rock clubmoss	*Huperzia porophila*	-	S1	Upper Bear
Sword moss	*Bryoxiphium norvegicum*	-	S1	Upper Bear

State Rank:
S1 represents critically imperiled in Alabama because of extreme rarity (5 or fewer occurrences) or because of some factor(s) making it especially vulnerable to extirpation from Alabama.
S2 represents imperiled in the state because of rarity (6 to 20 occurrences) or because of some factor(s) making it very vulnerable to extirpation from Alabama.
S3 represents rare or uncommon in Alabama (21 to 100 occurrences).

Species Accounts of Rare Plant Species Known From Bear Creek Project Lands

Allegheny Spurge (*Pachysandra procumbens*)
Allegheny spurge is found at four sites in the project area, three along Little Bear Creek and one in Devil's Den Branch near the headwaters of Upper Bear Creek. Relatively rare in Alabama, this species is more abundant in the northwestern portion of the state, generally favoring mature hardwood forests. Preservation of the upland forests where this species occurs would assure the continued existence of Allegheny spurge on TVA lands.

Goldenseal (*Hydrastis canadensis*)
Goldenseal, a rare species in Alabama, is known from three sites on TVA land, all of which are mature forests along Little Bear Creek Reservoir. This species is vulnerable to commercial exploitation, thus deeming it necessary to incorporate precautions for location disclosure. Several populations in nearby Bankhead National Forest have been destroyed by irresponsible plant collectors.

Goldenseal is best protected by maintaining the hardwood forest community where it occurs in natural condition. At most, this species would tolerate hand thinning of trees in its vicinity.

Gorge Filmy Fern (*Hymenophyllum tayloriae*)
A globally rare species, the gorge filmy fern is presently known from only a few sites in South Carolina and Alabama. Its distribution in Alabama is restricted to sandstone gorges in Franklin, Lawrence, Marion, and Winston Counties in the northwestern corner of the state. The two populations found during this survey occur in rockhouses along Upper Bear Creek Reservoir.

Preservation of forested bluff habitats would benefit gorge filmy fern. Logging operations pose the greatest threat through canopy removal, consequently altering the cool, humid micro-climate required by this species.

Green Gentian (*Frasera caroliniensis*)
Green gentian is a widespread species of the eastern United States extending as far south as Georgia, Alabama, Mississippi, and Louisiana. Rare in Alabama, this species is represented by 11 occurrences statewide, including one population along Little Bear Creek Reservoir in Franklin County. Sensitive to climatic conditions, green gentian grows and reproduces only when ideal precipitation and temperatures prevailed the previous growing season.

Preservation of this population can be best accomplished by maintaining current habitat conditions; a limestone-based area characterized by a partially open canopy of southern hardwoods and eastern red cedar. Although selective timber harvesting may be beneficial in some circumstances, it may also promote competition from undesirable weedy species.

Harper's Dodder (*Cuscuta harperi*)
Harper's dodder is confined to sandstone or granite outcrops in Alabama and Georgia. Four new occurrences were found during the 1999 survey, two of which are county records for Franklin and Winston Counties. Of the subject reservoirs, Harper's dodder is known from only the Upper Bear Creek Reservoir where it inhabits open sandstone glades along the shoreline. This species, as with all species of *Cuscuta*, is parasitic on other plants. Host species are few and they, in turn, have specialized habitat preferences.

Conservation of this globally imperiled species depends on maintaining the integrity of the glade habitat in which it occurs. Such areas are often used for informal camping and picnicking, thus subjecting the plants to trampling.

Horse-gentian (*Triosteum angustifolium*)
Horse-gentian inhabits limestone-based soils in mixed forests with partially open canopies of oaks, hickories, beech, and tulip tree. One population occurs on a gentle, north-facing slope along Little Bear Creek.

Management recommendations for this species are similar to that of other woodland species; selective timber harvesting may be beneficial, but only if done carefully. Excessive timber removal would encourage the establishment of undesirable weedy species.

Jamesianthus (*Jamesianthus alabamenisis*)
Jamesianthus is a member of the sunflower family (*Asteraceae*) that inhabits moist soil along forested streambanks. Restricted to northern Alabama and one county in Georgia, this species is known from several locations in Colbert, Franklin, and Winston Counties. One population is currently known from the project lands, a site discovered by Scott Gunn in 1992 along Tollison Creek in the Cedar Creek Reservoir.

The management of jamesianthus is best accomplished by preserving the streamside habitat where it occurs. Streamside canopy removal would be detrimental by promoting erosion and encouraging the encroachment of weedy vegetation.

Little Mountain Meadow-Rue (*Thalictrum mirabile*)
A globally rare species, this plant has highly specific habitat preferences, favoring cool, moist, often wet, shaded conditions of rockhouses, sandstone bluffs, and rocky crevices. Its presence in Alabama is centered in the remote forested ravines in the northwestern corner of the state, a habitat characterized by a prominence of hemlock and various hardwoods. Only three populations were known for the state prior to the 1999 field studies. Four populations are now known from Upper Bear Creek Reservoir.

Extremely sensitive to hydrologic alterations and increased light intensity, the best management policy for little mountain meadow-rue is preservation of the habitat where it occurs. Canopy removal would be detrimental by increasing temperatures, wind, and light that ultimately dry the thin soils required for its long-term survival.

Menge's Fame-Flower (*Talinum mengesii*)
Menge's fame-flower is a narrowly distributed species inhabiting sandstone glades in Alabama, Georgia, and Tennessee. In Alabama, the species is locally abundant, sometimes forming spectacular displays. Seven populations occur on project lands, all of which occur along Upper Bear Creek Reservoir.

Preservation of this species is best accomplished by preventing the degradation of its glade habitat from informal camping and picnicking.

Mountain Camellia (*Stewartia ovata*)
Mountain camellia is a rare species of the southern Appalachians ranging from southern Kentucky and Virginia south into northern Alabama and Georgia. In Alabama, it occurs along slopes, generally under a mixed canopy of hemlock, pine, and various hardwoods. Although more frequent in the northwestern section of the state, during this study this species was observed only along Upper Bear Creek Reservoir where it inhabits sandstone-based soils. Six populations occur on the project lands.

The preservation of the canopy under which this species occurs is essential for its continued existence. As the species possesses horticultural significance, protection from irresponsible plant collectors is warranted.

Muhly-Grass (*Muhlenbergia sobolifera*)
Extremely rare in Alabama, this species was discovered at two sites in the project area, one along a series of limestone bluffs overlooking Cedar Creek Reservoir and the other in similar habitat along Little Bear Creek Reservoir. This species has been reported only twice before in Alabama.

It is recommended that the associated forest canopy remain intact to preserve these populations. Canopy removal may promote soil drying and the invasion of undesirable species, thus leading to the loss of these populations.

Prairie Trillium (*Trillium recurvatum*)
A species of rich forests, this plant occurs at one site on project lands in an area of high limestone ledges along the uppermost limits of Little Bear Creek. Prairie trillium is a relatively common species in the northwest, but becomes rare in Alabama where only nine occurrences are known.

This species would tolerate only hand thinning of trees in its vicinity, and only if done in ways that minimize soil disturbance. Because prairie trillium is of horticultural interest, it should be protected from commercial exploitation by herb harvesters.

Riddell's Spikemoss (*Selaginella arenicola* ssp. *riddellii*)
Riddell's spikemoss is a rare upland species associated with open granite and sandstone outcrops; its range is from Georgia to Oklahoma and Texas. On TVA lands, the species frequently inhabits sandstone glades along the Upper Bear Creek Reservoir.

All locations for this species along Upper Bear Creek have been subjected to trampling associated with informal camping and picnicking. In some instances, these activities have resulted in the destruction of portions of these populations.

Protection for these populations would include restricting these recreational activities at these sites.

Rock Clubmoss (*Huperzia porophila*)
Rock clubmoss is a low-growing plant that generally inhabits cool, shaded sandstone ledges. Only one occurrence was documented from TVA lands during the course of the 1999 study. This small population grows on a series of high bluffs along the south side of Turkey Creek on Upper Bear Creek Reservoir. Although not common in Alabama, this species becomes more abundant further north in the Appalachians.

Management of rock clubmoss is best achieved by preserving the forested bluff system where the species occurs. Care should be exercised to assure that the canopy remains intact. Canopy removal would jeopardize the survival of this species by causing the soil to dry as the soil temperatures increase.

Sword Moss (*Bryoxiphium norvegicum*)
Sword moss is an inconspicuous bryophyte inhabiting moist, shaded sandstone walls of rockhouses and the undersides of cliffs. Discerning this species from associated mosses is extremely difficult because of its nondescript features and small size. On project lands, this species is known only from two rockhouse areas along the Upper Bear Reservoir in Franklin County. One additional record is documented from Alabama, also in Franklin County. Because of its small size, this species is likely overlooked, and with subsequent surveys, more occurrences might be discovered.

The long-term preservation of this plant is dependent upon maintaining the cool, humid atmosphere of rockhouses and shaded cliffs, its preferred habitat. Timber harvesting poses the greatest threat to the survival of this species. Thinning or removal of the forest canopy promotes soil drying and increases air temperatures in these habitats.

Table E-3. Rare Terrestrial Animals Known From or Potentially Occurring in Franklin, Marion, and Winston Counties in Alabama, Based on Heritage Program Records and Literature Surveys

Common Name	Scientific Name	Federal Status	Alabama State Status
Mammals			
Gray Bat	*Myotis grisescens*	Endangered	Protected
Indiana Bat	*Myotis sodalis*	Endangered	Protected
Long-tailed Weasel	*Mustela frenata*	-	Protected
Northern Myotis	*Myotis septentrionalis*	-	No Status*
Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*	-	Protected
Southeastern Myotis	*Myotis austroriparius*	-	Protected
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	Protected
Barn Owl	*Tyto alba*	-	No Status
Bewick's Wren	*Thryomanes bewickii*	-	Protected
Common Raven	*Corvus corax*	-	Extirpated
Cooper's Hawk	*Accipiter cooperii*	-	Protected
Osprey	*Pandion haliaetus*	-	Protected
Red-cockaded Woodpecker	*Picoides borealis*	Endangered	Protected
Reptiles			
Alligator Snapping Turtle	*Macroclemys temminckii*	-	Protected
Eastern Coachwhip	*Masticophis flagellum*	-	Protected
Coal Skink	*Eumeces anthracinus*	-	No Status
Flattened Musk Turtle	*Sternotherus depressus*	Threatened	Protected
Northern Pine Snake	*Pituophis melanoleucus melanoleucus*	-	No Status
Red Milk Snake	*Lampropeltis triangulum syspila*	-	No Status
Amphibians			
Black Warrior Waterdog	*Necturus alabamensis*	-	No Status
Eastern Hellbender	*Cryptobranchus alleganiensis*	-	Protected
Four-toed Salamander	*Hemidactylium scutatum*	-	No Status
Green Salamander	*Aneides aeneus*	-	Protected
Seepage Salamander	*Desmognathus aeneus*	-	No Status
Smallmouth Salamander	*Ambystoma texanum*	-	No Status

*No status indicates that these species are not formally listed by the state of Alabama. However, these species are considered rare or uncommon by the ALNHP.

Protected Terrestrial Animal Species Documented on Bear Creek Project Lands During 1999 Field Survey

Gray bat (*Myotis grisescens*)
Federal-endangered gray bats are a colonial species of bat that forages almost exclusively over lakes, rivers, and streams (Henry, 1998). Gray bats are restricted to limestone regions primarily throughout the southeastern United States. Relatively large populations of gray bats exist along the Tennessee River throughout North Alabama. TVA and ALNHP biologists captured a foraging gray bat at Parcel 45 on Upper Bear Creek Reservoir. This parcel consists of a heavily forested hardwood/hemlock forest and contains an extensive riparian corridor. Gray bat habitat of similar quality exists on portions of Parcels 17, 42, and 50 on Upper Bear Creek Reservoir; Parcel 30 on Cedar Creek Reservoir; and Parcel 13 on Little Bear Creek Reservoir. Gray bats were not previously known from the Bear Creek Reservoirs.

Gray bats roost only in caves and feed primarily along riparian corridors. Placing 200-foot buffer zones around cave openings and improving water quality by reducing sedimentation would benefit this species.

Bald Eagle (*Haliaeetus leucocephalus*)
Bald eagles have attempted to nest on Little Bear Creek for several years. One confirmed nest was located on Parcel 34; however, eagles have never successfully raised young at this site. Bald eagles are routinely sighted on nearby Cedar Creek Reservoir during winter and summer months; however, no evidence of nesting has been observed. Suitable bald eagle nesting and foraging habitat is abundant on all four Bear Creek Reservoirs.

Bald eagles normally nest in heavily forested areas; they also regularly perch on snags adjacent to water when foraging. Protecting large forested parcels and flooded, standing timber, such as the timber found in coves on Cedar Creek Reservoir, would benefit bald eagles.

Osprey (*Pandion haliaetus*)
Osprey are regularly sighted on all Bear Creek Reservoirs. This large, fish-eating bird nests in large exposed snags on Cedar Creek Reservoir. Active nests are located in flooded, standing timber offshore of Parcels 20 and 49. Protecting flooded, standing timber would benefit osprey.

Green Salamanders (*Aneides aeneus*)
Green salamanders are highly specialized salamanders that live in very narrow crevices found with forested sandstone bluffs. Sandstone bluffs are uncommon in northwest Alabama; most are restricted to portions of the Bankhead National Forest and Lewis Smith Lake. However, this habitat occurs extensively on Upper Bear Creek Reservoir. Biologists from the ALNHP found extensive populations of green salamanders on Parcels 21, 23, 24, 39, 42, 44, 45, 46, and 48. These populations are of regional significance due to the absence of this habitat on Cedar

Creek and Little Bear Creek Reservoirs and rarity of these habitats in northwest Alabama. Sandstone bluffs on Upper Bear Creek are near the westernmost extent of the plateau forest and woodland sandstone bluffs, which are indicative of more mountainous regions located in eastern Alabama, Tennessee, and western Georgia. Removal of timber along these forested sandstone bluffs would negatively affect green salamander populations on Upper Bear Creek.

Northern Myotis (*Myotis septentrionalis*)
This small species of bat is considered rare in Alabama. This species is usually found in mature forests. Few records of northern myotis are known from northern Alabama. One specimen was reported from a cave on Parcel 1 on Little Bear Creek Reservoir. Several northern myotis were captured in addition to a federal-endangered gray bat at Parcel 45 on Upper Bear Creek. Removal of large hollow trees and snags would negatively affect this species.

Barn Owl (*Tyto alba*)
Barn owls are considered rare or uncommon in north Alabama. Barn owls typically nest in old, man-made structures, hollow trees, and cave openings. In north Alabama, barn owls frequently nest in small caves located in forested bluffs along rivers or reservoirs. Populations of barn owls are reported to be declining in some parts of the country. The exact cause of these declines is not known but is suspected to be associated with changes in agriculture (Marti, 1992). An active barn owl nest was observed in a sandstone bluff on Parcel 57 on Upper Bear Creek. Three juveniles and one adult were observed in June 1999. Similar habitat is located throughout portions of Upper Bear Creek Reservoir. The placement of a 200-foot buffer zone around known barn owl nests and the protection of forested bluff habitats would benefit barn owls.

Table E-4. Master List of All Species of Plants Observed From Parcel Surveys on Little Bear Creek, Upper Bear Creek, and Cedar Creek Reservoirs, 1999

Allegheny spurge	*Pachysandra procumbens*
Alumroot	*Huechera parviflora*
American Beech	*Fagus grandifolia*
American Chestnut	*Castanea dentata*
American Elm	*Ulmus americana*
American Ginseng	*Panax quinquefolius*
American Holly	*Ilex opaca*
Appalachian Bristle-fern	*Trichomanes boschianum*
Appalachian Groundsel	*Senecio anonymus*
Appalachian Milkwort	*Polygala curtissi*
Ash	*Fraxinus pensylvanica*
Aster	*Aster paludosus*
Baneberry	*Actaea pachypoda*
Basswood	*Tilia americana*
Basswood	*Tilia heterophylla*
Bellwort	*Uvularia perfoliata*
Bellwort	*Uvularia sessilifolia*
Big Leaf Magnolia	*Magnolia macrophylla*
Bigleaf Snowbell	*Styrax grandifolia*
Bitternut-hickory	*Carya cordiformis*
Black Cherry	*Prunus serotina*
Black Oak	*Quercus velutina*
Black Walnut	*Juglans nigra*
Black Willow	*Salix nigra*
Blackberry spp.	*Rubus spp*
Blackgum	*Nyssa sylvatica*
Bladder-nut	*Staphylea trifolia*
Boxelder	*Acer negundo*
Bristle-fern	*Trichomanes imbricarium*
Broad-leaved Toothwort	*Cardamine diphylla*
Buttonbush	*Cephalanthus occidentalis*
Cardinal Flower	*Lobelia cardinalis*
Carolina Buckthorn	*Rhamnus caroliniana*
Cherrybark Oak	*Quercus pagoda*
Christmas Fern	*Polystichum acrostichoides*
Cliff-brake	*Pellaea atropurpurea*
Climbing Hydrangea	*Decumaria barbara*
Common Cattail	*Typha latifolia*
Common Ground-nut	*Apios americana*
Cottonwood	*Populus deltoides*
Cross-vine	*Bignonia capreolata*
Crotonopsis	*Crotonopsis elliptica*
Cucumber Tree	*Magnolia acuminata*
Cuthbert's Wild Onion	*Allium cuthbertii*
Deerberry	*Vaccinium stamineum*
Dodder	*Cuscuta* sp.
Downy Oatgrass	*Danthonia sericea*
Downy Serviceberry	*Amelanchier arboreum*

Table E-4. Master List of All Species of Plants Observed From Parcel Surveys on Little Bear Creek, Upper Bear Creek, and Cedar Creek Reservoirs, 1999

Dwarf Iris	*Iris verna*
Dwarf Larkspur	*Delphinium tricorne*
Eastern Hemlock	*Tsuga canadensis*
Eastern Hophornbeam	*Ostrya virginiana*
Eastern Prickly Pear	*Opuntia humifusa*
Eastern Red Cedar	*Juniperus virginiana*
Ebony Spleenwort	*Asplenium platyneuron*
False Nettle	*Boehmeria cylindrica*
False Solomon's Seal	*Smilacina racemosa*
False Water Pepper	*Polygonum hydropiperoides*
Flowering Dogwood	*Cornus florida*
Foam Flower	*Tiarella cordifolia*
Fog-fruit	*Phyla lanceolata*
Forestiera	*Forestiera ligustrina*
Forest-phlox	*Phlox divaricata*
Fragrant Sumac	*Rhus aromatica*
Fringe-tree	*Chionanthus virginicus*
Goldenrod	*Solidago caesia*
Goldenseal	*Hydrastis canadensis*
Gorge Filmy Fern	*Hymenophyllum tayloriae*
Grass	*Brachyelytrum erectum*
Green Gentian	*Frasera caroliniensis*
Green Violet	*Hybanthus concolor*
Hairy Tickseed	*Coreopsis pubescens*
Halberd-leaved Marsh Mallow	*Hibiscus militaris*
Harbinger of Spring	*Erigenia bulbosa*
Harper's Dodder	*Cuscuta harperi*
Hepatica	*Hepatica nobilis* var. *acuta*
Hercules' Club	*Aralia spinosa*
Hickory	*Carya* spp.
Honey locust	*Gleditsia triocanthes*
Hornbeam	*Carpinus caroliniana*
Horse-gentian	*Triosteum angustifolium*
Horse-sugar	*Symplocus tinctoria*
Hydrolea	*Hydrolea ovata*
Indian Cucumber-root	*Medeola virginiana*
Indian Pipe	*Monotropa uniflora*
Jack-in-the-pulpit	*Arisaema triphyllum*
Japanese Honeysuckle	*Lonicera japonica*
Knob-styled Dogwood	*Cornus amomum*
Lady-fern	*Athyrium felix-femina*
Large Yellow Lady-slipper	*Cypripedium calceolus* var. *pubescens*
Lesser Horse-gentian	*Trichosteum dichotomum*
Little Bluestem	*Schizachyrium scoparium*
Little Mountain Meadow-rue	*Thalictrum mirabile*
Loblolly Pine	*Pinus taeda*
Maple Leaf Viburnum	*Viburnum acerifolium*
Marsh St. John's-wort	*Triadenum virginicum*
May Apple	*Podophyllum peltatum*

Table E-4. Master List of All Species of Plants Observed From Parcel Surveys on Little Bear Creek, Upper Bear Creek, and Cedar Creek Reservoirs, 1999

Meadow-rue	*Thalictrum thalictroides*
Meadow-spikemoss	*Selaginella apoda*
Melic Grass	*Melica mutica*
Menge's Fame-flower	*Talinum mengesii*
Mockernut Hickory	*Carya tomentosa*
Moss	*Atrichum* sp.
Mountain Camellia	*Stewartia ovata*
Mountain Laurel	*Kalmia latifolia*
Mountain Spleenwort	*Asplenium montanum*
Muehlenberg Oak	*Quercus muehlenbergii*
Muhly-grass	*Muhlenbergia sobolifera*
Muscadine-grape	*Vitis rotundifolia*
Naked Tick-trefoil	*Desmodium nudiflorum*
Northern Red Oak	*Quercus rubra*
Oak-leaf Hydrangea	*Hydrangea quercifolia*
Oaks	*Quercus* spp.
Old Field Five-fingers	*Potentilla simplex*
Orange Touch-me-not	*Impatiens capensis*
Orange-grass	*Hypericum gentianoides*
Panic-grass	*Dichanthelium boscii*
Partridge Berry	*Mitchella repens*
Pawpaw	*Asimina triloba*
Pennywort	*Obolaria virginica*
Persimmon	*Diospyros virginiana*
Piedmont-azalea	*Rhododendron canescens*
Pignut Hickory	*Carya glabra*
Pinkroot	*Spigelia marilandica*
Poison ivy	*Toxicodendron radicans*
Possum-haw	*Ilex decidua*
Post Oak	*Quercus stellata*
Prairie Trillium	*Trillium recurvatum*
Privet	*Ligustrum sinense*
Rattlesnake Plantain	*Goodyera pubescens*
Red Buckeye	*Aesculus pavia*
Red Maple	*Acer rubrum*
Redbud	*Cercis canadensis*
Rice Cut-grass	*Leersia oryzoides*
Riddell's Spikemoss	*Selaginella arenicola* ssp. *riddellii*
Rock Chestnut Oak	*Quercus prinus*
Rock Clubmoss	*Huperzia porophila*
Sassafras	*Sassafras albidum*
Scarlet Oak	*Quercus coccinea*
Scrub Pine	*Pinus virginiana*
Sedge	*Carex cephalophora*
Sedge	*Carex crinita*
Sedge	*Carex lurida*
Sedge	*Carex picta*
Sedge	*Carex willdenowii*
September Elm	*Ulmus serotina*

Table E-4. Master List of All Species of Plants Observed From Parcel Surveys on Little Bear Creek, Upper Bear Creek, and Cedar Creek Reservoirs, 1999

Shagbark Hickory	*Carya ovata*
Shellbark-hickory	*Carya laciniosa*
Shoestring Fern	*Vittaria appalachiana*
Shortleaf Pine	*Pinus echinata*
Shumard Oak	*Quercus shumardii*
Slippery Elm	*Ulmus rubra*
Small-headed Blazing Star	*Liatris microcephala*
Smooth Alder	*Alnus serrulata*
Soft Rush	*Juncus effusus*
Sourwood	*Oxydendrum arboreum*
Southern Black Haw	*Viburnum rufidulum*
Southern Buckthorn	*Bumelia lycioides*
Southern Hackberry	*Celtis laevigata*
Southern Maidenhair Fern	*Adiantum pedatum*
Southern Red Oak	*Quercus falcata*
Southern Shagbark Hickory	*Carya carolinae-septentrionalis*
Southern Stoneseed	*Lithospermum tuberosum*
Southern Sugar Maple	*Acer barbatum*
Sparkleberry	*Vaccinium arboreum*
Spice-bush	*Lindera benzoin*
Spotted Wintergreen	*Chimphila maculata*
Spreading Chervil	*Chaerophyllum procumbens*
Spreading Jacob's Ladder	*Polemonium reptans*
St. Andrew's Cross	*Hypericum hypericoides*
St. John's-wort	*Hypericum frondosum*
Sugar Cane	*Erianthus giganteus*
Sweet Betsy	*Trillium cuneatum*
Sweet Gum	*Liquidambar styraciflua*
Sword Moss	*Bryoxiphium norvegicum*
Sycamore	*Platanus occidentalis*
Tick-trefoil	*Desmodium glutinosum*
Tick-trefoil	*Desmodium paniculatum*
Toadflax	*Linaria canadensis*
Toothwort	*Cardamine concatenata*
Trillium	*Trillium stamineum*
Tulip Tree	*Liriodendron tulipifera*
Uruguay Seedbox	*Ludwigia uruguayensis*
Virginia Creeper	*Parthenocissus quinquefolia*
Virginia Sweetspire	*Itea virginica*
Walking Fern	*Asplenium rhizophyllum*
Walter's Viola	*Viola walteri*
Water Willow	*Justicia americana*
White Ash	*Fraxinus americana*
White Avens	*Geum canadense*
White Oak	*Quercus alba*
White Turtlehead	*Chelone glabra*
Wild Bulrush	*Scirpus georgianus*
Wild Comfrey	*Cynoglossum virginianum*
Wild Geranium	*Geranium maculatum*

Table E-4. Master List of All Species of Plants Observed From Parcel Surveys on Little Bear Creek, Upper Bear Creek, and Cedar Creek Reservoirs, 1999

Wild Ginger	*Asarum canadense*
Wild Oats	*Chasmanthium latifolium*
Wild Oats	*Chasmanthium sessiliflorum*
Wild White Violet	*Viola macloskeyi* ssp. *pallens*
Winged Elm	*Ulmus alata*
Witch-hazel	*Hammamelis virginiana*
Wool-grass	*Scirpus cyperinus*
Yellow Birch	*Betula lenta*
Yellow Jessamine	*Gelsemium sempervirens*
Yellow-root	*Xanthorhiza simplicissima*

TERRESTRIAL ECOLOGY

Table E-5. Terrestrial Wildlife Species Observed During Surveys of Cedar Creek, Upper Bear Creek, and Little Bear Creek Reservoirs, 1999

Common Name	Scientific Name	Forest Lands	Managed Open Lands (Old fields & Ag. fields)	Wetland & Riparian Communities
Mammals				
Armadillo	*Dasypus novemcinctus*	X	X	X
Beaver	*Castor canadensis*	X		X
Common Muskrat	*Ondatra zibethicus*	X		X
Coyote	*Canis latrans*	X	X	X
Eastern Chipmunk	*Tamias striatus*	X		
Eastern Cottontail	*Sylvilagus floridanus*		X	
Eastern Gray Squirrel	*Sciurus carolinensis*	X		X
Eastern Pipistrelle	*Pipistrellus subflavus*	X	X	X
Eastern Red Bat	*Lasiurus borealis*	X	X	X
Gray Bat	*Myotis grisescens*			X
Hispid Cotton Rat	*Sigmodon hispidus*	X	X	X
House Mouse	*Mus musculus*	X	X	
Least Shrew	*Cryptotis parva*		X	
Marsh Rice Rat	*Oryzomys palustris*		X	X
Northern Myotis	*Myotis septentrionalis*	X		X
Raccoon	*Procyon lotor*	X		X
Red Fox	*Vulpes vulpes*	X	X	
Southern Flying Squirrel	*Glaucomys volans*	X		X
Southern Short-tailed Shrew	*Blarina carolinensis*	X	X	X
White-footed Mouse	*Peromyscus leucopus*	X	X	X
White-tailed Deer	*Odocoileus virginianus*	X	X	X
Woodchuck	*Marmota monax*	X	X	
Woodland Vole	*Microtus pinetorum*	X		
Birds				
Acadian Flycatcher	*Empidonax virescens*	X	X	X
American Crow	*Corvus brachyrhynchos*	X		
American Redstart	*Setophaga ruticilla*	X		
Bald Eagle	*Haliaeetus leucocephalus*	X		X
Baltimore Oriole	*Icterus galbula*	X	X	
Barred Owl	*Strix varia*	X		X
Belted Kingfisher	*Ceryle alcyon*			X
Black-and-White Warbler	*Mniotilta varia*	X		
Black Vulture	*Coragyps atratus*	X		
Blue-gray Gnatcatcher	*Polioptila caerulea*	X		X
Blue Jay	*Cyanocitta cristata*	X		
Blue-winged	*Vermivora pinus*	X		

Table E-5. Terrestrial Wildlife Species Observed During Surveys of Cedar Creek, Upper Bear Creek, and Little Bear Creek Reservoirs, 1999

Common Name	Scientific Name	Forest Lands	Managed Open Lands (Old fields & Ag. fields)	Wetland & Riparian Communities
Warbler				
Broad-winged Hawk	*Buteo platypterus*	X	X	
Brown Thrasher	*Toxostoma rufum*	X	X	
Canada Goose	*Branta canadensis*			X
Carolina Chickadee	*Parus carolinensis*	X		
Carolina Wren	*Thryothorus ludovicianus*	X	X	
Chuck-will's-widow	*Caprimulgus carolinensis*	X		
Cliff Swallow	*Hirundo pyrrhonota*			X
Common Loon	*Gavia immer*			X
Common Tern	*Sterna hirundo*			X
Common Yellowthroat	*Geothlypis trichas*	X	X	
Downy Woodpecker	*Picoides pubescens*	X		
Eastern Kingbird	*Tyrannus tyrannus*		X	
Eastern Phoebe	*Sayornis phoebe*	X	X	
European Starling	*Sturnis vulgaris*		X	
Field Sparrow	*Spizella pusilla*		X	
Gray Catbird	*Dumetella carolinensis*	X	X	
Great Blue Heron	*Ardea herodias*			X
Great Crested Flycatcher	*Myiarchus crinitus*	X		
Green Heron	*Butorides striatus*			X
Indigo Bunting	*Passerina cyanea*		X	
Killdeer	*Charadrius vociferus*			X
Least Sandpiper	*Calidris minutilla*			X
Louisiana Waterthrush	*Seiurus motacilla*	X		X
Mourning Dove	*Zenaida macroura*		X	
Northern Bobwhite	*Colinus virginianus*		X	
Northern Cardinal	*Cardinalis cardinalis*	X		
Northern Flicker	*Colaptes auratus*	X		
Northern Parula Warbler	*Parula americana*	X		
Osprey	*Pandion haliaetus*			X
Ovenbird	*Seiurus aurocapillus*	X		X
Pileated Woodpecker	*Dryocopus pileatus*	X		
Pine Warbler	*Dendroica pinus*	X	X	
Prairie Warbler	*Dendroica discolor*		X	
Purple Martin	*Progne subis*		X	X
Red-bellied Woodpecker	*Melanerpes carolinus*	X		
Red-eyed Vireo	*Vireo olivaceus*	X		
Red-shouldered Hawk	*Buteo lineatus*	X	X	
Red-tailed Hawk	*Buteo jamaicensis*	X	X	
Rock Dove	*Columba livia*		X	

Table E-5. Terrestrial Wildlife Species Observed During Surveys of Cedar Creek, Upper Bear Creek, and Little Bear Creek Reservoirs, 1999

Common Name	Scientific Name	Forest Lands	Managed Open Lands (Old fields & Ag. fields)	Wetland & Riparian Communities
Eastern Towhee	*Pipilo erythrophthalmus*	X		
Scarlet Tanager	*Piranga olivacea*	X		
Spotted Sandpiper	*Actitis macularia*			X
Summer Tanager	*Piranga rubra*	X		
Tufted Titmouse	*Parus bicolor*	X		
Turkey Vulture	*Cathartes aura*	X		
White-eyed Vireo	*Vireo griseus*	X		
White-throated Sparrow	*Zonotrichia albicollis*		X	
Wild Turkey	*Meleagris gallopavo*	X	X	
Wood Duck	*Aix sponsa*	X		X
Wood Thrush	*Hylocichla mustelina*	X		
Yellow-billed Cuckoo	*Coccyzus americanus*	X		
Yellow-breasted Chat	*Icteria virens*		X	
Yellow-rumped Warbler	*Dendroica coronata*	X		
Yellow-throated Vireo	*Vireo flavifrons*	X		
Yellow-throated Warbler	*Dendroica dominica*	X		
Reptiles				
Black Racer	*Coluber constrictor*		X	
Box Turtle	*Terrapene carolina*	X	X	
Common Snapping Turtle	*Chelydrya serpentina*			X
Five-lined Skink	*Eumeces fasciatus*	X		
Green Anole	*Anolis carolinensis*	X		
Ground Skink	*Scincella lateralis*	X		
Northern Water Snake	*Nerodia sipedon*			X
Pond Slider	*Trachemys scripta*			X
Ringneck Snake	*Diadophis punctatus*	X		
Soft-shell Turtle	*Apalone* sp.			X
Timber Rattlesnake	*Crotalus horridus*	X		
Worm Snake	*Carphophis amoenus*	X		
Amphibians				
Bird-voiced Treefrog	*Hyla avivoca*			X
Bullfrog	*Rana catesbeiana*			X
Cave Salamander	*Eurycea lucifuga*	X		
Cope's Gray Treefrog	*Hyla chrysoscelis*	X		X
Cricket Frog	*Acris crepitans*		X	X
Dusky Salamander	*Desmognathus fuscus*	X		
Fowler's Toad	*Bufo woodhousei fowleri*	X	X	
Green Frog	*Rana clamitans*			X

Table E-5. Terrestrial Wildlife Species Observed During Surveys of Cedar Creek, Upper Bear Creek, and Little Bear Creek Reservoirs, 1999

Common Name	Scientific Name	Forest Lands	Managed Open Lands (Old fields & Ag. fields)	Wetland & Riparian Communities
Green Salamander	*Aneides aeneus*	X		
Long-tailed Salamander	*Eurycea longicauda*	X		
Northern Cricket Frog	*Acris c. crepitans*		X	X
Pickerel Frog	*Rana palustris*			X
Red Salamander	*Pseudotriton ruber* ssp.	X		X
Slimy Salamander	*Plethodon glutinosus*	X		X
Southern Leopard Frog	*Rana utricularia*			X
Spring Peeper	*Pseudacris crucifer*		X	X

UNCOMMON COMMUNITIES

Table E-6. Cedar, Little Bear, and Upper Bear Creek Reservoir Parcels Designated as Sensitive Resource Management Zones Due to the Presence of Uncommon Communities, Rare Plants, and Rare Animals

Reservoir	Parcel Number	Category
Cedar Creek		
	2	Flooded Timber
	3	Flooded Timber
	6	Flooded Timber
	20	Presence of State-Protected Animals and Flooded Timber
	28	Muhlenberg/Shumard Oak Forest Community
	31	Presence of Rare Plants
	37	Muhlenberg/Shumard Oak Forest Community
	38	Presence of Rare Plants and Muhlenberg/Shumard Oak Forest Community
	49	Presence of State-Protected Animals and Flooded Timber
	51	Flooded Timber
Little Bear Creek		
	1	Karst Features
	3	Flooded Timber
	8	Presence of Rare Plants and Significant White/Red Oak—Southern Shagbark Hickory Forest
	13	Flooded Timber
	15	Presence of Rare Plants and Significant White/Red Oak—Southern Shagbark Hickory Forest
	16	Presence of Rare Plants and Significant White/Red Oak—Southern Shagbark Hickory Forest
	17	Presence of Rare Plants and Significant White/Red Oak—Southern Shagbark Hickory Forest
	18	Significant White/Red Oak—Southern Shagbark Hickory Forest
	22	Significant White/Red Oak—Southern Shagbark Hickory Forest
	23	Presence of Rare Plants
	26	Presence of Rare Plants, Significant White/Red Oak—Southern Shagbark Hickory Forest and Karst Features
	34	Presence of Federal and State-Protected Animals
	*37	TVA Natural Area-Small Wild Area
Upper Bear Creek		
	10	Flooded Timber
	*11	Presence of Rare Plants and Sandstone Glades
	14	Presence of Rare Plants
	17	Presence of Rare Plants and Flooded Timber
	*18	Presence of Rare Plants and Sandstone Glades
	*20	Presence of Rare Plants, Sandstone Glades, and Forested Sandstone Bluffs
	*21	Presence of Rare Plants, State-Protected Animals,

Table E-6. Cedar, Little Bear, and Upper Bear Creek Reservoir Parcels Designated as Sensitive Resource Management Zones Due to the Presence of Uncommon Communities, Rare Plants, and Rare Animals

		Sandstone Glades, and Forested Sandstone Bluffs
	*22	Presence of State-Protected Animals, and Forested Sandstone Bluffs
	*23	Presence of Rare Plants, State-Protected Animals, Sandstone Glades, and Forested Sandstone Bluffs
	*24	State-Protected Animals, and Forested Sandstone Bluffs
	*39	Presence of Rare Plants, State-Protected Animals, and Forested Sandstone Bluffs
	*40	Presence of Rare Plants and Forested Sandstone Bluffs
	*41	Presence of Rare Plants and Forested Sandstone Bluffs
	*42	Presence of Rare Plants, State-Protected Animals, Cumberland Plateau Forest, Forested Sandstone Bluffs
	43	Cumberland Plateau Forest, Forested Sandstone Bluffs
	*44	Presence of Rare Plants, State-Protected Animals, Sandstone Glades, and Forested Sandstone Bluffs
	*45	Presence of Rare Plants, State-Protected Animals, Sandstone Glades, and Forested Sandstone Bluffs
	*46	Presence of State-Protected Animals, and Forested Sandstone Bluffs
	*47	Presence of Rare Plants and Forested Sandstone Bluffs
	*48	Presence of Rare Plants, State-Protected Animals, and Forested Sandstone Bluffs
	50	Flooded Timber
	51	Forested Sandstone Bluffs
	55	Presence of Rare Plants
	56	Flooded Timber
	57	Presence of State-Protected Animals and Exposed Sandstone Bluffs

*Indicates TVA Habitat Protection Areas.

APPENDIX F – GLOSSARY OF TERMS

100-year floodplain - the area inundated by the 1 percent annual chance (or 100-year) flood.

benthic - refers to the bottom of a stream, river, or reservoir.

chelation - a chemical process by which metal ions bind to nonmetal substances so that the metal loses certain properties (i.e., toxicity, taste); however, the ions are still available to living organisms for use as micronutrients.

cumulative impacts - impacts which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable actions, regardless of what agency or person undertakes such actions (40 CFR 1508.7).

dam reservation - lands generally maintained in a park-like setting by TVA to protect the integrity of the dam structure, hydroelectric facilities, and navigation lock. The reservation also provides for public visitor access to the TVA dam facilities and recreation opportunities, such as public boat access, bank fishing, camping, picnicking, etc.

direct impacts - effects which are caused by the action and occur at the same time and place (40 CFR 1508.4).

dissolved oxygen - the oxygen dissolved in water, necessary to sustain aquatic life. It is usually measured in milligrams per liter or ppm.

drawdown - area of reservoirs exposed between full summer pool and minimum winter pool levels during annual drawdown of the water level for flood control.

dredging - the removal of material from an underwater location, primarily for deepening harbors and waterways.

embayment - a bay or arm of the reservoir.

emergent wetland - wetlands dominated by erect, rooted herbaceous plants such as cattails and bulrush.

endangered species - any species in danger of extinction throughout all or a significant portion of its range or territory.

fecal coliform - common intestinal bacteria in human and animal waste.

floodplains - any land area susceptible to inundation by water from any source by a flood of selected frequency. For purposes of the National Flood Insurance Program, the floodplain, as a minimum, is that area subject to a 1 percent or greater chance of flooding (100-year flood) in any given year.

flowage easement tracts - non-TVA lakeshore properties where TVA has (1) the right to flood the land as part of its reservoir operations, (2) no rights for vegetation management, and (3) the authority to review plans for the construction of structures under Section 26a of the TVA Act.

fragmentation - the process of breaking up a large area of relatively uniform habitat into one or more smaller, disconnected areas.

hydrologic unit (HU) - a geographical area determined by state and subwatershed boundaries within a major river's watershed, and designated by an 11-digit hydrologic unit code (HUC).

indirect impacts - effects which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable (40 CFR 1508.4).

macroinvertebrates - aquatic insects, snails, and mussels whose species, genus, etc., can be determined with the naked eye.

mainstream reservoirs - impoundments created by dams constructed across the Tennessee River.

National Ambient Air Quality Standards - uniform, national air quality standards established by the Environmental Protection Agency that restrict ambient levels of certain pollutants to protect public health (primary standards) or public welfare (secondary standards). Standards have been set for ozone, carbon monoxide, particulates, sulfur dioxide, nitrogen dioxide, and lead.

National Environmental Policy Act (NEPA) - legislation signed into law in 1970 which, among other provisions, requires U.S. government agencies to prepare environmental reviews on proposed policies, procedures, plans, approvals, and other proposed federal actions. Approval of a private water-use facility or sale of an easement to use federal land are examples of federal actions subject to NEPA.

neotropical migrant birds - birds which nest in the United States or Canada and migrate to spend the winter in Mexico, Central America, the Caribbean, or South America.

physiographic provinces - general divisions of land with each area having characteristic combinations of soil materials and topography.

plan tract - a numbered parcel of TVA fee-owned land which, prior to the Plan, has had no long-term commitments affecting future land uses as assigned through the reservoir land planning process.

riparian zone - an area of land that has vegetation or physical characteristics reflective of permanent water influence. Typically a streamside zone or shoreline edge.

riprap - stones placed along the shoreline for bank stabilization and other purposes.

riverine - having characteristics similar to a river.

Section 26a review process - Section 26a of the TVA Act requires TVA review and approval of plans for obstructions such as docks, fills, bridges, outfalls, water intakes, and riprap before they are constructed across, in, or along the Tennessee River and its tributaries. Applications for this approval are coordinated appropriately within TVA and the U.S. Army Corps of Engineers (USACE). USACE issues a joint public notice for those applications that are not covered by a USACE nationwide, general, or regional permit. The appropriate state water pollution control agency must also certify that the effluent from outfalls meets the applicable water quality standards.

scrub-shrub - woody vegetation less than about 20 feet tall. Species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions.

shoreline - the line where the water of a TVA reservoir meets the shore when the water level is at the normal summer pool elevation.

shoreline management zone - a barrier of permanent vegetation established or left undisturbed around a reservoir in order to buffer the adverse impacts resulting from development and increased human activity.

significant cultural resources - Some of the tract descriptions state that "the tract contains significant cultural resources" or that "cultural resource considerations may affect development of the tract." However, many of the parcel descriptions contain no reference to archaeological or other cultural resources. The lack of such references within a tract description does not necessarily indicate that significant cultural resources do not exist. The use of any tract for developmental purposes may require additional archaeological testing or mitigation of adverse impact to archaeological sites. The costs of required testing or mitigation would be the responsibility of the developer.

stratification - the seasonal layering of water within a reservoir due to differences in temperature or chemical characteristics of the layers.

substrates - the base or material to which a plant is attached and from which it receives nutrients.

summer pool elevation - the normal upper level to which the reservoirs may be filled. Where storage space is available above this level, additional filling may be made as needed for flood control.

tributary reservoirs - impoundments created by dams constructed across streams and rivers that eventually flow into the Tennessee River.

turbidity - all the organic and inorganic living and nonliving materials suspended in a water column. Higher levels of turbidity affect light penetration and typically decrease productivity of water bodies.

upland - the higher parts of a region, not closely associated with streams or lakes.

wetlands - as defined in *TVA Environmental Review Procedures*, "Wetlands are those areas inundated by surface or groundwater with a frequency sufficient to support and under normal circumstances do or would support a prevalence of vegetation or aquatic life that requires saturated or seasonably saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, mud flats, and natural ponds."

ENCLOSURE 8

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 2 AND 3

RESPONSE TO DECEMBER 22, 2005, NRC ROUND 3 REQUESTS FOR ADDITIONAL INFORMATION RELATED TO TECHNICAL SPECIFICATIONS (TS) CHANGE NO. TS-418 - REQUEST FOR EXTENDED POWER UPRATE OPERATION

(NON-PROPRIETARY VERSION)

This letter provides TVA's response to the NRC Staff's request for additional information, which was submitted to TVA by letter dated December 22, 2005 (ADAMS Accession No. ML053560177), in order to support review of the BFN Units 2 and 3 Extended Power Uprate (EPU) license amendment application.

TVA submitted the BFN Units 2 and 3 EPU application to the NRC by letter dated June 25, 2004 (ML041840301). TVA supplemented that application by letters dated February 23, 2005 (ML050560337), April 25, 2005 (ML051170242) and June 6, 2005 (ML051640391). This enclosure provides TVA's responses to the NRC requests.

CVIB (EMCB-A)

<u>NRC Request EMCB-A.1</u>

a) According to the license renewal submittal for Browns Ferry Nuclear Plant (BFN), it was stated that the effective full-power years (EFPYs) of operation at the end of license (EOL) extended term is 52 EFPYs Units 2 and 3. Based on previous plant experience, the staff requests that the licensee provide the projected neutron fluence (E > 1.0 MeV) for the reactor vessel beltline materials, including the extended power uprate (EPU) conditions, for the current licensing basis term and the extended period of operation for BFN Units 2 and 3.
b) Provide the following information related to the past operating history: (a) megawatt thermal power (MWt), (b) calendar years of operation, and (c) capacity factor. In addition, the staff requests that the licensee provide the information requested in items (a) through (c) with respect to the future projected operating conditions (i.e., with consideration of the extended period of operation and the EPU conditions). Also, indicate the projected number of EFPYs with consideration of the extended period of operation and the EPU conditions.

TVA Reply to EMCB-A.1

a) Fluences were calculated for the reactor vessels for the extended 60-year (52 EFPY for Units 2 and 3) licensed operating periods, using the methodology of NEDC-32983P, "General Electric Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluation." One bounding fluence calculation was performed for Units 1, 2 and 3. Peak fluences were calculated at the vessel inner surface (inner diameter) for the purposes of evaluating Upper Shelf Energy (USE) and Adjusted Reference Temperature (ART). The value of neutron fluence was also calculated for the 1/4T location into the vessel wall measured radially from the inside diameter using Equation 3 from Paragraph 1.1 of Regulatory Guide 1.99, Revision 2. This 1/4T depth is recommended in the ASME Boiler and Pressure Vessel Code Section XI, Appendix G Sub-article G-2120 as the maximum postulated defect depth.

Since BFN did not plan to implement EPU prior to approval of License Renewal, the requested fluence, including EPU, for the current licensing basis term is not available. Per 4.2.5 of BFN's UFSAR, "… Using assumptions of plant operation at 3440 Mw(t), 100 percent plant availability, and 40-year plant life, the neutron fluence at the inner surface of the vessel was calculated to be 3.8 X 10^{17} nvt for neutrons having energies greater than 1 MeV. The results of the analyses of the vessel wall neutron dosimeters which were removed from the BFN reactor vessels at the end of the first core cycle indicated that the neutron fluence at the inner surfaces of the vessels at the end of 40-year plant life would be 1.56 x 10^{18}, 1.34 x 10^{18}, and 1.31 x 10^{18} nvt for Units 1, 2, and 3, respectively. …"

The following excerpt from the table from BFN's License Renewal Application provides the fluence values, including EPU, for the extended period of operation:

Table 4.2.2.1
60 - Year Analysis Results for BFN Units 1, 2, & 3

Parameter	Unit 1 (54 EFPY)	Unit 2 (52 EFPY)	Unit 3 (52 EFPY)
Peak Surface Fluence (n/cm^2)	1.95 x 10^{18}	2.3 x 10^{18}	2.3 x 10^{18}
1/4T Fluence (n/cm^2)	1.35 x 10^{18}	1.59 x 10^{18}	1.59 x 10^{18}

b) See the following tables for the history for Units 1, 2, and 3 relating to (a) megawatt thermal power (MWt), (b) calendar years of operation, and (c) capacity factor.

Data in these tables is provided by operating cycle with the following acronyms:

ARI: all rods inserted,
CF: capacity factor,
CTP: core thermal power, and
OLTP: original licensed thermal power.

The tables do not provide calendar years directly; however, the beginning and ending of each cycle plus "Plant EFPY" is provided for each cycle.

TABLE EMCB-A.1-1 - UNIT 1 OPERATING HISTORY

Cycle	Critical	ARI	Rated CTP (MWt)	Full Power Years	Plant EFPY (OLTP)	Thermal CF
1A	08/17/1973	03/22/1975	3293	0.77	0.766	0.480
1B	09/14/1976	09/13/1977	3293	0.68	1.445	0.681
2	01/13/1978	11/26/1978	3293	0.64	2.084	0.735
3	01/17/1979	01/03/1980	3293	0.82	2.900	0.848
4	03/22/1980	04/11/1981	3293	0.92	3.817	0.869
5	09/30/1981	04/16/1983	3293	1.31	5.128	0.851
6	12/29/1983	03/19/1985	3293	1.02	6.150	0.838

TABLE EMCB-A.1-2 - UNIT 2 OPERATING HISTORY

CYCLE	Critical	ARI	Rated CTP (Mwt)	Full Power Years	Plant EFPY (OLTP)	Thermal CF
1A	07/20/1974	03/22/1975	3293	0.306	0.306	0.456
1B	08/27/1976	03/18/1978	3293	0.997	1.303	0.641
2	06/26/1978	04/27/1979	3293	0.724	2.027	0.864
3	05/27/1979	09/05/1980	3293	1.015	3.042	0.792
4	11/19/1980	07/30/1982	3293	1.369	4.411	0.809
5	03/18/1983	09/15/1984	3293	1.138	5.549	0.760
6	05/24/1991	01/29/1993	3293	1.350	6.899	0.800
7	05/25/1993	10/01/1994	3293	1.269	8.167	0.939
8	11/21/1994	03/23/1996	3293	1.264	9.432	0.947
9	04/21/1996	09/27/1997	3293	1.357	10.788	0.947
10	10/18/1997	04/11/1999	3293	1.442	12.230	0.975
11	05/06/1999	03/18/2001	3458	1.907	14.137	0.972
12A	04/22/2001	04/23/2002	3458	1.007	15.144	0.957
12B	04/30/2002	10/19/2002	3458	0.462	15.605	0.936
12C	10/28/2002	02/24/2003	3458	0.294	15.900	0.862
13	03/15/2003	03/21/2005	3458	2.03	17.928	0.957
14	04/16/2005	**02/07/2007**	3458	**cycle has not ended**		

TABLE EMCB-A.1-3 - UNIT 3 OPERATING HISTORY

CYCLE	Critical	ARI	Rated CTP Mwt	Full Power Years	Plant EFPY (OLTP)	Thermal CF
1	08/08/1976	09/08/1978	3293	1.479	1.479	0.710
2	11/22/1978	08/21/1979	3293	0.618	2.097	0.828
3	12/06/1979	11/23/1980	3293	0.780	2.877	0.806
4	01/17/1981	10/30/1981	3293	0.677	3.553	0.861
5	05/20/1982	09/07/1983	3293	1.125	4.678	0.865
6	10/22/1984	03/09/1985	3293	0.191	4.870	0.504
7	11/19/1995	02/22/1997	3293	1.137	6.006	0.901
8A	03/12/1997	04/07/1998	3293	1.042	7.048	0.974
8B	04/18/1998	09/20/1998	3293	0.381	7.430	0.900
9	10/14/1998	04/15/2000	3458	1.549	8.979	0.982
10	05/03/2000	03/26/2002	3458	1.962	10.941	0.986
11A	04/09/2002	06/19/2003	3458	1.237	12.178	0.987
11B	07/01/2003	03/01/2004	3458	0.681	12.860	0.973
12	03/30/2004	**02/24/2006**	3458	**Cycle had not ended when table was prepared.**		

The projected operating conditions through the 20-year life extension period at EPU conditions are based on 120% of OLTP at 97.0% capacity factor. The projected number of EFPYs with consideration of the extended period of operation and the EPU conditions is addressed in section a).

Since it has the most operating time, Unit 2's actual projected EFPY would be bounding for all three units. Unit 2's EFPY is projected as follows:

EFPY = Observed EFPY + (1.2)(.97)(years of operation remaining)

EFPY = 17.928 + (1.2)(.97)(29)*

EFPY = 17.928 + 30.164

EFPY = 48.092

* For ease of calculation, the 29 years assumes EPU operation beginning at the start of cycle 14.

This projection is conservative and bounding for the actual operating conditions.

NRC Request EMCB-A.2

Tennessee Valley Authority (TVA) has committed to implement the Boiling-Water Reactor (BWR) Vessel and Internals Project (ISP)(BWRVIP) Report, BWR Integrated Surveillance Program (ISP)(BWRVIP-116) report, for monitoring neutron embrittlement of the BFN Units, reactor pressure vessel beltline materials and welds, for the extended period of operation. Implementation of the EPU for the BFN units will change the neutron fluence values, which will affect the projected neutron fluence of the ISP capsules. The BWRVIP-116 report states that implementation of the ISP during the extended period of operation provides additional data from host reactor capsules to meet surveillance monitoring needs of the BWR fleet for license renewal. The following table, which was extracted from the BWRVIP-116 report and the BWRVIP's responses to the staff's request for additional information on BWRVIP-116 and submitted by letter dated January 11, 2005, provides information on the current status of the ISP at BFN during the extended period of operation.

Representative Material	ISP Capsule EFPY	Estimated Fluence of the ISP Capsule (n/cm^2)	EOL 1/4 T Fluence of Target (n/cm^2)	Estimated EOLE 1/4 T Fluence of Target (n/cm^2)	ISP Capsule Fluence as a % of EOLE 1/4 T Fluence
Plate - Heat # A0981-1	40	1.37×10^{18}	7.8×10^{17}	1.2×10^{18}	117.3%
Weld	40	1.37×10^{18}	7.8×10^{17}	1.2×10^{18}	117.3%

According to the license renewal submittal for BFN the extended term is for 52 EFPYs. Based on the projected EOL extended fluence, discuss how the surveillance program is affected by the EPU and provide a basis for this position. Provide information regarding the effect of the EPU on the BFN Units 2 and 3 ISP capsule withdrawal schedule, the estimated fluence of the ISP capsules, EOL 1/4 thickness (T) target fluence values, estimated EOL extended 1/4 T target fluence values and supplemental capsule fluences as a percentage of EOL extended 1/4 T fluence.

TVA Reply to EMCB-A.2

The values in the above table were provided prior to recalculation of the EPU EOL extended fluence values. As stated in BWRVIP-116:

> Throughout the term of the ISP and ISP(E), the BWRVIP will monitor the progress, coordinate future actions such as withdrawal and testing of future capsules and reporting of surveillance capsule test results, and identify additional program needs. A reevaluation of the ISP test matrix and capsule withdrawal schedule will be performed on a periodic basis or when a significant event occurs that may require special consideration.

BFN Unit 2 is an ISP Host Plant with capsule withdrawal planned for the year 2026. BFN Unit 3 is not an ISP Host Plant, and the surveillance capsules will remain in place and will continue to be irradiated during plant operation. BFN will continue to work with the BWRVIP ISP and ensure that appropriate information is provided to address additional program needs.

NRC Request EMCB-A.3

According to the time-limited aging analysis contained in Section 4.7.7, Stress Relaxation of Core Plate Hold-Down Bolts, in the license renewal application (LRA), the hold-down bolts were addressed for the extended period of operation. EPU conditions will enhance the neutron fluence at the core plate region, which will consequently affect the preloading condition in the core plate hold-down bolts, due to stress relaxation. Provide a basis of how the EPU conditions will affect the integrity of the core plate hold-down bolts through the EOL extended term.

TVA Reply to EMCB-A.3

TVA submitted an application for the license renewal of BFN Units 1, 2 and 3 on December 31, 2003 (ML040060359). Since TVA planned to submit the EPU applications for all three units soon after, this attribute of the License Renewal Application was submitted assuming EPU conditions.

TVA provided information on a plant specific calculation for the core plate hold-down bolts that addressed the combined effects of EPU and License Renewal in letter dated June 29, 2005 (ML051520139). This evaluation incorporated the BFN specific core plate geometry and temperature. It also used the BFN fluence calculation which was performed considering EPU operating power and time conditions. The maximum fluence that was applicable to the bolts in the highest fluence region of the core plate was determined to be 5 x 10^{19} n/cm^2 at the end of the 60-year plant life. The resultant relaxation was determined to be 15% based on GE Design Documents. The analysis assumed that all of the bolts were at this fluence even though many bolts experience a lower fluence depending on their specific location. The plant-specific analysis is bounded by the original application that assumed a higher value of 20% relaxation. Further information was provided in letters dated June 29, 2005, and September 6, 2005 (Accession Nos. ML051940291 and ML052570462, respectively).

Stress relaxation of the core plate hold-down bolts was an Open Item (OI) 4.7.7 in the Safety Evaluation Report (SER) Related to the License Renewal of the Browns Ferry Nuclear Plant, Units 1, 2, and 3, dated January 12, 2006. As stated in this SER, the open item was resolved by a BFN commitment to perform a plant-specific analysis consistent with BWRVIP-25. Appropriate corrective action will be taken if the plant-specific analysis does not satisfy the criteria stated in the SER. This analysis or the corrective action taken to resolve the issue will be submitted for the NRC staff review two years prior to the period of extended operation. Thus, this plant-specific analysis will include EPU conditions.

NRC Request EMCB-A.4

Austenitic stainless steel reactor vessel internal components are susceptible to irradiation-assisted stress corrosion cracking (IASCC) when exposed to higher neutron fluence due to EPU conditions. The four components listed below are susceptible to IASCC. Discuss the inspection programs in place, to address the aging affects due to IASCC, in the
(a) top guide, (b) core shroud, (c) core plate, and
(d) in-core instrumentation guide dry tubes and guide tubes,
under EPU conditions. Specifically, discuss what BWRVIP inspections are required for each component and if there are any additional requirements beyond the BWRVIP requirements for those components. Additionally, address the impact of the EPU conditions on the inspection programs documented in the BWRVIP reports and any additional requirements for the EPU conditions.

TVA Reply to EMCB-A.4

The top guide, core shroud, core plate and in-core instrumentation dry tubes and guide tubes are considered susceptible to IASCC. The discussions of these components as part of the License Renewal Application (LRA) are applicable to EPU as the calculated neutron fluence included both the effects of LRA and EPU. These components will be inspected in accordance with the applicable BWRVIP reports except as discussed below.

Three components, top guide, shroud, and incore instrumentation dry tubes and guide tubes, have been evaluated by the BWRVIP, as described in the Inspection and Evaluation Guidelines for each component: BWRVIP-26 (Top Guide), BWRVIP-76 (Shroud), and BWRVIP-47 (in-core instrumentation dry tubes and guide tubes).

As part of license renewal, BFN addressed the top guide in the response to RAI-B.2.1.12-1(A) in TVA letter to NRC dated January 31, 2005 (ML0503220145) as follows. NRC letter to Carl Terry, BWRVIP Chairman, dated June 10, 2003 states the following: "The staff believes that a comprehensive evaluation of the impact of IASCC and multiple failures of the top guide beams is necessary, and that an inspection program for top guide beams for all BWRs should be developed by the BWRVIP to ensure that all BWRs can meet the requirements of 10 CFR Part 54 throughout the period of extended operation." TVA will work as part of the BWRVIP to resolve these issues generically. When resolved, TVA will follow the BWRVIP recommendations resulting from that resolution. Prior to the period of extended operation, BFN will develop a site specific inspection program if these issues are not generically resolved.

The core shroud welds are inspected in accordance with "Category C" core shroud inspection requirements contained in BWRVIP-76.

Due to widespread cracking found during inspection of the Unit 2 and 3 dry tubes, all 12 SRM/IRM dry tubes were replaced in Unit 2 and Unit 3 with dry tubes of improved materials and design that have been manufactured after 1986. The new dry tube design eliminated a crevice in the upper portion (plunger area) of the existing design. Additionally, the material in the plunger area was changed from the existing 304 stainless steel material to 304L stainless steel, making the new dry tubes less susceptible to IGSCC and IASCC. Inspection of the Unit 1 dry tubes has revealed widespread cracking. All 12 of Unit 1's SRM/IRM dry tubes were replaced with the same design currently installed in Units 2 and 3. No inspection is recommended for dry tubes manufactured after 1986 until they have reached the expected 20-year life.

The core plate has been determined to be susceptible to IASCC and this is considered a plant-specific Time-Limited Aging Analysis (TLAA). For the period of extended operation, the BWR Vessel Internals Program will perform inspections of the core plate in the regions of the highest fluence.

Current BFN inspection requirements for these components are contained in plant procedures and are discussed below. This discussion provides a synopsis of the currently planned inspection requirements. TVA reserves the right to modify the inspection program should BWRVIP documents be revised in the future.

Core Shroud

The examination of the core shroud is performed in accordance with the augmented examination requirements of BWRVIP-76. The BFN core shroud is considered to be "Category C," as defined in Appendix B of BWRVIP-76.

The circumferential welds are ultrasonically (UT) examined at the frequency specified in Table EMCB-A.4-4, which was taken from BWRVIP-76. The percent of the examined circumferential weld length and percent of the circumferential weld length examined are listed in Table EMCB-A.4-1 for Unit 1, EMCB-A.4-2 for Unit 2, and Table EMCB-A.4-3 for Unit 3.

The vertical welds are ultrasonically examined per the recommendations specified in BWRVIP-76. The schedule for core shroud weld examinations is listed in Table EMCB-A.4-1 for Unit 1, Table EMCB-A.4-2 for Unit 2, and Table EMCB-A.4-3 for Unit 3.

Shroud support welds H8 (shroud support plate to shroud support cylinder) and H9 (shroud support plate to RPV wall) were visually examined (single-sided EVT-1) during the U2C10 and U3C9 Refueling Outages in accordance with BWRVIP-38. Since that time, however, BWRVIP-104 has been issued to address technical issues resulting from an assessment of GE SIL No. 624, and additional inspection requirements have been recommended to address the cracking documented in GE SIL No. 624.

BWRVIP-38 does not require the inspection of the shroud support leg welds (H10 and H12) provided the H8 and H9 welds are structurally adequate.

The existing access hole cover (AHC) design serves to maintain a leak-tight barrier between the annulus and lower plenum. The core shroud access hole covers are examined in accordance with GE SIL No. 462, Revision 1.

Top Guide

The examination of the top guide and associated components is performed in accordance with the augmented examination recommendations of BWRVIP-26. The components which comprise the top guide are itemized below along with the BWRVIP-26 "location" designation:

1. Location 1 - Grid Beam and Beam-to-Beam Crevice Slot

   There are no safety consequences associated with failure at a single beam intersection. There is no inspection currently required for location 1.

2. Locations 2 and 3 - Aligner Pins and Sockets in Top Guide and Shroud

   The top guide is positioned by four vertical alignment pins and bosses/sockets are fillet welded to both the top guide rim and the shroud to engage the pins. Locations 2 and 3 require VT-1 visual examination. The inspection frequency is two adjacent alignment pin assemblies every other refueling outage. If cracking is found, expand inspection to all four aligner assemblies.

3. Location 4 - Grid Beam to Cover Plate and Bottom Plate Pins

   There are no safety consequences associated with failure at this location, because the pins are captured and perform their function even if the retaining fillet welds fail. There is no inspection required for location 4.

4. Location 5 - Not applicable to BFN (applicable to BWR/3 plants only).

5. Location 6 - Fuel Guard Welds and Bolting

   These components perform no safety function during operation. They are intended to prevent inadvertent placement of fuel bundles at these peripheral locations. There is no inspection required for location 6.

6. Location 7 - Not applicable to BFN per BWRVIP-26, Table 2-2.

7. Locations 8, 9, and 9a - Not applicable to BFN per BWRVIP-26, Table 2-2.

8. Locations 10 and 11 - Rim Pins and Rim Welds

   The rim pins will perform their function even if the fillet welds that retain them in place fail. Structural integrity of the rim weld is required to prevent transfer of the lateral loads to the shroud through the lower reinforcement pins and the bottom plate. The normally accessible portions of the rim weld (location 11) require an EVT-1 visual examination. The inspection frequency is every other refueling outage. If cracking is found the inspection shall be expanded to include 25% of one side of the rim weld for qualitative evaluation.

9. Location 12 - Rim and Cover Plate Fabrication Welds

   Because of the redundancy of the grid beams to the rim through the cover and bottom plates, failure of these welds has minimal consequences. There are no inspection requirements for this location.

10. Locations 13, 15, and 16 - Eye Bolt Boss, Threaded Boss to Cover Plate, and Lifting Lug to Rim Bolt or Weld

    These components do not have a safety function for off-normal transients. There are no inspection requirements for these locations. (NOTE: Locations 15 and 16 do not exist at BFN per examination results.)

11. Location 14 - Not applicable to BFN per BWRVIP-26, Table 2-2.

12. Location 17 - Not applicable to BFN per BWRVIP-26, Table 2-2.

<u>SRM/IRM Dry Tubes</u>

Visual inspection of the SRM/IRM Dry Tubes is performed per the recommendations in GE SIL No. 409 R2. The Unit 1 dry tubes were replaced prior to unit restart. The dry tubes in Units 2 and 3 were replaced with dry tubes manufactured after 1986, which incorporate a non-creviced design using less susceptible material. No inspection is recommended for dry tubes manufactured after 1986 until they have reached the expected 20-year life, at which time inspections will be considered.

Core Plate Bolts/Plugs

The Aligner Pin Socket to Rim Welds (Location 8) do not require examination in accordance with the Final NRC SE for BWRVIP-25 provided that inspection of the rim holddown bolts (Location 10) is performed. [NOTE: The Core Plate Wedge Retainer (Location 9) inspection is not applicable since BFN does not currently contain core plate wedges.]

The core plate rim holddown bolts (Location 10) that become accessible during normal refueling activities require examination in accordance with BWRVIP-25 to ensure that their locking devices are in place. There are thirty-four (34) holddown bolts present for the core plates at BFN. BWRVIP-25 requires an EVT-1 examination from below the core plate, or UT from above the core plate, of 50% (17) of the holddown bolts. If cracking is detected, the remaining 50% of the bolts will be inspected. Inspections for Unit 2 and Unit 3 have been extremely difficult to perform because of poor accessibility and high radiation conditions with fuel in an operating reactor pressure vessel (RPV). Presently, a VT-3 examination of accessible holddown bolts has been the best possible examination that can be performed for an operating RPV to verify that the bolt is still performing its design function. Unit 1 performed an EVT-1 examination from below the core plate of 50% (17) of the rim holddown bolts prior to restart since access below the core plate was available.

A given population of Unit 2 core plate plugs (Location 13), coincident with the number of control rod blades that will be replaced, require visual examination to determine their condition or if the plugs are dislodged or unseated. The Unit 3 core plate plugs were inspected during the Unit 3 recovery.

Core plate plug replacements will be scheduled for each unit prior to the time when spring relaxation could cause the core plate plugs to become dislodged.

Acceptance Criteria

If flaws are found in the sample population being examined, then the remaining locations of a similar type should be examined during the same outage. If the flaw can be correlated to a specific event which would not affect other locations, then additional examinations would not be required and a justification should be prepared. The methodologies contained in BWRVIP documents, BFN Flaw Evaluation Handbooks, and other flaw evaluation documents are used to support evaluation of identified flaws.

- Core Shroud

  A plant specific analysis is required to support continued operation for one fuel cycle for circumferential core shroud horizontal welds with cracking in excess of 30% of the inspected length.

  The core shroud horizontal welds are evaluated for continued operation using the methodology contained in Appendix D of BWRVIP-76. This evaluation is done using the BWR Core Shroud Distributed Ligament Length (DLL) Computer Program (Version 2.1) contained in BWRVIP-20. The DLL Computer Program calculates the limit load safety factors (for all welds) and linear elastic fracture mechanics (LEFM) acceptability (for core shroud barrel welds H-3 and H-4 located in the beltline region of the reactor vessel, provided that the cracking is $\geq$ 10% of the total length inspected for each weld) required for continued operation.

- Other Components

  Plant-specific evaluations are required on a case-by-case basis for flaws.

Inspection Frequency

Inspection frequencies for these components are provided in Tables EMCB-A.4-1, EMCB-A.4-2, and EMCB-A.4-3 for Units 1, 2, and 3, respectively.

Table EMCB-A.4-1: Unit 1 RPVII Examination Frequency

COMPONENT	EXAM METHOD	BASELINE EXAM	EXAM FREQUENCY									COMMENTS
			C6 Restart	C7 11/08	C8 11/10	C9 11/12	C10 11/14	C11 11/16	C12 11/18	C13 11/20	C14 11/22	
Core Shroud (BWRVIP-38, -76, -104)												BWRVIP baseline inspection performed during U1C6R RFO except where noted Examined / Flawed
<u>Welds</u> H1	UT	U1C6R RFO	X					X				83.0% examined, 0.0% flawed upper side 82.1% examined, 2.1% flawed lower side (2001)
H2	UT	U1C6R RFO	X					X				81.8% examined, 0.4% flawed upper side 88.7% examined, 0.0% flawed lower side
H3	UT	U1C6R RFO	X					X				88.7% examined, 0.0% flawed upper side 79.2% examined, 5.1% flawed lower side (2001)
H4	UT	U1C6R RFO	X					X				90.0% examined, 20.1% flawed upper side 89.6% examined, 2.6% flawed lower side
H5	UT	U1C6R RFO	X					X				91.3% examined, 1.2% flawed upper side 91.3% examined, 0.0% flawed lower side
H6	UT	U1C6R RFO	X					X				91.9% examined, 0.0% flawed upper side 91.9% examined, 11.2% flawed lower side
H7	UT	U1C6R RFO	X					X				91.4% examined, 12.0% flawed upper side 78.0% examined, 0.0% flawed lower side
H8	UT or EVT-1	U1C6R RFO	EVT-1, VT-3									Inspect per BWRVIP-104 (10% minimum coverage)
H9	UT or EVT-1	U1C6R RFO	UT, EVT-1, VT-3									Inspect per BWRVIP-104 (10% minimum coverage)
H10	VT-3	U1C6R RFO	X									Shroud Support Leg Welds (6 each)
H12	VT-3	U1C6R RFO	X									Shroud Support Leg Welds (6 each)
<u>Access Hole Cover</u> (GE SIL No. 462)												Replacement required prior to unit restart -DCN 51193 installed bolted repair design. Inspect nut to retainer tack welds only.
0°	VT-1	U1C6R RFO	X	X								Re-inspect per GE-NE-0000-0045-5983
180°	VT-1	U1C6R RFO	X	X								Re-inspect per GE-NE-0000-0045-5983
<u>Shroud Head Bolts</u> (GE SIL No. 433)	VT-1											Replaced per DCN 51193, visual baseline performed
Bolts 1 - 48												

Table EMCB-A.4-1: Unit 1 RPVII Examination Frequency

COMPONENT	EXAM METHOD	BASELINE EXAM	EXAM FREQUENCY									COMMENTS
			C6 Restart	C7 11/08	C8 11/10	C9 11/12	C10 11/14	C11 11/16	C12 11/18	C13 11/20	C14 11/22	
Lower Plenum (185 CRDs total) (BWRVIP-47)												Baseline inspection of 10% of total guide tube population (19 blades) to be performed during U1C6 RFO
CRGT-1	VT-3	U1C6R RFO	X									CRD Guide Tube Sleeve-to-Alignment Lug Weld
CRGT-2	EVT-1	U1C6R RFO	X									CRD Guide Tube Body-to-Sleeve Weld
CRGT-3	EVT-1	U1C6R RFO	X									CRD Guide Tube Base-to-Body Weld
FS/GT-ARPIN-1	VT-3	U1C6R RFO	X									Guide Tube & Fuel Support Alignment Pin-to-Core Plate Weld, and the Alignment Pin
SRM/IRM Dry Tubes	VT-3											All 12 SRM/IRM Dry Tubes replaced during U1C6R RFO
Core Plate (BWRVIP-25)												BWRVIP baseline inspection U1C6 RFO
Location 8	N/A											Inspection not required if holddown bolts are inspected
Location 9	N/A											RPV does not currently contain core plate wedges
Holddown Bolts (Location 10)	EVT-1	U1C6R RFO	X	X								100% (34) of holddown bolts inspected from the top side, 50% (17) of holddown bolts inspected from the bottom side
Plugs (Location 13)	VT-3	U1C6R RFO	X	X							-	3 Core Plate Plugs replaced; Reinspect per GE-NE-0000-0045-7764

Table EMCB-A.4-2: Unit 2 RPVII Examination Frequency

COMPONENT	EXAM METHOD	BASELINE EXAM	EXAM FREQUENCY									COMMENTS
			C8 03/96	C9 10/97	C10 04/99	C11 04/01	C12 03/03	C13 03/05	C14 03/07	C15 03/09	C16 03/11	
Core Shroud (BWRVIP-38, -76, -104)												
Welds H1	UT	U2C9 RFO	X	X					X			63.2% accessible, indications reported [1.62% flawed for examined weld length]
H2	UT	U2C9 RFO	X	X					X			63.2% accessible, indications reported [0.87% flawed for examined weld length]
H3	UT	U2C9 RFO	X	X					X			69.3% accessible, indications reported [4.42% flawed for examined weld length]
H4	UT	U2C9 RFO		X					X			64% accessible, no indications reported
H5	UT	U2C9 RFO	X	X					X			67.2% accessible, indications reported [2.46% flawed for examined weld length]
H6	UT	U2C9 RFO	X	X					X			67.6% accessible, indications reported [11.11% flawed for examined weld length]
H7	UT	U2C9 RFO	X	X					X			63.4% accessible, indications reported [16.95% flawed for examined weld length]
H8	UT or EVT-1	U2C10 RFO			EVT -1			EVT -1			X	EVT-1 visual examination performed (U2C13 RFO), no indications reported
H9	UT or EVT-1	U2C10 RFO			EVT -1			X			X	Manual UT exam performed (U2C13 RFO), no indications reported
V7	UT								X			Vertical weld between H6 and H7
V8	UT								X			Vertical weld between H6 and H7
Access Hole Cover (GE SIL No. 462)												Examine in accordance with the recommendations of GE SIL No. 462 R1
0°	UT or VT-1	U2C8 RFO	UT		UT			EVT -1	UT			
180°	UT or VT-1	U2C8 RFO	UT		UT			EVT -1	UT			

Table EMCB-A.4-2: Unit 2 RPVII Examination Frequency

COMPONENT	EXAM METHOD	BASELINE EXAM	EXAM FREQUENCY									COMMENTS
			C8 03/96	C9 10/97	C10 04/99	C11 04/01	C12 03/03	C13 03/05	C14 03/07	C15 03/09	C16 03/11	
<u>Shroud Head Bolts</u> (GE SIL No. 433)	UT	N/A										Inspection required for original designed bolts only
Top Guide (BWRVIP-26)												
Locations 1, 4, 6, 10, 12, 13, 15, 16	EVT-1	U2C11 RFO				X						Initial baseline inspection: Locations 15 & 16 identified as N/A to BFN during U2C11 RFO.
Location 2	VT-1	U2C10 RFO			X		X		X		X	2 adjacent aligner assemblies each inspection
Location 3	VT-1	U2C10 RFO			X		X		X		X	2 adjacent aligner assemblies each inspection
Location 11	EVT-1	U2C10 RFO			X		X		X		X	Examine accessible portion of weld locations, additional exams required if cracking found.
SRM/IRM Dry Tubes	VT-3											All 12 SRM/IRM Dry Tubes replaced during U2C7 RFO. Inspections will be considered after the 20-year life per GE SIL No. 409 R2.
Core Plate (BWRVIP-25)												
Location 8	N/A											Identified as not accessible during U2C11 RFO; inspection not required if holddown bolts are inspected
Location 9	VT-3											RPV does not currently contain core plate wedges
Holddown Bolts (Location 10)	EVT-1		VT-3	VT-3	VT-3	VT-3	VT-3	VT-3	X	X	X	34 bolts (100%) examined during U2C11, U2C12, & U2C13 RFOs; VT-3 is best possible exam that has been performed to date
Plugs (Location 13)	VT-3		X	X	X	X (8)	X (15)	X (33)				

Table EMCB-A.4-3: Unit 3 RPVII Examination Frequency

COMPONENT	EXAM METHOD	BASELINE EXAM	EXAM FREQUENCY C6 Restart	C7 03/97	C8 09/98	C9 04/00	C10 03/02	C11 03/04	C12 03/06	C13 03/08	C14 03/10	C15 03/12	COMMENTS
Core Shroud (BWRVIP-38, -76, -104)													
Welds H1	UT	U3C8 RFO	X	X	X				X				78.7% accessible, indications reported [3.94% flawed for examined weld length]
H2	UT	U3C8 RFO	X		X				X				78.7% accessible, indications reported [1.41% flawed for examined weld length]
H3	UT	U3C8 RFO	X		X				X				82.8% accessible, indications reported [0.30% flawed for examined weld length]
H4	UT	U3C8 RFO	X	X	X				X				60.3% accessible, indications reported [3.72% flawed for examined weld length]
H5	UT	U3C8 RFO	X	X	X			X	X				72.1% accessible (U3C8 RFO), indications reported [34.05% flawed for examined weld length]. 51.1% accessible (U3C11 RFO), indications reported [34.04% flawed for examined weld length].
H6	UT	U3C7 RFO	X	X				X	X				60.7% accessible (U3C7 RFO), no indications reported. 3.43% accessible (U3C11 RFO), no indications reported. Inspection required during U3C12 RFO due to insufficient coverage obtained during U3C11 RFO.
H7	UT	U3C7 RFO	X	X				X	X				59.7% accessible (U3C7 RFO), indications reported [2.45% flawed for examined weld length]. 2.22% accessible (U3C11 RFO), indications reported [4.12% flawed for examined weld length]. Inspection required during U3C12 RFO due to insufficient coverage obtained during U3C11 RFO.
H8	UT or EVT-1	U3C9 RFO				EVT -1		EVT -1			X		EVT-1 visual examination performed (U3C11 RFO), no indications reported
H9	UT or EVT-1	U3C9 RFO				EVT -1		X			X		Manual UT exam performed (U3C11 RFO), no indications reported
V5	UT	U3C11 RFO						X	X				Vertical weld between H4 and H5 - 61.62% accessible (U3C11 RFO), no indications reported

Table EMCB-A.4-3: Unit 3 RPVII Examination Frequency

COMPONENT	EXAM METHOD	BASELINE EXAM	EXAM FREQUENCY										COMMENTS
			C6 Restart	C7 03/97	C8 09/98	C9 04/00	C10 03/02	C11 03/04	C12 03/06	C13 03/08	C14 03/10	C15 03/12	
V6	UT	U3C11 RFO						X	X				Vertical weld between H4 and H5 - 61.62% accessible (U3C11 RFO), no indications reported
<u>Access Hole Cover</u> (GE SIL No. 462)													Examine in accordance with the recommendations of GE SIL No. 462 R1. EVT-1 examination performed during U3C11 RFO
0°	UT or VT-1	U3C8 RFO	UT		UT			EVT -1		UT		UT	No indications reported (U3C11 RFO)
180°	UT or VT-1	U3C8 RFO	UT		UT			EVT -1		UT		UT	No indications reported (U3C11 RFO)
<u>Shroud Head Bolts</u> (GE SIL No. 433)	UT	N/A	X										Indications reported, replaced during U3C6 RFO with non-crevice design bolts
Top Guide (BWRVIP-26)													
Locations 1, 4, 6, 10, 12, 13, 15, 16	EVT-1	U3C9 RFO				X							Initial baseline inspection: Locations 1, 15, and 16 not accessible during U3C9 RFO.
Location 2	VT-1	U3C9 RFO				X		X		X		X	2 adjacent aligner assemblies each inspection
Location 3	VT-1	U3C9 RFO				X		X		X		X	2 adjacent aligner assemblies each inspection
Location 11	EVT-1	U3C9 RFO				X		X		X		X	Examine accessible portion of weld locations, additional exams required if cracking found.
SRM/IRM Dry Tubes	VT-3												All 12 SRM/IRM Dry Tubes replaced during U3C6 RFO. Inspections will be considered after the 20-year life per GE SIL No. 409 R2.
Core Plate (BWRVIP-25)													
Location 8	VT-3					X							Inaccessible during U3C10 RFO & U3C11 RFO; inspection not required if holddown bolts are inspected
Location 9	VT-3												RPV does not currently contain core plate wedges

Table EMCB-A.4-3: Unit 3 RPVII Examination Frequency

COMPONENT	EXAM METHOD	BASELINE EXAM	EXAM FREQUENCY										COMMENTS
			C6 Restart	C7 03/97	C8 09/98	C9 04/00	C10 03/02	C11 03/04	C12 03/06	C13 03/08	C14 03/10	C15 03/12	
Holddown Bolts (Location 10)	EVT-1				VT-3	VT-3	VT-3	VT-3	X	X	X	X	18 bolts (53%) examined during U3C9 RFO, 34 bolts (100%) examined during U3C10 & U3C11 RFOs; VT-3 is best possible exam that has been performed to date.
Plugs (Location 13)	VT-3								X				Inspect all plugs that are accessible during U3C12 RFO

Table EMCB-A.4-3: Core Shroud Reinspection Intervals for Category B and C Plants (in years)

Percent Cracking[1, 2]	Stress[3] = 1 ksi		Stress[3] = 3 ksi		Stress[3] = 6 ksi	
	Limit Load	LEFM[4]	Limit Load	LEFM[4]	Limit Load	LEFM[4]
x < 10	10.0	10.0	10.0	10.0	10.0	10.0
10 ≤ x < 20	10.0	10.0	10.0	10.0	10.0	6.0
20 ≤ x < 25	6.0	6.0	6.0	6.0	6.0	6.0
25 ≤ x < 30	6.0	6.0	6.0	6.0	6.0	Note 6
x ≥ 30	Note 6					

Notes:

1. Length of weld inspected must be at least 50% of the weld circumference with either volumetric or two sided surface technique.

2. Cracking is defined as the total length of as-found cracks as a percentage of the total length inspected for each weld. Crack lengths should be rounded up to the next whole number.

3. Stress values are for faulted loading conditions. Interpolation between stress values is acceptable.

4. Applies to welds with cracking ≥ 10% where neutron fluence is greater than 3×10^{20} n/cm^2 and less than 5×10^{20} n/cm^2 (E > 1MeV). For fluences exceeding 5×10^{20} n/cm^2, a plant-specific analysis is required to be submitted to the NRC.

5. Linear extrapolation of the reinspection intervals is permitted up to a value of 10 ksi. Values should be capped (or rounded down) at values consistent with the approach in the above table.

6. Plant-specific analysis is required.

NRC Request EMCB-A.5

According to Aging Management Program B.2.1.8, Boiling Water Reactor Feedwater Nozzle Program, in the LRA for BFN, the feedwater (FW) nozzles are inspected in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, Subsection IWB (B.2.1.4), and the recommendations of the General Electric (GE) NE-523-A71-0594 Report, Alternate BWR Feedwater Nozzle Inspection Requirements. Describe the analysis that is performed on the FW nozzles, with respect to the GE topical report and how the EPU conditions will affect those analyses.

TVA Reply to EMCB-A.5

The fracture mechanics analysis for the feedwater nozzles was reperformed for EPU conditions. This analysis included considerations for extended operation for 60 years. For this evaluation, the startup/shutdown transient and scram transient were used with temperatures and pressure modified to reflect EPU conditions. These effects were incorporated into the range of thermal cycles. Additionally, the bounding number of startup/shutdown cycles including scram events and loss of feedwater events for a period of 60 years was projected. Based on these conditions, the crack growth in the limiting location of the feedwater nozzles was determined. The results of the fracture mechanics analysis do not change the inspection frequency for BFN.

EQVA (IPSB-A)

NRC Request IPSB-A.1

Page E-3 of the April 25, 2005, states that, "BFN UFSAR [Updated Final Safety Analysis Report] Section 13.5.2.2. presents a general description of the initial startup testing that was performed for Unit 1 and Section 13.5.2.3 for Units 2 and 3. These UFSAR sections provide the objectives and acceptance criteria for the initial startup tests. The objectives and acceptance criteria as modified to reflect operation at 120% reactor thermal power will be used for planned EPU tests."

However, UFSAR Section 13.5 states that "[t]his section presents a general description of the startup test that was planned for Browns Ferry and has been retained in the FSAR as a historical reference only. This test description is not in conformance with Regulatory Guide (RG) 1.68 and should not be used as a model for future test programs."

Based on the UFSAR Section 13.5 information, (1) explain why page E-3 and Table 1 of the submittal relies on the UFSAR Section 13.5 information as a basis for their specific acceptance criteria for the EPU testing program, when the UFSAR specifically states that it should not be used;
(2) provide copies of the Units 2 and 3 Summary Report of Startup Tests dated May 23, 1975, and May 9, 1977, respectively; and (3) confirm whether or not the proposed EPU test plan is in conformance with RG 1.68. If the EPU test plan is not in conformance with RG 1.68, provide a justification.

TVA Reply to IPSB-A.1

(1) RG 1.68 describes the general scope of initial test programs and provides a representative listing of tests that should be demonstrated during the initial test program. RG 1.68 does not provide specific acceptance criteria for the tests proposed for EPU. The acceptance criteria of the initial startup tests are appropriate for EPU testing.

(2) Copies of the BFN Units 2 and 3 Summary Report of Startup Tests dated May 23, 1975 and May 9, 1977 are provided in Enclosures 4 and 5, respectively. In compiling the copy of the BFN Unit 3 summary report, it was noticed that page 44 appears to be missing. Additional searching, which included a licensing service search of the NRC Public Document Room (PDR), could not locate the missing page or determine if the original pages could have been numbered incorrectly. This missing page does not adversely impact the BFN Unit 3 testing program.

(3) RG 1.68 provides the general scope and depth of initial test programs acceptable to the NRC staff. Standard Review Plan (SRP) 14.2.1 provides the general guidelines for reviewing proposed EPU testing programs. The proposed EPU startup test plan was evaluated in accordance with the guidance provided in SRP 14.2.1. As stated in the April 25, 2005 letter which provides the evaluation requested by SRP 14.2.1, the information provided on the proposed EPU startup test plan demonstrates that structures, systems, and components will perform satisfactorily at the requested power level and thus the plant can be operated safely at the uprated power level.

NRC Request IPSB-A.2

Table 1 of the April 25, 2005, submittal describes the original startup test procedure (STP) 11, LPRM ([Local Power Range Monitor] Calibration), and states that the "method and approach used to perform LPRM calibration is not affected by EPU." Therefore, Table 1 indicates that the LPRM calibration will be performed in accordance with standard plant procedures at less than 90 percent of original licensed thermal power (OLTP). However, Tables 13.5-5 and 13.5-6 of the UFSAR states that STP 11 was performed at 95 to 100-percent power at the 100-percent flow control line. Explain why it is not necessary to perform STP 11 at 95 to 100-percent power at the 100-percent flow control line during power testing at EPU conditions.

TVA Reply to IPSB-A.2

Normal startup testing requires two LPRM calibrations to be performed utilizing the traversing incore probe (TIP) system. One calibration is performed below 75% power and one above 75% power. The calibration performed above 75% power is typically taken during startup at or near 100% power while allowing xenon to increase to a near stable level. The need for the performance of a LPRM calibration is not driven by a specific power level but by the correlation of calculated axial power shape to the measured LPRM readings. Therefore, during the EPU startup test program which includes multiple test plateaus, the LPRM calibration may be performed at less than 100% EPU power and not need to be repeated at 100% EPU power, especially if no significant change in control rod pattern is made.

NRC Request IPSB-A.3

Table 1 of the April 25, 2005, submittal describes the original STP 24, Bypass Valves, and states that, "no modifications to the turbine control valves or the turbine bypass valves are required for operation at the EPU conditions. Confirmation testing will be performed during power operation." Therefore, Table 1 indicates that the bypass valve testing will be performed in accordance with standard plant procedures at less than 90 percent of OLTP. However, Tables 13.5-5 and 13.5-6 of the UFSAR states that STP 24 was performed at 95 to 100-percent power at the 100-percent flow control line. In addition, both Table 1 and UFSAR Section 13.5.2.3 state that one of the purposes of STP 24 is to "demonstrate that the bypass valve can be tested for proper functioning at rated power without causing a scram." Explain why it is not necessary to perform STP 24 at 95 to 100-percent power at the 100-percent flow control line during power testing at EPU conditions.

TVA Reply to IPSB-A.3

Testing of the bypass valves will be performed during EPU startup testing to determine the highest acceptable power level without causing a scram. Contrary to what was shown in Table 1 of the April 25, 2005 submittal (ML051170242), this testing will be performed at incremental power levels up to 100% of the EPU power level until testing criteria indicates scram setpoints are being approached.

NRC Request IPSB-A.4

Table 1 of the April 25, 2005, submittal describes the original STP 33, Main Turbine Stop Valve (TSV) Surveillance Test, and states that, "individual main turbine stop valves must be closed periodically during plant operation as required for plant surveillance testing. As described in EPU safety analysis report Section 3.5.2, the TSV bounding closing time was utilized in EPU analysis." Table 1 indicates that the main TSV testing will be performed in accordance with standard plant procedures at less than 90 percent of OLTP. However, Tables 13.5-5 and 13.5-6 of the UFSAR states that STP 33 was performed at 95 to 100-percent power at the 100-percent flow control line. In addition, both Table 1 and UFSAR Section 13.5.2.3 state that the purpose of STP 33 is to "demonstrate acceptable procedures for daily turbine stop valve surveillance test at a power level as high as possible without producing a scram."

Section 3.5.2 of the Enclosure 4 of the submittal dated June 25, 2004 (Power Uprate Safety Analysis Report (PUSAR)) evaluates the main steam piping system and associated branch piping compliance with U.S.A. Standards, USAS-B31.1.10 Code stress criteria due to the 20-percent increase in flow due to EPU. This evaluation does not appear to meet the purpose of the original test. Explain why it is not necessary to perform STP 33 at 95 to 100-percent power at the 100-percent flow control line during power testing at EPU conditions.

TVA Reply to IPSB-A.4

Testing of the main turbine stop valves will be performed during EPU startup testing to determine the highest acceptable power level without causing a scram. Contrary to what was shown in Table 1 of the April 25, 2005 submittal (ML051170242), this testing will be performed at incremental power levels up to 100% of the EPU power level until testing criteria indicates scram setpoints are being approached.

NRC Request IPSB-A.5

Provide a table that describes the BFN Units 2 and 3 EPU power ascension test plan. The table should provide the test/modification and the power level that the test/modification will be performed. An example of the information requested and the level of detail can be found in Attachment 3 of the Entergy Request for Additional Information response dated January 29, 2004, for the Waterford Unit 3 EPU (ADAMS Accession No. ML040340728).

TVA Reply to IPSB-A.5

The requested information is provided in Enclosure 3.

NRC Request IPSB-A.6

Section B and Table 3 of the April 25, 2005 submittal briefly describe the impact of individual modifications on dynamic plant response. Provide a description of the process/methodology used in considering how, in the aggregate, the planned EPU modifications could affect expected system interactions, transient behavior of systems important to safety, functional system requirements in response to abnormal operating occurrences and other factors which could affect the dynamic response of the plant.

TVA Reply to IPSB-A.6

Modifications, set point adjustments, and operating parameter changes were identified as part of the EPU project. As part of the EPU project, evaluations were prepared to document the scope of impacts to systems and various programs. System interactions were considered in these evaluations as results from specific system evaluations were used as inputs to other system evaluations and the references were documented.

Additionally, plant modifications, including those identified for EPU, are controlled by procedure SPP-9.3, "Plant Modification and Engineering Change Control." As part of the modification process, supporting analyses are performed to assess the impact on component design functions and system functions from the modification. Furthermore, evaluations are prepared to document technical and safety aspects of changes. Plant modifications receive reviews from a core group of plant organizations which aid in this evaluation.

In addition to the modification process described above, a review was performed to identify EPU changes that, when considered in the aggregate, had the potential to impact the dynamic response of the plant. The EPU changes were reviewed in accordance with SRP 14.2.1.III.B. The required changes were reviewed to determine if the change was first-of-a-kind, if the change introduced new system interactions, or if the change involved a change in system response per the guidance of SRP 14.2.1. The required changes were reviewed to determine those that impacted (a) functions important to safety, (b) functions required to mitigate a plant transient, and (c) functions that involve the integrated response of multiple systems, structures, and components in accordance with the guidance of SRP 14.2.1. The review considered the aggregate impact to functions important to safety that could potentially adversely affect the plant EPU safety analyses including anticipated operational occurrences (AOOs).

The changes identified by this review are (a) feedwater / condensate pump modifications, (b) MSIV modifications, (c) Electro Hydraulic Control (EHC) system modifications as identified in the April 25, 2005 submittal (ML051170242). The most significant of these three modifications is the feedwater/condensate pump modifications. The EPU safety analyses have been performed utilizing the higher capacity system with acceptable results. The detailed design, including the post-maintenance modification testing requirements, for these modifications is still in process. Post modification testing will be performed to confirm design parameters and assumptions used in the analytical models to validate the predicted response of the systems.

In summary, the changes were reviewed in accordance with SRP 14.2.1.III.B. The changes identified as having the potential to contribute to an aggregate impact are analyzed using EPU safety analyses, applicable plant calculations, or both, and determined acceptable. Testing is performed to validate analyses or assure the plant response is as expected.

REBB

NRC Request REBB.1

Provide a copy of documentation sent to the U.S. Fish and Wildlife Service (USFWS) in response to the TVA's endangered species conference call with USFWS on October 27, 2005.

TVA Reply to REBB.1

The following documents were provided to the USFWS:

- Guidelines for Heritage Emap Reviews,
- A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities,
- Hydrothermal Modeling of Browns Ferry Nuclear Plant With Units 1, 2, and 3 at Extended Power Uprate,
- Bear Creek Reservoirs Land Management Plan, and
- Environmental Assessment Bear Creek Reservoirs Land Management Plan.

Copies of these documents are provided in Enclosure 7.

NRC Request REBB.2

Page 4-2 of Enclosure 2, Browns Ferry Extended Power Uprate Environmental Report, of the submittal dated June 25, 2004, mentions the potential relocation of transmission line towers. Identify which transmission line towers might be relocated and where. Discuss whether surveys would be conducted to identify cultural and historical resources and protected species. Discuss whether this relocation would alter the vegetative management in the area of the relocated towers. Discuss whether new ground would be cleared for the relocation and whether such a relocation affects compliance with the National Electric Safety Code. Describe any environmental impacts that might occur as a result of relocating transmission line towers.

TVA Reply to REBB.2

The Environmental Report submitted to Support the BFN Units 2 and 3 applications indicated that some transmission line towers adjacent to substations may need to be relocated to accommodate potential modifications inside the substations. However, since submittal of the initial license applications, TVA has updated its Transmission System Study and determined these modifications will not be necessary. Therefore, TVA has no plans to relocate any transmission system towers to accommodate EPU operation.

NRC Request REBB.3

Address whether there are any potential affects from increased noise on fauna due to the additional cooling tower operation mentioned on page 7-2 of Enclosure 2 to the submittal dated June 25, 2004.

TVA Reply to REBB.3

In the Environmental Impact Statement issued in 2002 for the Operating License Renewal of the Browns Ferry Nuclear Plant (Section 3.19), noise surveys and projections of noise levels were conducted, focusing on the impacts to the nearby human residents of the BFN site. The results of these surveys and predictions indicated that the noise level of the cooling towers would be barely audible past the site boundaries. The area around the cooling towers has been an industrialized area for over 30 years, and wildlife species commonly observed in the area include those species that are less sensitive to human disturbance and that are common in the region. The noise produced during cooling tower operation is a combination of low-frequency steady humming produced by the cooling tower fans and sounds associated with the cascading water through the cooling tower fill - a sound not unlike a waterfall. Under normal operation, there are no high-pitched sounds or intermittent loud noises that would serve to disrupt local wildlife. On-site observations indicate that the wildlife in the area has adapted to the industrial noise of the site, and there is no indication that operation of the cooling towers disturbs the wildlife in the area. There are no listed endangered species within 5 miles of the BFN site, which, in any case is well beyond the audible range of noises associated with cooling tower operation.

NRC Request REBB.4

Page 7-2 of Enclosure 2 of the submittal dated June 25, 2004, indicates that the report compiled consistent with the Environmental Protection Agency's Phase II rule for Section 316(b) of the Clean Water Act would be issued in the fall of 2005. Provide the Phase II 316(b) report that was estimated to be issued in the fall of 2005.

TVA Reply to REBB.4

Our initial estimate regarding the availability of the requested report by fall of 2005 has changed. Due to sampling schedule changes and subsequent data analysis work loads by the contractor compiling the report, we now expect to have the report available in early summer 2006.

NRC Request REBB.5

Identify any changes to the Enclosure 2 of the submittal dated June 25, 2004, including modifications and additional information, since completion of the Environmental Report in 2004. Beyond any identified changes, confirm the validity of the 2004 Environmental Report as it will be used in the Nuclear Regulatory Commission's (NRC's) environmental analysis.

TVA Reply to REBB.5

On May 19, 2004 the TVA Board of directors approved the preferred alternative in the Reservoir Operations Study (ROS) Final Environmental Impact Statement, and directed TVA staff to begin implementing the new operating policy for the Tennessee River and tributary system on June 1, 2004. Record of Decision and additional information are available on TVA's external website at www.tva.gov.

The new operating policy maintains TVA's ability to meet fundamental responsibilities for flood control, commercial navigation, and power production, while protecting water quality and accommodating increased demands created by recreational and residential growth. It shifts the focus of TVA reservoir operations from achieving specific summer pool elevations on TVA-managed reservoirs to managing the flow of water through the river system.

Highlights of the new operating policy include leaving reservoir levels higher through Labor Day and continuing to ensure areas prone to flooding will not have an increased flooding risk as a result of changes in the operating policy. Winter water levels on Wheeler Reservoir in North Alabama (where BFN is located) will be higher under the new policy to provide a greater depth for navigation.

As noted in the Upstream River Temperature portion of the Model Overview in the Hydrothermal Modeling of Browns Ferry Nuclear Plant With Units 1, 2, and 3 at Extended Power Uprate report dated February 2005, "… it is anticipated that changes in river flow brought about by the ROS will have only a minor impact on the running 24-hour average temperature upstream of BFN. …" A full copy of the report is provided in Enclosure 7.

As provided in the TVA reply to REBB.2 above, the Environmental Report submitted to support the BFN Unit 1 application indicated that some transmission line towers adjacent to substations may need to be relocated to accommodate potential modifications inside the substations. However, since submittal of the initial license application, TVA has updated its Transmission System Study and determined these modifications will not be necessary. Therefore, TVA has no plans to relocate any transmission system towers to accommodate EPU operation.

The data and conclusions reached in Enclosure 2 of the submittal dated June 25, 2004 remain valid except as noted above.

SPSB (SPLB-A)

NRC Request SPLB-A.1

Refer to, Section 7.4 of the Enclosure 4 of the June 25, 2004, submittal, NEDC-33047P, DRF 0000-0011-1328, Revision 2, Browns Ferry Units 2 and 3 Safety Analysis Report for Extended Power Uprate, or the PUSAR and Enclosure 7, Browns Ferry Extended Power Uprate Listing of Planned Modifications, and provide additional information for the following:

a) Describe the impact that EPU will have on the plant response to the loss of a condensate pump and/or condensate booster pump, including a discussion of the reactor FW pump (RFP) response, design features that prevent a loss of all RFPs, how margins to RFP trip are affected, and any design or operational changes that are necessary to achieve acceptable performance.

b) Describe the impact that EPU will have on the plant response to the loss of an RFP, including design features that prevent a loss of all RFPs, how margins to RFP trips are affected, and any design or operational changes that are necessary to achieve acceptable performance.

c) Describe transient testing that will be performed to assure acceptable performance with respect to a) and b) above, or provide proper justification(s) for why testing is not warranted.

TVA Reply to SPLB-A.1

a) Prior to EPU, the unit can not operate at 100% power with a loss of a condensate, condensate booster, or feedwater pump. As a result of condensate pump (CDP), condensate booster pump (CBP) and reactor feedwater pump (RFP) upgrades that will be made prior to or as part of EPU implementation, the plant will be able to operate at full EPU power with adequate NPSH following the loss of a single CDP, CBP or RFP. The RFP response to the trip of a CDP or a CBP will be that the feedwater control system will cause the RFPs to increase in speed to maintain reactor vessel water level. Adequate RFP margins to trip on low suction pressure are being maintained by the pump upgrades. Prior to EPU, the RFPs normally operate with approximately 120 PSIG of suction pressure trip margin. The post-EPU RFP suction pressure will normally have approximately 90 PSIG of trip margin. With the loss of a CDP or CBP post-EPU, the RFP suction pressure trip margin will reduce to approximately 55 or 57 PSIG, respectively.

b) As noted in the response to Item "a" above, pump upgrades will be made prior to or as part of EPU implementation, including new, larger reactor feedwater pumps and upgraded RFP turbine drives. These upgrades will allow the plant to operate at full EPU power following the loss of a single RFP with adequate suction pressure for the remaining RFPs. Adequate RFP margins to trip on low suction pressure are being maintained by the EPU pump upgrades. With the loss of a RFP post-EPU, the RFP suction pressure trip margin will reduce from approximately 91 PSIG to 84 PSIG. The RFP response to the trip of one RFP will be that the feedwater control system will cause the remaining RFPs to increase in speed to maintain reactor vessel water level. Presently, BFN has a reactor recirculation runback interlock that is initiated based on reactor vessel water low level and a RFP low flow. At current power levels, as well as at EPU conditions, a recirculation pump runback does not occur on a single RFP trip and is not necessary to prevent a reactor low water level scram.

c) During startup and power ascension for EPU, system operating data will be recorded to confirm the design parameters and assumptions used in the analytical models in order to validate the predicted response of the system. Additionally, dynamic feedwater flow testing will be performed during start-up, which will confirm the stable response of the reactor water level control system when subjected to prompt flow changes. As further validation of the hydraulic design, a CDR, CBP, and RFP trip test will be performed at EPU power levels.

NRC Request SPLB-A.2

Implementation of the proposed EPU for BFN Units 2 and 3 requires increased volumetric flow rates, which result in higher flow velocities and flow volumes in the existing piping systems for the uprate conditions. Provide the calculated flow velocities that will result due to the proposed EPU conditions, and compare them to the design criteria and industry guidelines for plant systems such as main steam and associated systems, condensate and FW system, and other plant systems that are affected. Also, discuss in detail any dynamic loading and water hammer affects that the EPU will have on system functional and design capabilities.

TVA Reply to SPLB-A.2

Flow velocities increase in several systems as shown in the following tables. These were calculated by using a PEPSI heat balance model and the GE heat balance. The maximum recommended velocities are taken from the references listed in the tables. Flow velocities for Extraction Steam, Condensate and Feedwater, Heaters and Heater Drains, and Main Steam are show in Tables SPLB-A.2-1 through 4. Proposed EPU modifications are reflected in the results. Velocities that are higher than the recommended velocities are shown in **bold**.

Piping segments with velocity greater than the recommended velocity are considered for additional monitoring to ensure that the piping will continue to perform its intended functions during EPU operation. These monitoring activities include evaluation for addition and/or revision to the flow accelerated corrosion program.

The turbine stop valve closure transient is the only dynamic pipe load that is impacted by EPU since the transient is dependent on flow rate. The main steam piping between the outboard containment anchors and the high pressure turbine was evaluated for pressure, thermal, and transient loading and found to be acceptable.

Table SPLB-A.2-1: Extraction Steam Velocity

Line Branch Description	Velocity at 120% Power (fps)	Recommended Velocity (fps)[1]
Moisture Separator Cross around to #1 Heaters (18″)	96.7	150
Moisture Separator Cross around to #1 Heaters (24″)	79.8	150
Moisture Separator Cross around to #1 Heaters (30″)	106.2	150
Low Pressure Turbine to #5 Heaters	53.1	125
Low Pressure Turbine to #4 Heaters	80.1	150
Low Pressure Turbine to #3 Heaters	128.6	150
Low Pressure Turbine to #2 Heaters (24″)	125.8	150
Low Pressure Turbine to #2 Heaters (12″)	**157.4**	150

1. These values are consistent with industry and TVA design standards and practices.

Table SPLB-A.2-2: Condensate and Feedwater Velocity

Line Branch Description	Velocity at 120% Power (fps)	Recommended Velocity (fps)[1]
Condenser to Condensate Pumps	3.8	4
Condensate Pumps Bypass to Demineralizers (Unit 1)	18.9	25
Condensate Pumps Bypass to Demineralizers (Units 2/3)	**44.0**[2]	25
Condensate Pumps to Steam Packing Exhauster	1.0	25
Condensate Pumps to Steam Jet Air Ejectors (14″)	9.8	25
Condensate Pumps to Steam Jet Air Ejectors (10″)	4.3	25
Condensate Pumps to Off-Gas Condenser	12.1	25
Steam Packing Exhauster to Demineralizers	1.0	25
Steam Jet Air Ejector to Demineralizers (10″)	4.3	25
Steam Jet Air Ejector to Demineralizers (14″)	9.8	25
Off-Gas to Demineralizers	12.1	25
Header to/from A-K Demineralizer (12″)[3]	11.8	25
Header to/from G-K Demineralizer (30″)[3]	15.9	25
Header to/from D-F Demineralizer (24″)[3]	18.9	25
Header to/from B-C Demineralizer (18″)[3]	17.1	25
Condensate Pump Return Header (30″)	15.9	25
Condensate Pump Return Header (24″)	18.9	25
Demin to Condensate Tank	0.4	25
Demin Make-up to Condensate Tank	2.6	25

Table SPLB-A.2-2: Condensate and Feedwater Velocity

Line Branch Description	Velocity at 120% Power (fps)	Recommended Velocity (fps)[1]
Condensate Tank to Condenser Hotwell A	0.4	25
Condensate Tank Make-up to Condenser Hotwell A	2.6	25
Inlet to Condensate Booster Pump (30″)	15.9	25
Inlet to Condensate Booster Pump (18″)	15.2	25
Condenser Recirculation (10″)	18.5	25
Condenser Recirculation (12″)	12.9	25
Condensate Booster to #5 Drain Cooler	15.5	25
Condensate Outlet Header	16.2	25
Condensate Booster Discharge Header to #5 Drain Cooler	15.5	25
#5 Drain Cooler to #5 Heater	15.5	25
#5 Heater to #4 Heater	15.8	25
#4 Heater to #3 Heater	16.1	25
#3 Heater to Feedwater Pumps	16.7	25
Feedwater Pumps to #2 Heaters (18″)	18.7	25
Feedwater Pumps to #2 Heaters (24″)	21.0	25
Feedwater Pumps to #2 Heaters (30″)	19.0	25
#2 to #1 Heater	15.4	25
#1 Heater to Reactor Vessel External Check Valve (18″)	19.8	25
#1 Heater to Reactor Vessel External Check Valve (30″)	20.0	25
#1 Heater to Reactor Vessel External Check Valve (24″)	16.6	25
Feedwater line A/B External to Internal Check Valve	16.6	25
Internal Check Valve to Reactor Vessel (20″)	8.0	25

Table SPLB-A.2-2: Condensate and Feedwater Velocity

Line Branch Description	Velocity at 120% Power (fps)	Recommended Velocity (fps)[1]
Internal Check Valve to Reactor Vessel (24")	8.3	25
Inlet to Reactor Vessel	19.9	25

1. These values are consistent with industry and TVA design standards and practices.
2. This line is being replaced with a 24" line which will lower the velocity to less than 25 fps.
3. There are ten demineralizers and associated piping segments. The line velocities are the same for each noted section, so individual velocities are not repeated.

Table SPLB-A.2-3: Heaters and Heater Drains Velocity

Line Branch Description	Velocity at 120% Power (fps)	Recommended Velocity (fps)[1]
Moisture Separator to #2 Heaters (18″)	1.1	25
Moisture Separator to #2 Heaters (4″)	20	25
Moisture Separator to #2 Heaters (6″)	8.8	25
Moisture Separator to #2 Heaters (16″)	33.8	150
Drains from #1 to #2 Heaters (HI, 8″)	5.1	25
Drains from #1 to #2 Heaters (LO, 8″)	12.9	25
Drains from #2 to #3 Heaters (HI, 14″)	6.4	25
Drains from #2 to #3 Heaters (HI, 10″)	10.6	25
Drains from #2 to #3 Heaters (LO, 12″)	26.79	150
Drains from #2 to #3 Heaters (LO, 14″)	21.9	150
Bypass from #2 Heaters High level dump Valve to Condenser	**990.8**[2]	150
Drain from #3 Heaters to #4 Heater (HI, 16″)	5.6	25
Drain from #3 Heaters to #4 Heater (HI, 10″)	12.9	25
Drain from #3 Heaters to #4 Heater (LO, 12″)	59.2	125
Drain from #3 Heaters to #4 Heater (LO, 20″)	23.0	125
Drain from #4 Heaters to Flash Tank (HI)	5.1	25

Table SPLB-A.2-3: Heaters and Heater Drains Velocity

Line Branch Description	Velocity at 120% Power (fps)	Recommended Velocity (fps)[1]
Drain from #4 Heaters to Flash Tank (LO, 12″)	**165.6**	150
Drain from #4 Heaters to Flash Tank (LO, 26″)	37.4	125
Drain from #4 Heaters to Flash Tank (LO, 18″)	80.1	125
Bypass from #4 Heater High Level Dump valve to Condenser (14″)	**1133.6**[2]	125
Flash Tank Drain to Heater #5 Drain Cooler	54.9	125
Flash Tank Vent to Heater #5	**143.8**	125
Heater #5 Drain	1.4	25
#5 Drain Cooler to Condenser (HI)	6.2	25
#5 Drain Cooler to Condenser (LO, 12″)	6.5	25
#5 Drain Cooler to Condenser (LO, 18″)	6.5	25
#5 Drain Cooler to Condenser (LO, 12″)	6.5	25

1. These values are consistent with industry and TVA design standards and practices.
2. This line is only used to provide a bypass past the subject heater during start ups and if the normal level control valve should become unable to control normal flow. The length of pipe from the valve to the condenser is kept very short and the duration of use is kept to a minimum.

Table SPLB-A.2-4: Main Steam Velocity

Line Branch Description	Velocity at 120% Power (fps)	Recommended Velocity (fps)[1]
Main Steam Line A (26")	178[2]	333
Main Steam Line A (24")	220[2]	333
Main Steam Line B (26")	181[2]	333
Main Steam Line B (24")	224[2]	333
Main Steam Line C (26")	182[2]	333
Main Steam Line C (24")	225[2]	333
Main Steam Line D (26")	180[2]	333
Main Steam Line D (24")	223[2]	333

1. TVA BFN Design Criteria BFN-50-7001, "Main Steam System"
2. The numbers shown here are the maximum velocities through the main steam lines from the Unit 1 evaluation and bound all of the values for Units 2 and 3.

NRC Request SPLB-A.3

Referring to Standard Review Plan (SRP) Section 3.4.1, describe the impact of EPU on flooding as a consequence of postulated tank and vessel failures.

TVA Reply to SPLB-A.3

The tanks and vessels that are of interest for consideration of flooding are as follow:

- Condensate Storage Tank,
- Demineralized Water Storage Tank, and
- Suppression Pool.

The water volumes and design limits of the Condensate Storage Tanks, the Demineralized Water storage tanks, and the Suppression Pools are unaffected by EPU. Thus, there is no increase in the consequences of a pipe rupture in systems supplied by these water sources.

NRC Request SPLB-A.4

Refer to Matrix 5, Section 2.5.1.2.1 of the letter dated February 23, 2005, which states that "[t]he BFN internally generated missiles evaluations are not impacted by BFN EPU." In light of higher FW flows, possibly higher FW system pressures, and transient response following the proposed power uprate, discuss the basis for this conclusion.

TVA Reply to SPLB-A.4

Increased feedwater flow due to EPU operation requires replacement of the feedwater pumps. The new feedwater pumps will use the existing suction and discharge connections; they are oriented in the same direction; and they will be operated in the same manner as the existing pumps. Therefore, the existing missile evaluation remains valid. The pumps are located in the turbine building where no safety-related structures, systems, or components (SSCc) are located. However, the feedwater piping does go from the turbine building to the reactor building, and in doing so passes close to safety-related SSCs. These SSCs are protected from high energy line breaks from systems like the feedwater system by pipe whip restraints and missile barriers. The existing design of the pipe whip restraints and missile barriers is based on the system design pressure and not on the system operating pressure. Since the feedwater system design pressure is not changing, no changes are required to the pipe whip restraints or missile barriers associated with the feedwater system. Thus, there is no adverse impact on safety related SSCs from the higher feedwater system operating pressures.

Transients which affect the feedwater pumps and turbines will be limited by the protective features of the feedpump control. Thus, there is no adverse impact associated with transients on the feedwater system.

NRC Request SPLB-A.5

Discuss the current turbine control and overspeed protection features/systems, and by referring to Section 7.1 of the PUSAR explain:

a) The impact that EPU modifications will have on the existing turbine overspeed protection features and requirements, and how protection from turbine overspeed will continue to be assured, including turbine overshoot considerations,

b) The changes that are required for the turbine overspeed protection trip setpoints, and,

c) The impact that EPU will have on the capability to protect equipment important to safety from the effects of turbine missiles.

TVA Reply to SPLB-A.5

a) As stated in 7.1 of the PUSAR, the overspeed calculation compares the entrapped steam energy contained within the turbine and the associated piping, after the stop valves trip, and the sensitivity of the rotor train for the capability of overspeeding. The entrapped energy increases slightly for the EPU conditions.

The scenario considered is the emergency case where the EHC controls and the Control and Intercept Valves fail to respond to the initial overspeed due to a load rejection event. For this scenario, the unit rapidly accelerates to the overspeed trip set point, thereby trip closing the main and intermediate stop valves.

The operating condition analyzed was the maximum power, Valves Wide Open case, with low backpressure. This approach accounts for the two basic contributors to peak overspeed due to a load rejection event: 1) the energy due to entrapped (or entrained) steam within the steam path and inlet piping downstream of the main and intermediate steam valves; and 2) what is termed "valve lag overspeed," which takes into account the energy contributed by new steam entering the machine during response time of the control and trip systems, and during the actual closing time of these valves.

The overspeed trip set point is established such that the resulting peak speed will not exceed the 120% emergency overspeed limit due to overshoot. This ensures that the turbine is protected in an overspeed event.

b) The turbine and turbine control system design changes for EPU are in progress and the specific control setpoints have not been established. The setpoints will be adjusted to ensure that the turbine will not exceed 120% of rated speed due to overshoot.

c) Equipment important to safety associated with the plant is protected from main turbine missiles by physical barriers and favorable alignment. Additionally, the Independent Spent Fuel Storage Installation has been evaluated and determined acceptable with regard to plant generated main turbine missiles using the EPU turbine failure probability analyses as input. Additional details are provided in the reply to

SRXB-A.23. The effect of EPU is offset by ensuring that the turbine speed will not exceed 120% of rated during an overspeed event.

NRC Request SPLB-A.6

Referring to Section 10.1 and 10.2 and Table 10-1 of the PUSAR, explain why safety-related systems, structures, and components (SSCs) will not be affected due to postulated high energy line breaks and medium energy line breaks at the proposed EPU conditions. In Section 10.1.3, it is stated that the mass and energy releases for double-ended breaks and critical cracks in FW lines were re-analyzed at EPU conditions, but no conclusions were drawn regarding the protection of SSCs important to safety from these postulated breaks. Also, in Table 10-1, changes in mass releases are noted for FW line breaks in the steam tunnel or main steam valve vault and for reactor water cleanup breaks in the Reactor Building, but there is no discussion of the consequences and why they are acceptable. Please provide justification regarding acceptability of these releases or whether they are bound by the current licensing basis regarding the protection of SSCs from these postulated breaks.

TVA Reply to SPLB-A.6

BFN's EQ program includes evaluation of all required equipment with consideration for bounding temperature profiles based on the entire range of break sizes resulting from a breach in a particular system. The results of HELB analyses that were performed to support EPU conditions are given in PUSAR Table 10-1. This table shows that the maximum change in area temperatures was minimal (e.g., < 10°F for the RWCU break conditions). With such a small maximum change, the bounding EQ temperature profiles for an RWCU break were unaffected by EPU conditions. The change due to EPU was low relative to the temperature resulting from other breaks and particularly when compared to the qualification temperatures of equipment located in the reactor building. The effect of this slightly higher temperature was found to be within the qualification limits of all required equipment located in these areas. As discussed in section 10.3 of the PUSAR, the effects on various types of equipment were evaluated to ensure that equipment qualification is maintained, including the slightly higher area temperature effects due to the change from EPU conditions.

NRC Request SPLB-A.7

Provide a discussion of the Turbine Gland Sealing System (TGSS), and confirm that the capability of the TGSS to contain activated nitrogen and to limit exposure to radiation will not be impacted by the proposed power uprate.

TVA Reply to SPLB-A.7

As stated in 11.4 of the BFN UFSAR, each turbine sealing system includes a steam seal regulator with the necessary valves to maintain a constant positive pressure in the steam seal supply header and a single steam-packing exhauster condenser equipped with two full-capacity blowers to prevent steam leakage at the turbine shaft seals. The turbine sealing system prevents the leakage of steam into the turbine building and also prevents the leakage of air into the main condenser. During normal power operations, a pressure regulator valve and two seal steam header unloader valves maintain the seal steam header pressure at approximately 4 psig. To regulate the seal steam header pressure, the unloader valves divert excess seal steam to the main condenser. For EPU, larger unloader valves are being installed to provide additional capability to maintain the seal steam header pressure at approximately 4 psig. EPU conditions will not affect the capability of the turbine sealing system to contain activated nitrogen and to limit exposure to radiation.

NRC Request SPLB-A.8

a) In Section 6.4.5 of the PUSAR, it is stated that:

> the service water (UHS [ultimate heat sink]) temperature assumed in the DBA [design-basis accident] analyses was increased from 92 °F to 95 °F. Therefore, the TS [Technical Specifications] for UHS limits are changed to reflect these new analyses.

Discuss all UHS licensing basis considerations and justify the proposed TS change with respect to these considerations, including confirmation that the analyses and assumptions that were used to justify the proposed change are the same as those used to justify the original UHS temperature limit. Also, confirm that data trends (e.g., air and water temperatures, humidity, wind speed, water volume) do not establish more severe conditions than those assumed in the analyses that were performed.

b) Also, the last paragraph in Section 6.4.5 states that:

> The UFSAR includes a discussion relative to heatup of the downstream portion of the pool that would exist following the loss of the downstream dam on the Tennessee River. The river thermal rise post-shutdown would increase due to the increase in decay heat associated with EPU conditions but would not significantly affect this event.

Specifically, describe what the significance is with respect to water inventory and limiting water temperature considerations.

c) Explain how instrument uncertainties are accounted for when confirming that the TS limit is not exceeded.

TVA Reply to SPLB-A.8

a) The quoted text in the NRC request only exists in the Units 2 and 3 PUSAR. No TS change for RHR Service Water (RHRSW) UHS temperature is being requested for Unit 1. It is also noted that PUSAR Section 6.4.5 applies to TS Section 3.7.1, "Residual Heat Removal Service Water System (RHRSW) and Ultimate Heat Sink (UHS)." TS Surveillance Requirement 3.7.2.1 for TS Section 3.7.2, "Emergency Equipment Cooling Water (EECW) System and Ultimate Heat Sink (UHS)," already specifies "average water temperature of UHS is $\leq$ 95°F." It is not affected by this change.

For BFN, the original licensing basis RHRSW temperature for the DBA analysis was 95°F. As part of the BFN Units 2 and 3 5% power uprate (TVA to NRC letter dated October 1, 1997, "Browns Ferry Nuclear Plant (BFN) - Units 2 and 3 - Technical Specification (TS) Change TS-384 - Request for License Amendment for Power Uprate Operation"), the DBA LOCA long term containment temperature response evaluation was evaluated with a RHRSW temperature decrease to 92°F. As shown in TS Figure 3.7.1-1, the current TS requires reactor thermal power to be reduced for UHS temperatures greater than 92.5°F. The Unit 1 licensing basis RHRSW temperature was not changed by the 5% power uprate request for Units 2 and 3, and is unchanged from the original temperature of 95°F.

The overall licensing basis considerations for UHS consist of 1) cooling water supply to the RHRSW system for post-LOCA containment and suppression pool heat removal, 2) cooling water supply to the EECW system, and 3) water supply to the standby coolant supply connection. The TS change on Units 2 and 3 only affects the RHRSW inlet temperature (item 1). The UHS temperature associated with the EECW system (item 2) is unchanged for EPU and remains 95°F for all three units. The temperature of the UHS is not a consideration for the standby coolant supply function (item 3).

In the EPU analyses for all three units, the containment cooling and performance analyses were performed at a RHRSW temperature value of 95°F. The containment performance results at EPU conditions and a RHRSW temperature of 95°F are provided in Table 4-1 of the PUSAR. Based on the results of the containment system response analysis, the RHRSW UHS has adequate cooling/heat removal capability to perform its safety related functions with UHS temperature as high as 95°F.

For BFN, the UHS consists of the upstream portion of Wheeler Lake that supplies cooling water following a DBA. RHRSW system discharge returns to the downstream portion of Wheeler Lake. The UHS does not rely upon cooling systems to maintain a specified temperature. Variables such as air and water temperatures, humidity, wind speed, and water volume are not a consideration for a DBA. Historically, BFN has not been forced to reduce reactor thermal power due to the UHS exceeding the established design and licensing basis limit. Additionally, since the approval of the 5% power uprate for Units 2 and 3, BFN has not been forced to reduce reactor thermal power due to exceeding the current 92°F temperature limit.

b) UFSAR Section 2.4.2.2.2 contains a discussion of heatup of the downstream portion of the pool that would exist following failure of the downstream dam (Wheeler Dam). If Wheeler Dam were to fail, a pool of water approximately 1000 feet wide and seven miles long would be available at the BFN site. The trapped pool is essentially divided into two parts with about 33% downstream and 67% upstream of the diffusers. Heat rejection from the plant would result in a temperature distribution in the downstream portion of the pool. Diffusion of hot water in the upstream direction will be retarded by the restricted communication between the two portions of the pool. A combined heat rejection from BFN of the decay heat from all three reactors and the heat rejection from four diesel generator sets operating at full load will produce thermal rises of the river, based on minimum flow (100 cfs), as follows:

	River Thermal Rise	
Time After Shutdown	**Pre-EPU**	**EPU**
10 hrs	23°F	26°F
1 day	18°F	20°F
5 days	11°F	11°F

c) Daily surveillance includes the documentation of the UHS temperature when any unit is in Modes 1, 2, or 3. The range of the temperature indicator is 85°F to 95°F. The instrument has an inaccuracy of ± 1.2°F. Procedure requirements for TS SRs 3.7.1.2 and 3.7.2.1 require "… when indicated … river temperature is > 91°F … actions shall be initiated to verify the accuracy of the indications or to further evaluate the operability of the UHS."

NRC Request SPLB-A.9

Describe the impact that EPU will have on the capability of the liquid waste management system to limit offsite release of radioactive materials and to satisfy as low as reasonably achievable (ALARA) principles in accordance with the provisions of Title 10 to the *Code of Federal Regulations* (10 CFR) Section 20.1302; 10 CFR Part 50, Appendix I, Sections II.A and II.D; draft General Design Criteria (GDC)-70; and other licensing-basis criteria that apply.

TVA Reply to SPLB-A.9

The current quantity of liquid radwaste processed with Units 2 and 3 in power operation is approximately 21,000,000 gallons/year. The anticipated increase due to the restart of Unit 1 operating at EPU conditions along with EPU operation of Units 2 and 3 was calculated to be approximately 12,000,000 gallons/year for a total of approximately 33,000,000 gallons/year.

This volume of liquid radwaste calculated for three unit operations under EPU conditions remains well within the designed liquid radwaste system processing capacity of approximately 42,400,000 gallons/year.

The per reactor unit increase due to EPU operation was determined by evaluating the increase from the two major sources of additional liquid waste: the condensate filter demineralizer backwash and the reactor water clean up (RWCU) filter demineralizer backwash. EPU results in an increased flow rate through the condensate demineralizers, resulting in a reduction in the average time between backwashes. Similarly, the RWCU filter demineralizers require more frequent backwashes due to higher levels of impurities entering the reactor as a result of the increased feedwater flow.

EPU does not have an adverse effect on the capability or processing of liquid radwaste since it does not change flows, temperatures, or pressures in any portion of the liquid radwaste management system. There are no significant environmental effects. Under current operational practices, liquid radioactive material is released periodically from the plant under controlled conditions as part of planned evolutions. Such radioactive liquid effluents are controlled on a batch basis and each batch is sampled and analyzed prior to discharge. The limits for each release are defined to keep radioactive material concentrations (above background) in the discharge canal as low as practicable and below the limits given in 10 CFR 20.

Liquid radwaste processing is controlled by plant operating instructions. Batch transfers are made when tank levels or operating conditions warrant. Steps are contained in the operating instructions to notify the radiological protection organization during plant evolutions that could cause a rise in plant area radiation levels. Radwaste equipment is selected, arranged, and shielded to permit operation, inspection, and maintenance while keeping personnel exposures within the limits specified in 10 CFR 20 and applicable plant procedures. As stated above, operation of three units under EPU conditions will necessitate additional backwash operations beyond those currently required; however, given the liquid radwaste system design and the use of plant operating instructions, the increase in occupational dose to the plant staff will not be significant.

NRC Request SPLB-A.10

Describe the impact that EPU will have on the capability of the gaseous waste management system to limit offsite release of radioactive materials and to satisfy ALARA principles in accordance with the provisions of 10 CFR 20.1302; 10 CFR Part 50, Appendix I, Sections II.A and II.D; draft GDC-70; and other licensing-basis criteria that apply.

TVA Reply to SPLB-A.10

The gaseous radwaste system is designed to limit offsite doses from routine plant releases to significantly less than the limits or guideline values given in applicable NRC rules and regulations and to stay within the limits established in the plant operating license. Shielding has been provided as necessary for process piping and equipment. Noncondensable radioactive offgas is continuously removed from the main condenser by the air ejectors during plant operation. This offgas volume is the major source of radioactive gases and is larger than all other plant sources combined. Release limits for the offgas system are specified in the Offsite Dose Calculation Manual (ODCM). The offgas system is designed to control the release of plant-produced radioactive material to within the limits specified in the ODCM, and it is designed to meet the requirements of 10 CFR 20 and 10 CFR 50, Appendix I.

Offgas system airflow is not power dependent, but rather is a function of fuel cladding performance, main condenser air inleakage, charcoal adsorber inlet dew point, and charcoal adsorber temperature. The radiological release rate is administratively controlled to remain within existing site release rate limits.

Main condenser inleakage pathways are not affected by EPU, since the internal condenser vacuum levels are not changed by EPU operation. Because the condenser air inleakage and dynamic adsorption coefficient do not change as a result of EPU, adsorber holdup times under EPU conditions are unaffected. Plant maintenance and operations activities related to the off-gas system are not affected by EPU, so there is no negative ALARA impact for the plant staff.

NRC Request SPLB-A.11

Refer to Table 1, Comparison of BFN Initial Testing and Planned EPU Testing, in the letter dated April 25, 2005, and provide additional information for the following STP items:

a) STP 23 - Feedwater System:

Confirm that the FW system tests that are being conducted will include testing at the 100-percent EPU power level for the purposes described in the STP 23, which are:

i) to adjust the FW control system settings for all power and FW pump modes,

ii) to demonstrate stable reactor response to subcooling changes, and

iii) to demonstrate the capability of the FW system response in that one of the three operating FW pumps tripped and the automatic flow runback circuit acted to drop power to within the capacity of the remaining pumps, thereby preventing a reactor low water level scram.

b) STP 24 - Bypass Valves:

The original test description states that, "[o]ne of the turbine bypass valves was tripped open and closed. The pressure transient was measured and evaluated to aid in making final adjustments to the pressure regulator." Describe how the confirmatory test will be conducted to demonstrate:

i) the capability of the pressure regulator to minimize the reactor pressure disturbance while the plant is operating at 100-percent EPU power during an abrupt change in reactor steam flow, and

ii) that a bypass valve is capable of being tested for proper functioning at rated power without causing a high flux scram.

c) STP 25 - Main Steam Isolation Valves (MSIVs):

The original test description indicates that fast full closure testing of each MSIV was performed at hot standby and at selected power levels to determine the maximum power conditions at which individual valve full closure testing could be performed without causing a reactor scram, and that functional checks (10-percent closure) of each MSIV were performed at selected power levels above the maximum power condition for individual MSIV full closure. According to Table 1, these tests will not be repeated for EPU implementation. Explain how the maximum power conditions for performing individual MSIV full closure tests and functional tests during EPU operation will be determined such that MSIV testing during EPU operation will not result in a reactor trip.

d) STP 33 - Main Turbine Stop Valve Surveillance Test:

As described in STP 33, the purpose of this testing was to determine the highest reactor power level for performing daily TSV surveillance tests without causing a reactor scram. Describe how this power level will be determined for EPU operation.

TVA Reply to SPLB-A.11

a) Feedwater System Testing during EPU startup is planned as follows:

   i) Testing to adjust FW control system settings is part of normal testing conducted for power ascension after refueling outages at various power levels and will include testing at EPU power levels.

   ii) Testing to demonstrate stable reactor response to subcooling changes is part of normal testing conducted for power ascension after refueling outages at various power levels and will include testing at EPU power levels.

   iii) Testing to demonstrate the capability of the FW system response in that one of the three operating FW pumps is tripped will include testing at EPU power levels. At current power levels, as well as at EPU conditions, a recirculation pump runback does not occur on a single FW pump trip and is not necessary to prevent a reactor low water level scram. This testing will be performed to ensure that the two remaining pumps can maintain the proper water level thus preventing a low water level scram.

b) Bypass Valves testing during EPU startup is planned as follows:

   i) Testing to minimize reactor pressure disturbances will be performed during EPU startup. Testing will be done during startup to demonstrate smooth pressure control transition between control valves and bypass valves by introducing pressure step changes to check the basic stability of the pressure control loop and demonstrate proper control system settings. Pressure step changes will be input via the EHC control system as is accomplished in the current testing procedures.

   ii) Testing of the bypass valves via cycling of the valves will be performed during EPU startup testing to determine the highest acceptable power level without causing a scram. Testing will be performed at incremental power levels up to 100% of the EPU power level until testing criteria indicates scram setpoints are being approached.

c) MSIV testing during EPU startup is planned as follows:

Previously, BFN Technical Specifications required individual full closure of the MSIVs at least once per quarter. This requirement has been subsequently removed from the Technical Specifications. Full closure tests of the MSIVs are now performed to satisfy Inservice Testing (IST) program requirements on a cold shutdown and refueling outage frequency. Testing to determine the maximum power level at which the full closure can be performed is no longer necessary.

Partial closure testing of the MSIVs can be performed without a power reduction. The initial startup test did not include testing to determine maximum power conditions for performing the partial closure tests. Testing of the MSIVs will also include post modification testing as required by the EPU modifications to the MSIVs.

d) Main Turbine Stop Valve testing during EPU startup is planned as follows:

Testing of the main turbine stop valves via cycling of the valves will be performed during EPU startup testing to determine the highest acceptable power level without causing a scram. This testing will be performed at incremental power levels up to 100% of the EPU power level until testing criteria indicates scram setpoints are being approached. Note that cycling of the main turbine stop valves is currently performed on a quarterly basis instead of the previously required daily basis.

ACVB

NRC Request ACVB.1

Enclosure 3, Extended Power Uprate RS-001 Revised Areas of Review Matrix, of the letter dated February 23, 2005, Matrix 7, Section 2.7.2, addressed the ESF Atmosphere Cleanup.

a) Address whether the high efficiency particulate air and carbon adsorber filters have sufficient capacity to mitigate DBAs with respect to contaminant retention, efficiency, and no impairment of function with the increased EPU source term.

b) Clarify the extent to which the standby gas treatment system (SGTS) is shared among the three units and the impact of EPU on achieving a negative draw down pressure in the secondary containment.

c) Identify the maximum SGTS inlet temperature under EPU operating conditions and its relationship to any design inlet temperature limitations.

d) Clarify if the SGTS serves as the ventilation for spent fuel areas under DBA conditions and identify any impact resulting from EPU conditions such as fuel with higher burn up in the spent fuel pool (SFP).

TVA Reply to ACVB.1

a. As indicated in 4.5 of the PUSAR, TVA requested a license amendment on July 31, 2002 (ML-022200382), for a full scope application of AST methodology for BFN Units 1, 2, and 3. The AST submittal included the radiological dose consequences for the design basis accidents and included SGTS operating parameters at EPU conditions. NRC approved the license amendment by letter dated September 27, 2004 (Reference 8 Accession No. ML042730028). In the BFN AST analyses, the plant-specific product inventories were calculated which bounded the effect of two-year fuel cycles, power operation at EPU conditions (102% of 3952 MWt), and current and anticipated fuel designs.

In the DBA radiological analyses, no credit is taken for the SGTS charcoal adsorption of elemental iodine, organic iodine, or noble gases for any DBA. Additionally, credit for the SGTS HEPA filter particulate removal is only taken in the DBA LOCA analysis. A separate system evaluation of the SGTS and its function considered the capability of the High Efficiency Particulate Air (HEPA) filters and the charcoal adsorber bed removal efficiency for radioiodine and determined that there was sufficient design margin to accommodate additional fission product loading.

Based on these analyses and evaluations, the SGTS has sufficient capacity to mitigate DBAs with respect to contaminant retention, efficiency, and no impairment of function with the EPU source term.

b. The secondary containment at BFN is made up of the Reactor Building exterior walls, floors, penetrations, and the structure covering the refueling floor. The purpose of the secondary containment is to limit the release of radioactivity to the environs after an accident so the resulting dose is within the guideline values of 10 CFR 50.67. Secondary containment is divided into four ventilation zones which may be isolated independently of each other. However, the refueling zone and the three reactor zones are interconnected by way of equipment hatches. The SGTS aligns to each of the four secondary containment zones automatically in the event of a containment isolation signal.

EPU does not change the volume or alignment of the secondary containment, the normal operating conditions of the secondary containment atmosphere, nor the alignment, actuation, or operation of the SGTS. Therefore, the ability to achieve a negative draw down pressure in the secondary containment is not affected by EPU.

c. The maximum SGTS inlet temperature used in EPU analysis was 128°F at a filter train normal flow rate of 8100 cfm. The criterion for the system inlet temperature is ≤ 150°F at a filter train normal flow rate of ≥ 1000 cfm.

d. Under DBA conditions, the SGTS is aligned to the secondary containment which includes the refueling floor. The DBA event that involves the fuel pool is the refueling accident. The refueling accident was analyzed as part of the AST analyses discussed in 'a)' above. This analysis was performed at EPU conditions and included bounding fuel types and burnup. The radiological consequences of this accident are within regulatory limits.

NRC Request ACVB.2

Enclosure 3, Extended Power Uprate RS-001 Revised Areas of Review Matrix, of the letter dated February 23, 2005, Matrix 7, Section 2.7.3, addressed the Control Room (CR) Area Ventilation System. Describe what was considered in determining that there was no EPU effect. This discussion should include identification of the major cooling loads both inside the CR and outside the CR such as switchgear and motor control centers, that are cooled by this system and the potential to carry increased heat to the CR.

TVA Reply to ACVB.2

The scope of the evaluation determined the effect of EPU process temperature and electrical heat load changes on the Control Room HVAC System considering:

- present HVAC equipment capacity,
- area heat and electrical load changes, and
- area temperature changes.

The Control Bay HVAC systems serve the three floors in the control bay and the six shutdown electrical board rooms in the Reactor Building immediately adjacent to, and normally entered from, the control bay. There are several separate subsystems serving these areas. Included are the Control Bay, Units 1 and 2 Control Room (elevation 617), Units 1 and 2 elevation 593 (computer rooms, electrical board rooms, auxiliary instrument rooms), switchyard relay room (elevation 617), and the Unit 3 Control Room (elevation 617). The Unit 3 elevation 593 area is heated and cooled with a separate air supply system, but it is not thermostatically controlled. The air supply systems for three areas serve a group of rooms with only cooling. These areas are the Unit 1 Electric Board Rooms, Unit 2 Electric Board Rooms, and the Unit 3 Electric Board Rooms.

Each cable spreading room (rooms A and B - elevation 606) is ventilated by one 100% capacity fresh-air supply fan. Two 100% exhaust fans serve both of these rooms. These two rooms serve all three BFN units.

The Control Bay does not contain steam cycle process equipment, but rather it primarily contains the electrical and instrumentation equipment necessary to control the process equipment. There is no heat dissipation increase by this electrical and instrumentation equipment due to EPU operation. EPU does not impact the design conditions of the system evaluated and the present HVAC equipment capacity remains adequate.

NRC Request ACVB.3

Enclosure 3, Extended Power Uprate RS-001 Revised Areas of Review Matrix, of the letter dated February 23, 2005, Matrix 7, Section 2.7.4, addressed the SFP Ventilation System.

a) Discuss whether the SFP area is normally ventilated through the reactor building ventilation system or some other system and provide information on the impact of EPU on that system.

b) Certain information was noted in Section 6.6 of the PUSAR for increases in area temperatures of the reactor building. Address whether there are other effects relative to higher burnup fuel in the SFP that need to be addressed.

c) Discuss whether there any effects due to EPU on the ventilation system that could result from loss of SFP cooling. For ventilation under accident conditions, reference can be made to the SGTS if appropriate.

TVA Reply to ACVB.3

The Spent Fuel Pool (SFP) area is ventilated by the reactor building ventilation system. The general Reactor Building areas are heated, cooled, and ventilated during normal and shutdown operation by a once-through air system. The ventilation system provides 100% makeup air. The spent fuel pool cooling heat exchangers and pumps are located on floor elevation 621. The spent fuel pools themselves are located between floor elevations 621 and 664. There are no process temperature changes or electrical load changes associated with the Spent Fuel Pool Cooling System that result from EPU operation. The reactor building ventilation air is supplied to the reactor building spaces via supply fans, drawn through the building by roof-mounted exhaust fans, and then directly exhausted to the atmosphere via ductwork monitored for radiation. EPU does not impact the design conditions of the system, and the present HVAC equipment capacity remains adequate.

The primary EPU impact on SFP is an increase in the pool decay heat loads following discharge of spent fuel in refueling outages. Simply stated, operation at higher power levels requires the burn-up of more fuel, and therefore a greater heat load will accompany the discharge of this fuel in an outage. Spent Fuel Pool temperature will increase and makeup water demand will increase, but both parameters remain within existing acceptance criteria. Individual SFP system components are not affected by EPU. The Spent Fuel Pool Cooling System design flows, temperatures, and pressures are adequate for rejecting the increased SFP heat load. The Technical Specifications limit of 150 ^{o}F is not being changed, and the pool will therefore be maintained below this temperature during EPU operation in the same manner it is currently.

Loss of SFP cooling was evaluated for EPU conditions for both the batch and full core offload scenarios. Maximum boil off rates remain well within pool inventory make-up capacity. No SFP system modifications are required to support EPU. The existing SFP design temperature limits are unchanged for EPU conditions.

NRC Request ACVB.4

Enclosure 3, Extended Power Uprate RS-001 Revised Areas of Review Matrix, of the letter dated February 23, 2005, Matrix 7, Section 2.7.5, addressed the Auxiliary and Radwaste Area Ventilation System. A note to Section 2.7.5 indicates that there was no EPU effect. Provide a discussion addressing what was considered in determining that there was no EPU effect. This discussion should include identification of major cooling loads in this area and increased cooling requirements due to higher temperature components that could result in higher room temperatures.

TVA Reply to ACVB.4

The scope of the evaluation determined the effect of EPU process temperature and electrical heat load changes on the Radwaste Building Ventilation System considering:

- present HVAC equipment capacity,
- area heat and electrical load changes, and
- area temperature changes.

EPU does not impact the design conditions of the system evaluated and the present HVAC equipment capacity remains adequate. EPU results in no process temperature changes in the Radwaste Building. As discussed in the response to NRC Request SPLB-A.9, there is an increase in the volume of liquid radwaste which must be processed as a result of EPU operations, but the individual batch quantities of water being processed will only increase in number, not in process temperature. There will also be no additional work required for the processing of these additional batches, therefore there are also no electrical load changes. With no additional heat load from either the liquid radwaste volume or the work required to process it, it can be seen there is no additional load on the radwaste building HVAC equipment resulting from EPU operations.

NRC Request ACVB.5

Enclosure 3, Extended Power Uprate RS-001 Revised Areas of Review Matrix, of the letter dated February 23, 2005, Matrix 7, Section 2.7.6 addresses ESF Ventilation Systems. A note to Section 2.7.6 indicates that there are not changes to the ESF ventilation as a result of EPU. Provide a description of what was considered in determining that there was no EPU effect. This discussion should include identification of major cooling loads in this area and increased cooling requirements due to higher temperature components that could result in higher room temperatures, impact on filter efficiencies and loading, and impact on flow rates, if any.

TVA Reply to ACVB.5

EPU impacts on the air-conditioning and ventilation systems in the control bay and the electrical board rooms that are functionally part of the control bay spaces are discussed previously in the response to question ACVB.2. EPU impacts on the Unit 3 4-kV shutdown boards, the Diesel Generator Building, and the RHR pump and core spray pump areas in the reactor building are addressed below.

The scope of the evaluation determined the effect of EPU process temperature and electrical heat load changes on the Diesel Generator Buildings, Unit 3 4-kV shutdown board rooms, and RHR/core spray pump spaces considering:

- present HVAC equipment capacity,
- area heat and electrical load changes, and
- area temperature changes.

The 4-kV shutdown boards for Unit 3 are located in rooms within the Unit 3 Diesel Generator Building. The Unit 3 electric board rooms are cooled by redundant air-conditioning units.

The Diesel Generator Building (DGB) Heating, Ventilation, and Air Conditioning (HVAC) systems are designed to maintain the required environmental conditions for safety related equipment located in the Units 1/2 and the Unit 3 DGB. Ventilation cooling and fume removal from each of the eight (8) (DG) rooms is provided by one of two redundant exhaust fans (A & B per DG) with associated room inlet and outlet and fan discharge motor operated dampers. These fans discharge into a common exhaust plenum open to the atmosphere for each respective building.

The RHR pumps and the core spray pumps are located in the basement rooms of the Reactor Building. The heat loss from the motors, pumps, and piping is removed by air-cooling units. The air-cooling units are designed to maintain the air at 148°F when the unit is supplied with 95°F cooling water. An equipment area air-cooling unit starts automatically when a RHR pump (or a core spray pump) in that compartment starts. The air-cooling units also start automatically when compartment temperatures approach 100°F.

Due to EPU, there are minimal area heat load impacts in the core spray and RHR rooms. The temperature increase in the CS pump rooms is less than 3°F. The temperature increase in the RHR pump rooms is less than 2°F. Increase in suppression pool temperature increases the suppression piping heat loads. The torus space temperature also increases due to the increase in suppression pool temperature. The torus space adjoins the RHR and CS rooms and will increase the wall heat transfer load into these rooms. The heat rejection capacity for these room coolers was reviewed, and the coolers are deemed adequate for EPU conditions in the RHR and CS rooms.

In summary, the above ventilation systems affecting ESF equipment were reviewed to determine the primary heat loads and EPU impact. The present ventilation systems are adequate to support EPU operation.

NRC Request ACVB.6

Section 4.1.1 of the PUSAR addresses containment pressure and temperature response. Verify that all input parameters to the containment peak pressure and temperature, minimum pressure, environmental and subcompartment analyses remain the same as those in the UFSAR except for those affected by the power uprate. For example: containment volume, heat sink descriptions, heat exchanger performance, equipment flow rates and flow temperatures, initial relative humidity, ultimate heat sink temperature etc. … Justify any changes made for the power uprate analyses.

TVA Reply to ACVB.6

FSAR/CLTP values are for Units 2 and 3. EPU values are for all three units.

INPUT PARAMETERS	UNIT	FSAR/CLTP	EPU
Drywell Free Volume (including vent system)	ft^3	171,000	171,000
Credit Taken for Heat Sinks in LOCA	N/A	No	No
RHR Heat Exchanger k-factor	Btu/sec-°F	223	223
RHR Shell Side Flow (Minimum)	gpm	6,500	6,500
RHR Tube Side Flow (Minimum)	gpm	4,000	4,000
RHR Tube Side (Service Water) Temperature	°F	92	95
Suppression Pool Temperature	°F	95	95
Initial Drywell Relative Humidity	%	20	20
Initial Wetwell Relative Humidity	%	100	100

Input parameters, with the exception of "RHR Tube Side (Service Water) Temperature" for Units 2 and 3 are unchanged. Justification for this change was provided in TVA letter, T. E. Abney to NRC, "Browns Ferry Nuclear Plant (BFN) - Units 2 and 3 - Proposed Technical Specifications (TS) Change TS-418 - Request for License Amendment Extended Power Uprate (EPU) Operation," dated June 25, 2004. As stated in this letter, "… PUSAR Sections 4.1, "Containment System Performance," and 6.4.5, "Ultimate Heat Sink," provides the details for this change."

NRC Request ACVB.7

Provide graphs of wetwell and drywell temperature and pressure for the large break loss-of-coolant accident (LOCA), anticipated transient without scram (ATWS), Station Blackout (SBO) and limiting Appendix R fire events.

TVA Reply to ACVB.7

Containment temperature and pressure graphs for the large break LOCA (short-term and long-term) are provided in Figures ACVB.7-1, ACVB.7-2, ACVB.7-3, and ACVB.7-4. Containment temperature and pressure graphs for Appendix R are provided in Figures ACVB.7-5, ACVB.7-6, ACVB.7-7, and ACVB.7-8. Containment temperature and pressure graphs for SBO are provided in Figures ACVB.7-9 and ACVB.7-10. The suppression pool temperature and pressure graph for the ATWS event with greatest peak temperature/pressure (Pressure Regulator Failure Open [PRFO] at end-of-cycle) is provided in Figure ACVB.7-11. Drywell temperature and pressure are not provided for the ATWS. The containment model used for ATWS is a simplified control volume of the wet-well with boundary conditions of SRV flow providing the heat source and suppression pool cooling inputs for heat losses. The drywell is not explicitly modeled because all of the energy is delivered to the suppression pool and the drywell temperature and pressure conditions would simply follow the suppression pool response.

Figure ACVB.7-1: EPU Short-Term DBA-LOCA Containment Pressure Response

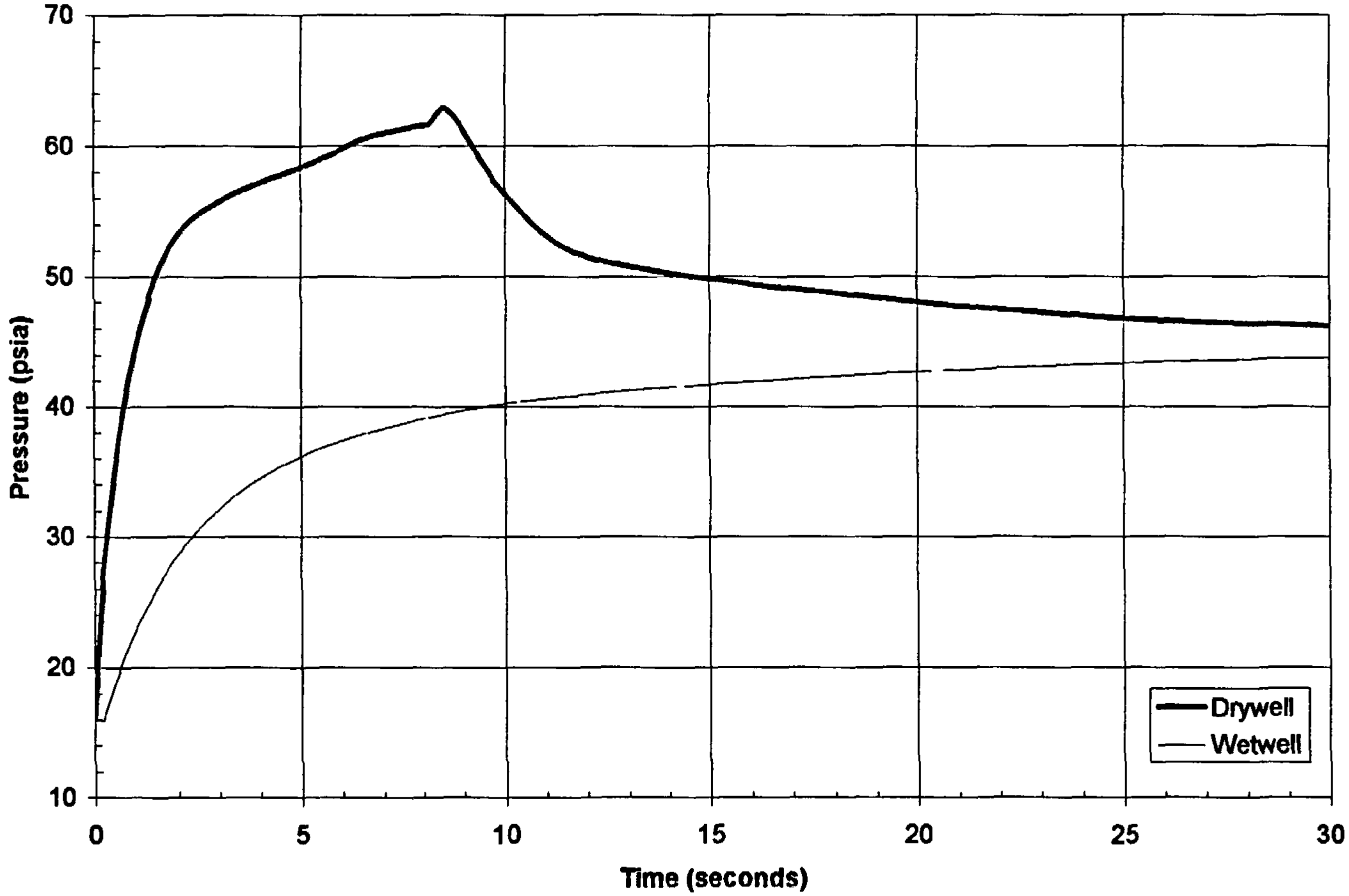


Figure ACVB.7-2: EPU Short-Term DBA-LOCA Containment Temperature Response

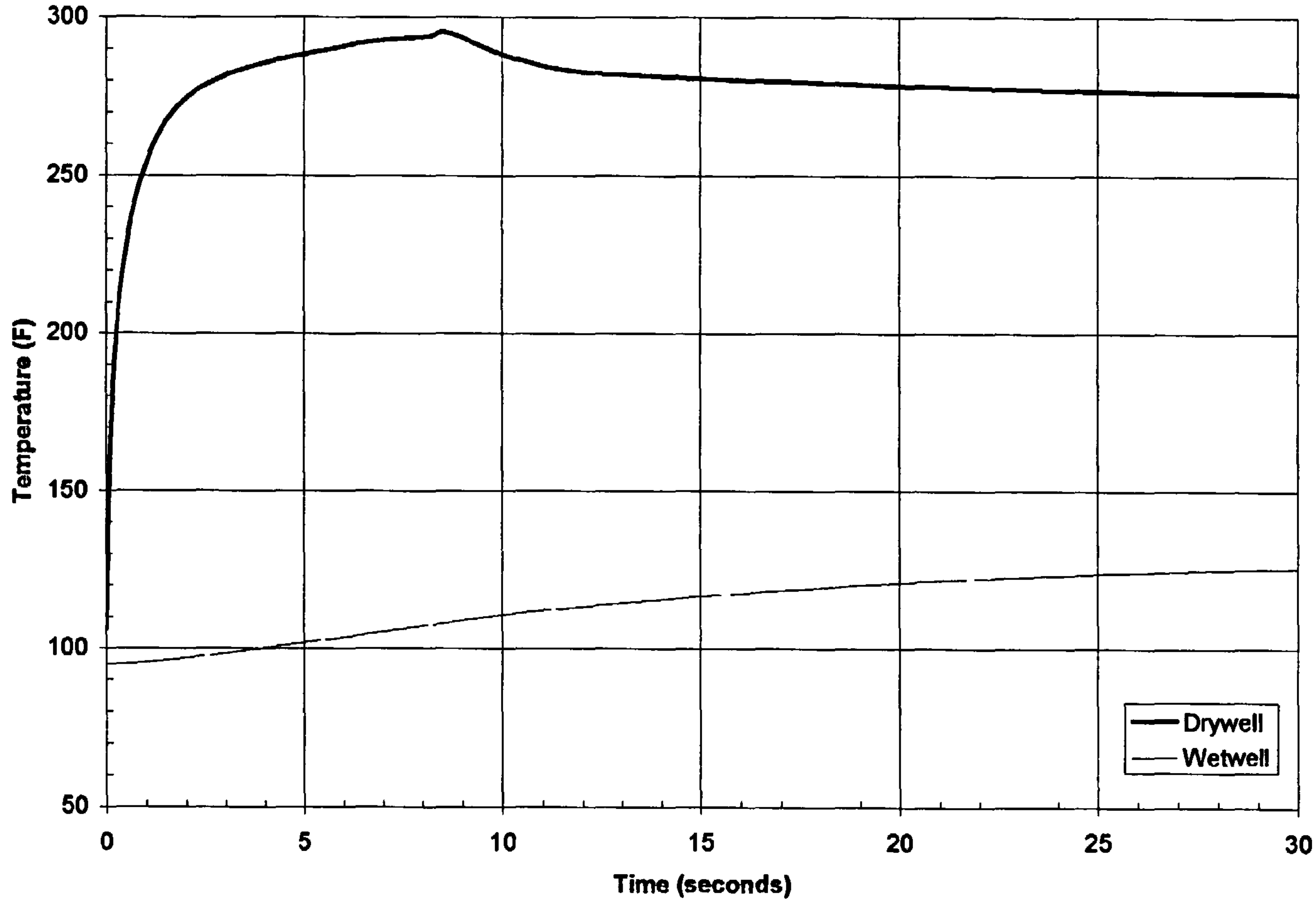


Figure ACVB.7-3: EPU Long-Term Containment Pressure Response To DBA-LOCA for Peak SP Temperature

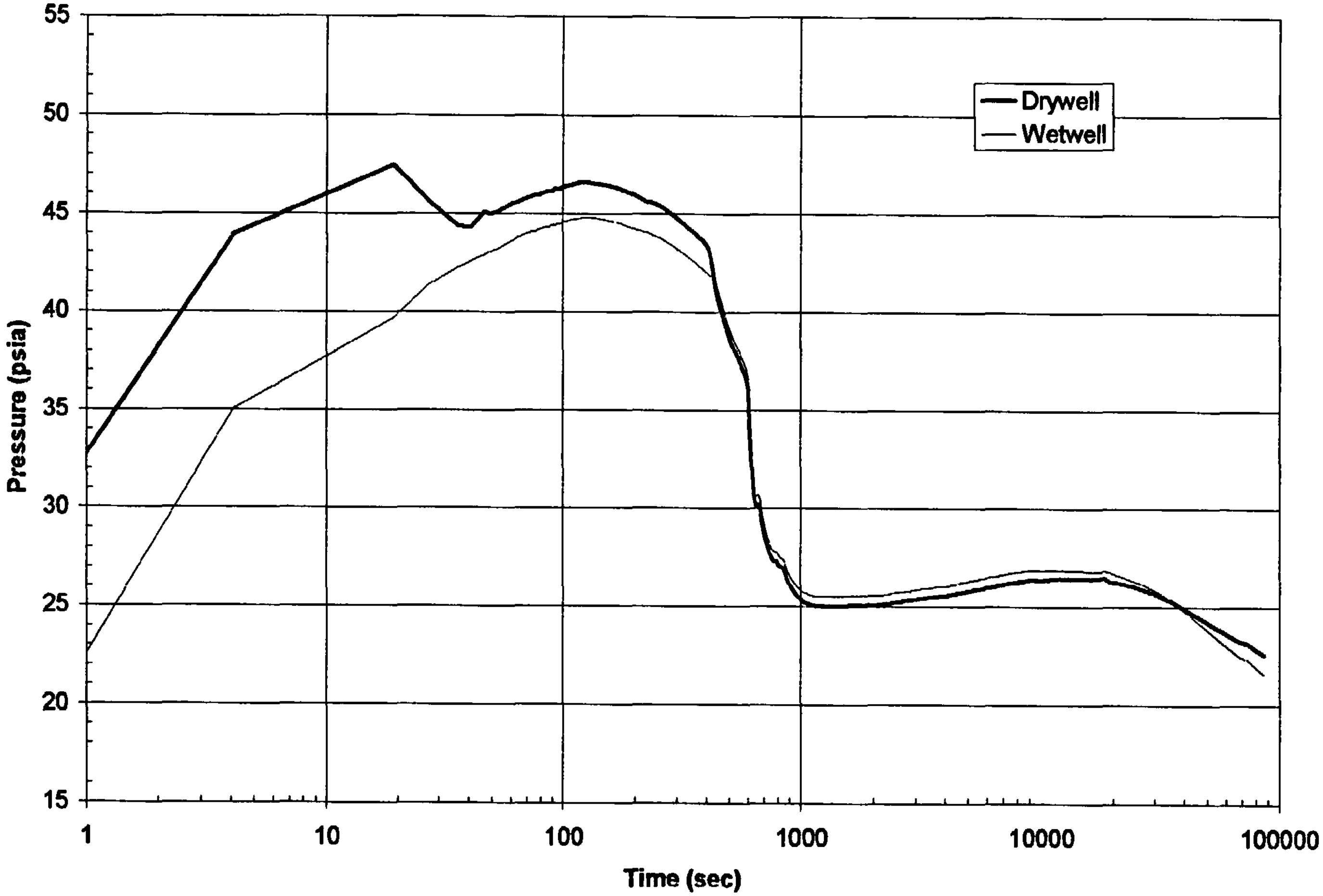


Figure ACVB.7-4: EPU Long-Term Containment Temperature Response
To DBA-LOCA for Peak SP Temperature

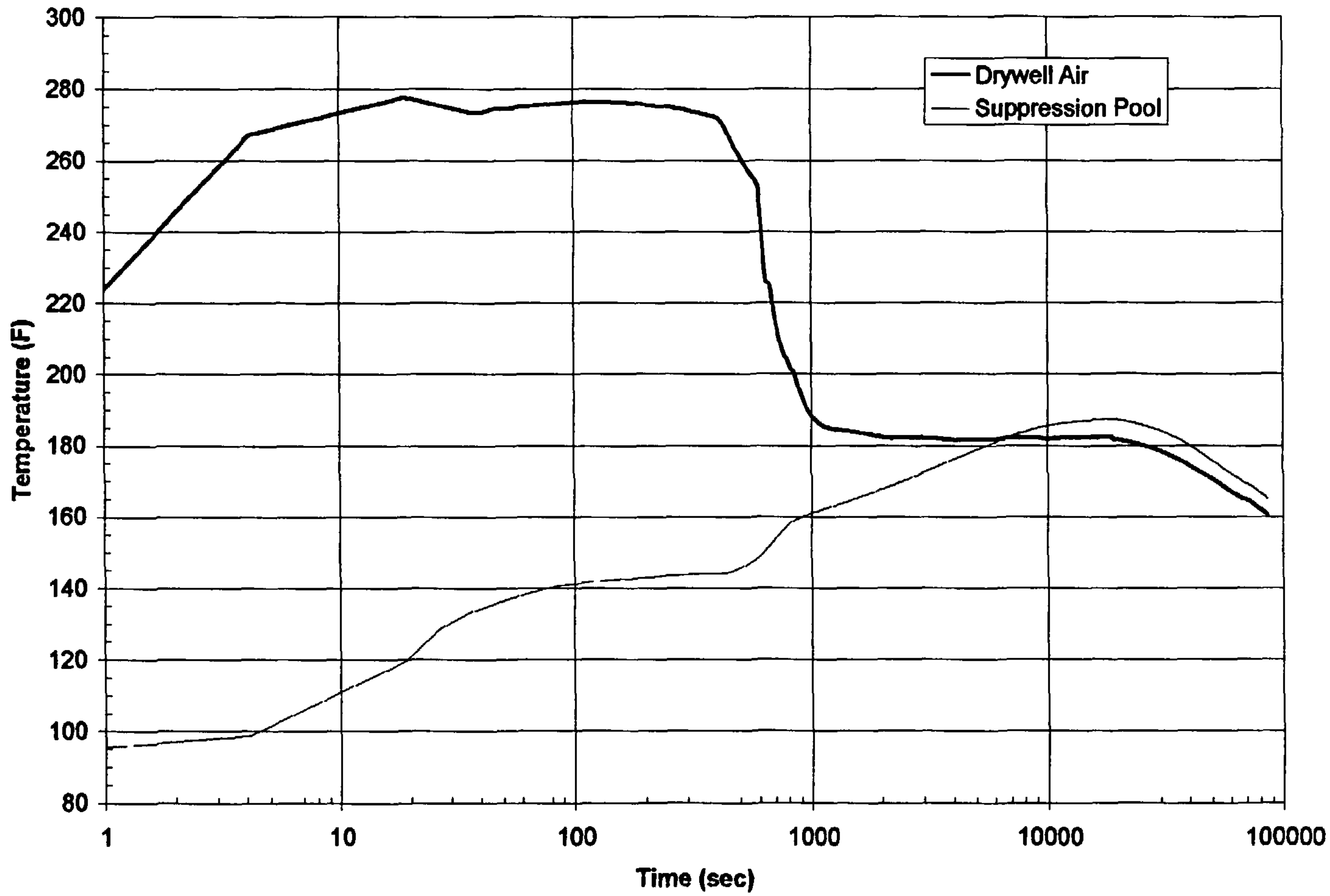


Figure ACVB.7-5: EPU Appendix R Drywell Pressure

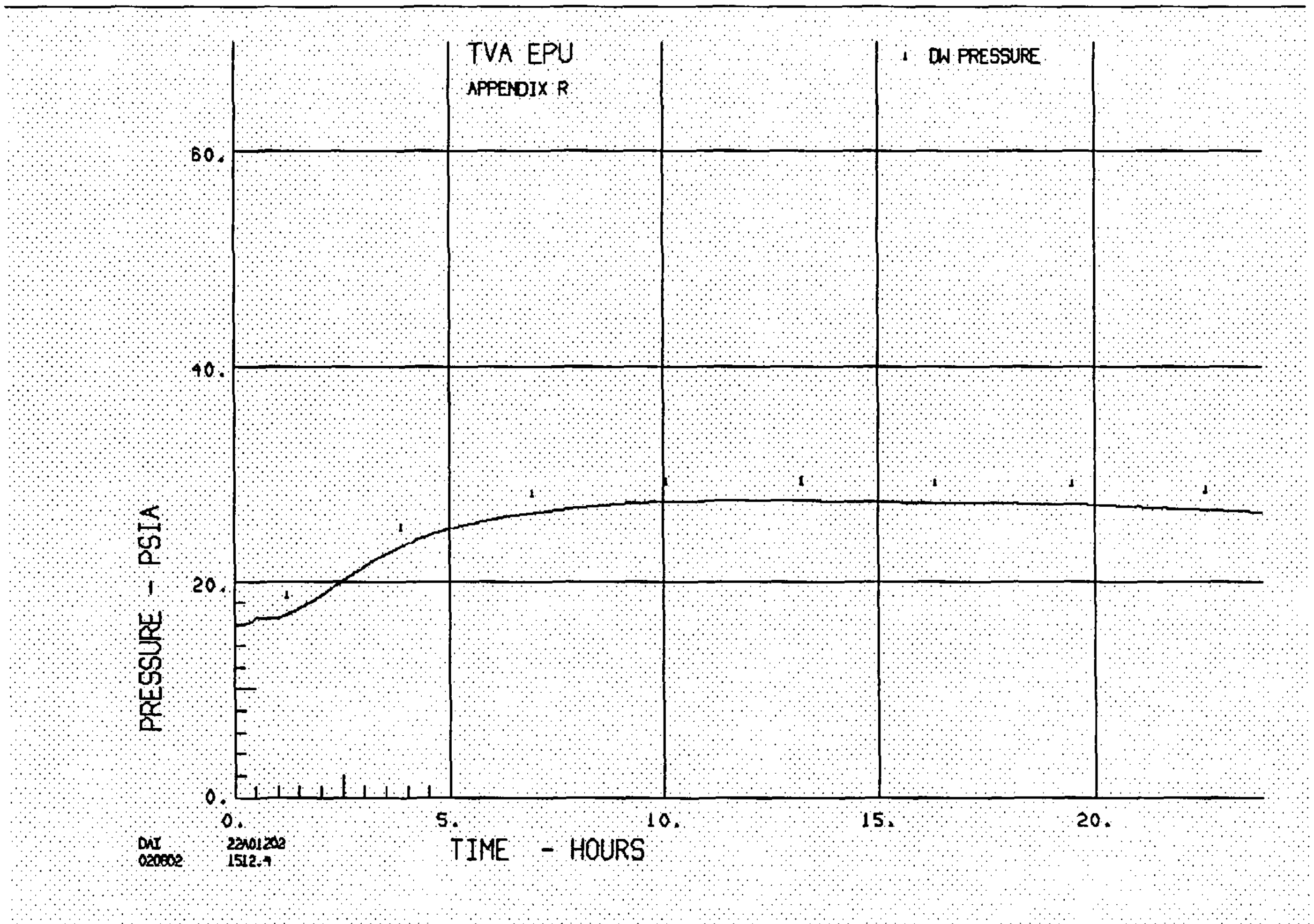


Figure ACVB.7-6: EPU Appendix R Drywell Temperature

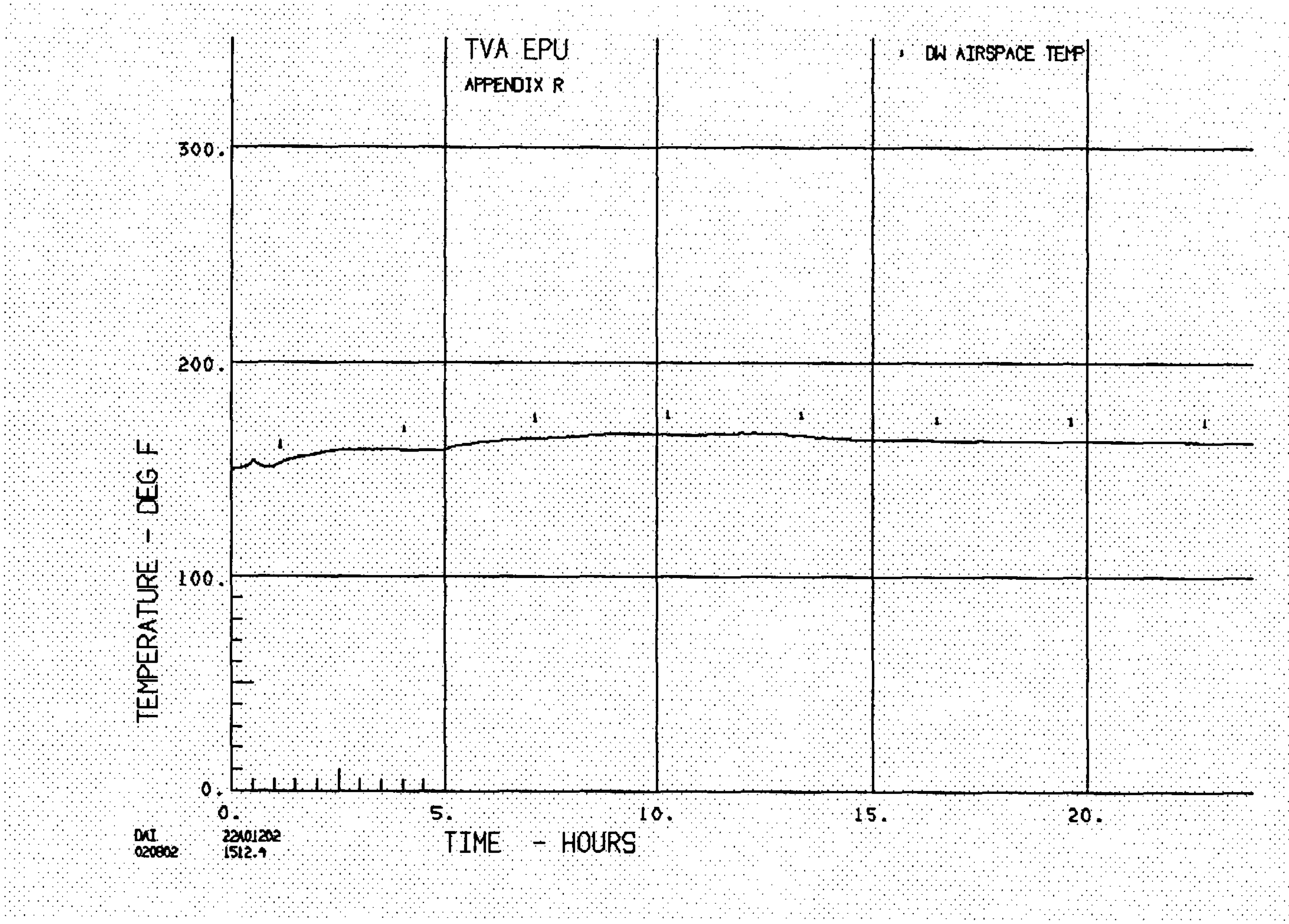


Figure ACVB.7-7: EPU Appendix R Suppression Pool Temperature

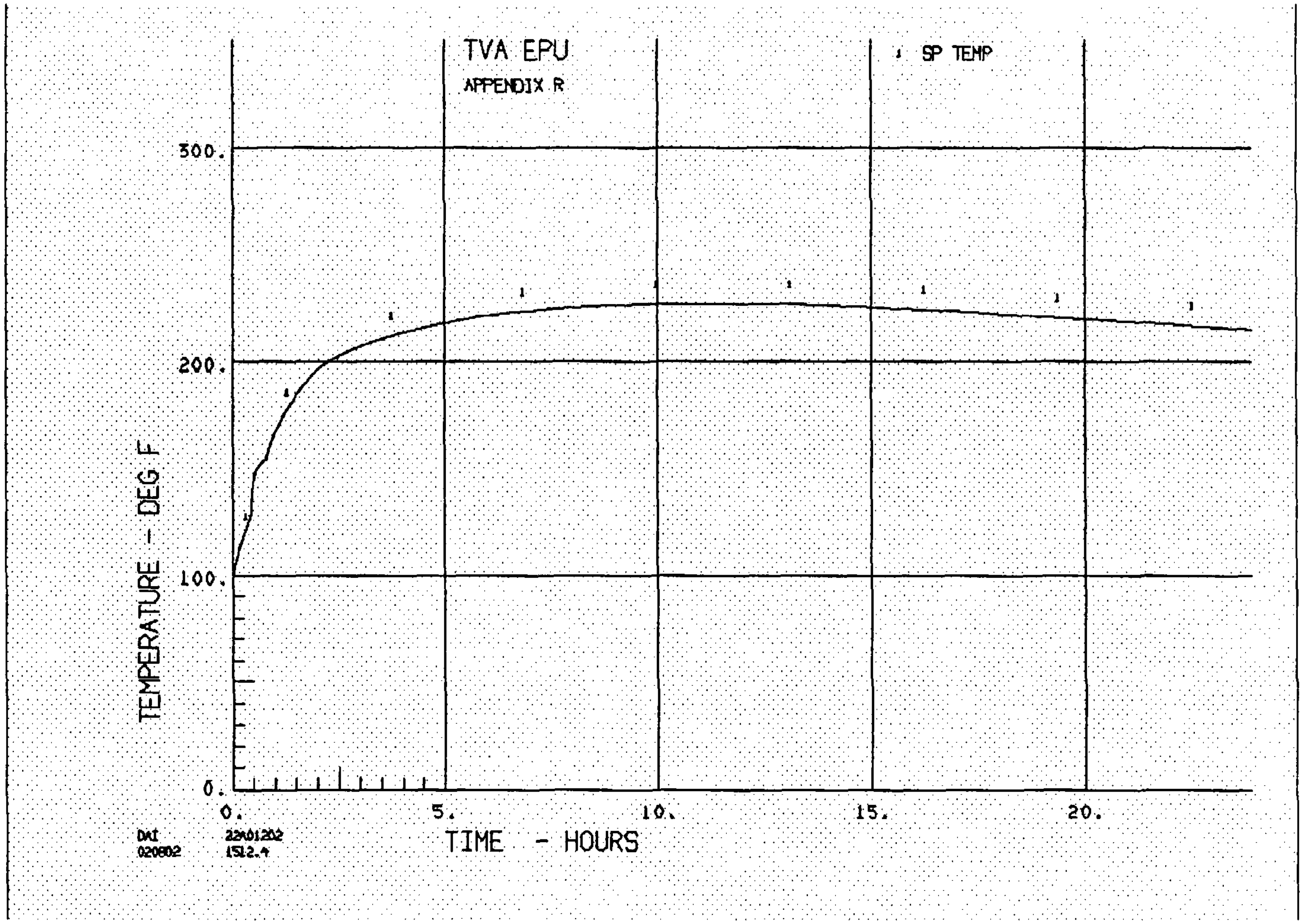


Figure ACVB.7-8: EPU Appendix R Wetwell Pressure

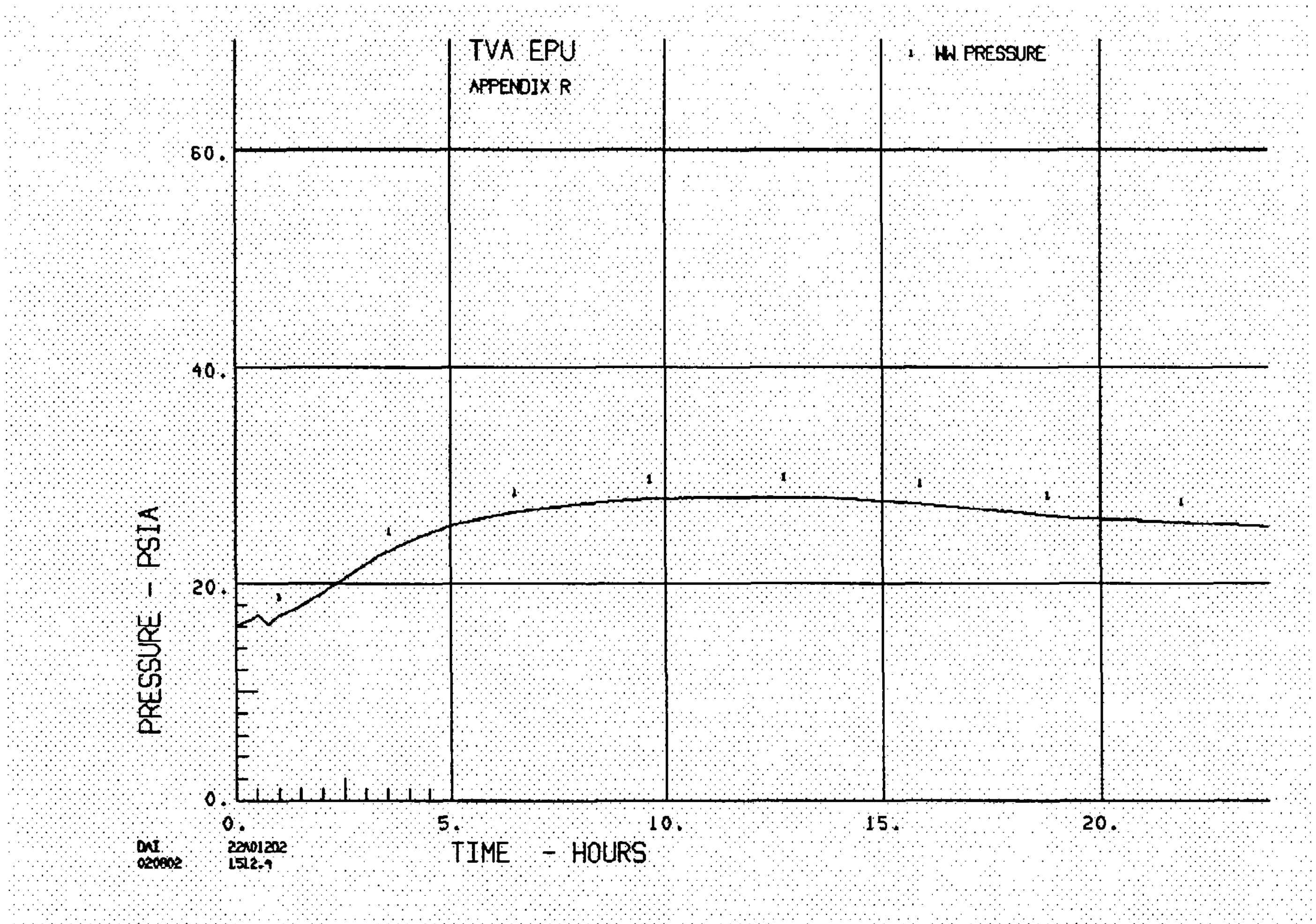


Figure ACVB.7-9 EPU SBO Containment Temperature

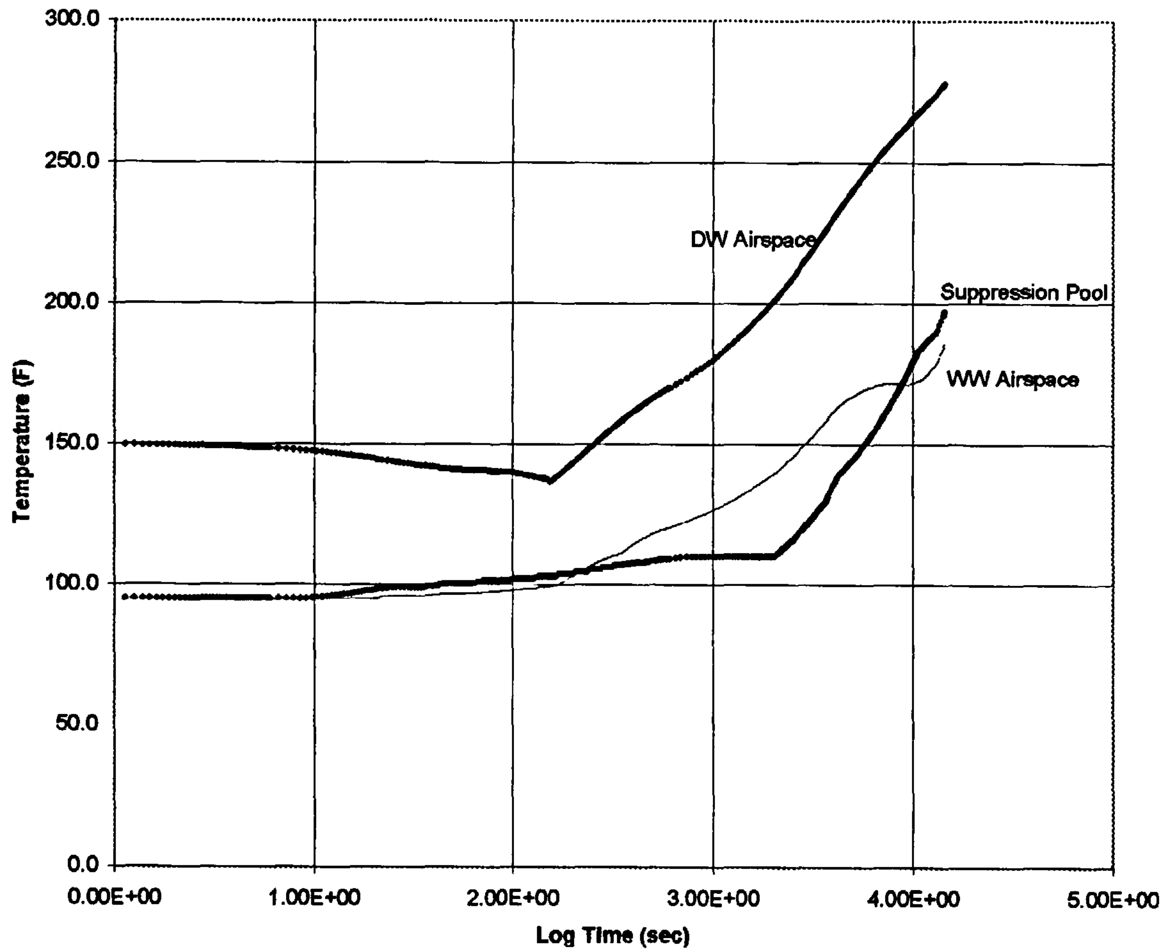


Figure ACVB.7-10 EPU SBO Containment Pressure

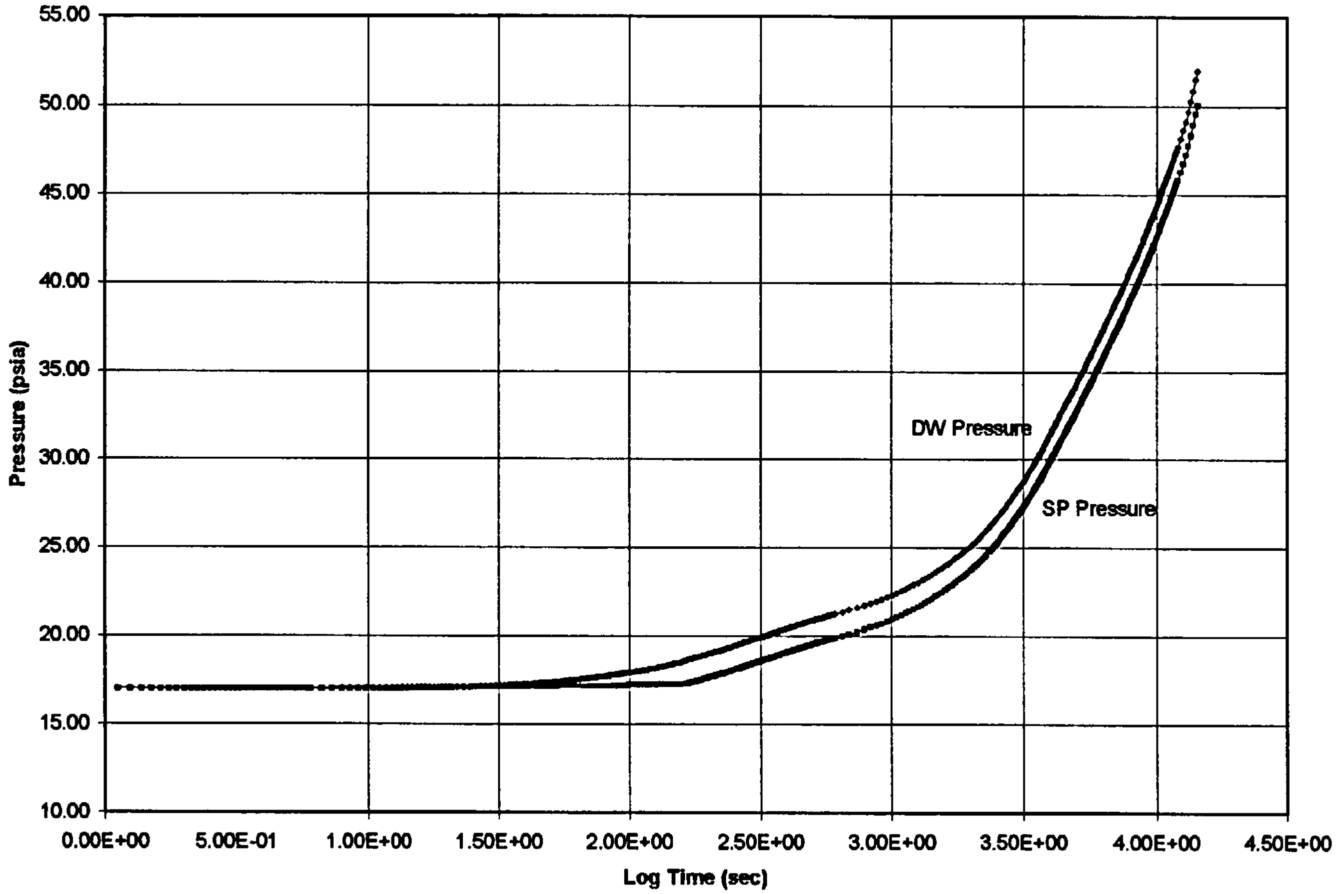
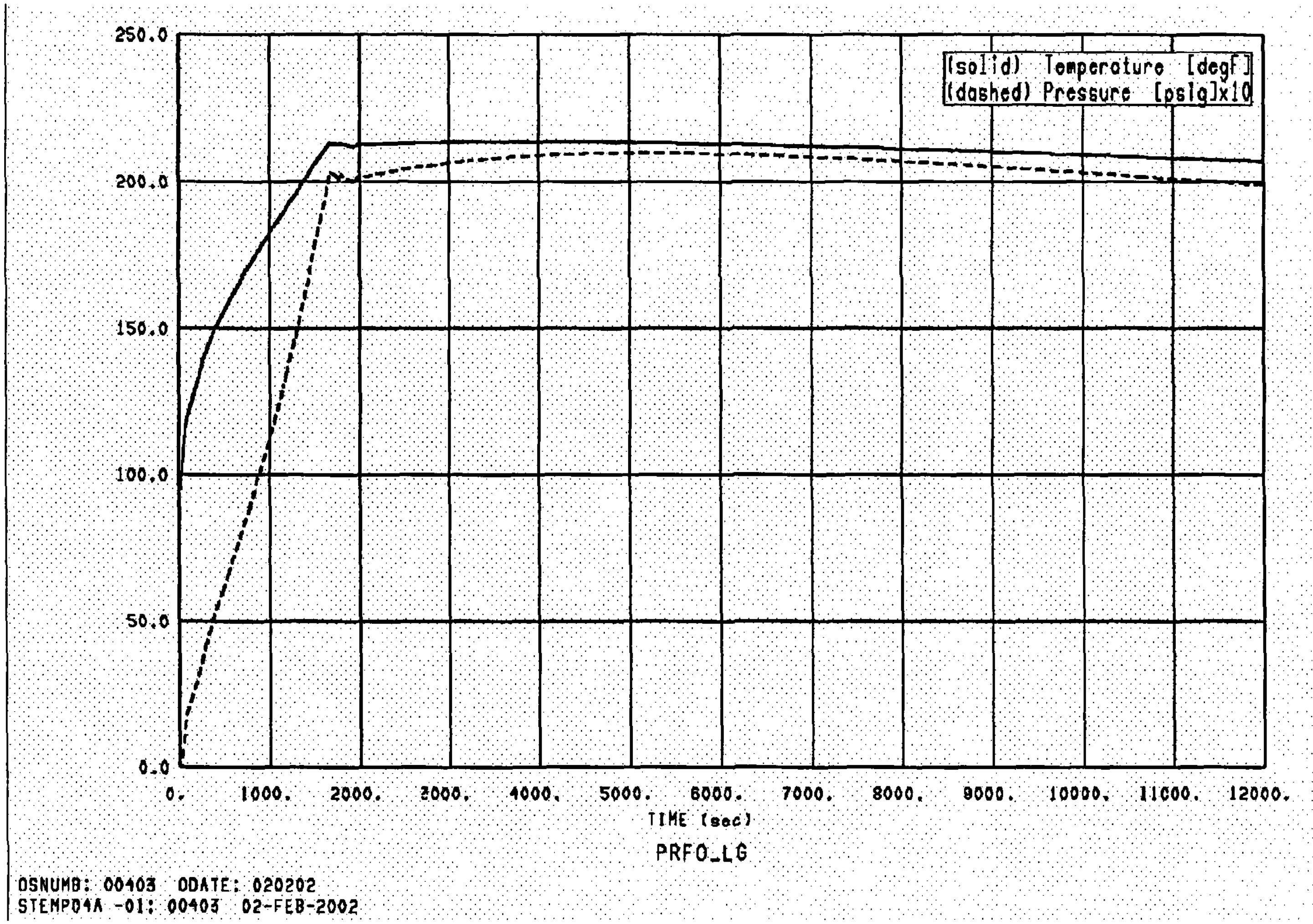


Figure ACVB.7-11: EPU ATWS Suppression Pool Temperature and Pressure



NRC Request ACVB.8

In Section 4.1.1.1(a) of the PUSAR on bulk pool temperature it is noted that the heat exchanger k-factor (K) remains unchanged. Discuss why this is considered conservative and describe the program to ensure that this K value is not exceeded.

TVA Reply to ACVB.8

The heat exchanger k-factor of 223 Btu/sec-°F for EPU conditions is unchanged from the current value for the RHR heat exchangers. The k-factor is a function of the heat exchanger effectiveness, ε, (which is based on the heat transfer area and fouling factors) and the minimum flow rate through either side of the heat exchanger. The k-factor for these heat exchangers did not change since the amount of allowable tube plugging, the fouling factors, and the minimum flow rates were unchanged for EPU conditions.

These values are considered conservative since the actual tube plugging currently present in any individual heat exchanger is less than one-half of the allowed value considered. In addition, the fouling factors used are consistent with Heat Exchanger Institute (HEI) "Standards for Power Plant Heat Exchangers," 3rd Edition, for the service conditions seen by these heat exchangers. The minimum flow rate through these heat exchangers is based on an RHRSW flowrate of 4000 gpm per heat exchanger. This RHRSW flowrate value is a design basis requirement for the RHRSW System capability, and is verified through quarterly surveillance testing.

In addition, for BFN, thermal performance testing of selected heat exchangers has been performed to satisfy the requirements of GL 89-13. Based on this testing, appropriate inspections are performed to ensure that tube fouling does not adversely affect heat exchanger performance. The heat exchanger program ensures the heat exchanger effectiveness will continue to meet the design requirements by detecting degradation before the heat transfer capabilities are adversely impacted.

Thus, surveillance of heat exchanger performance and the RHRSW System flow characteristics ensure that the k-factor utilized in the design basis containment analysis will not be exceeded.

NRC Request ACVB.9

Table 4-1 of the PUSAR addresses the containment performance results. Explain Note 3 in Table 4-1, and explain the differences between the original and the M3CPT and LAMB methods.

TVA Reply to ACVB.9

This question and reply applies to the Unit 2/3 PUSAR Table 4-1 which contains the Note 3 discussion on M3CPT and LAMB.

The results reported in Table 4-1 at current rated power for the "UFSAR" and "Current Method" and the results reported in Table 4-1 at EPU Power, were all obtained with the M3CPT containment response code using break mass flow and enthalpy calculated with the LAMB code. Note 3 in Table 4-1 describes the selection process for the mass and enthalpy values that are generated by the LAMB code and input to the M3CPT code. [[

]] The LAMB points used for the M3CPT analyses at Current Rated Power with Current Method and at EPU were selected to provide a bounding, but closer match to the LAMB output than the points selected for the UFSAR analysis. This technique results in lower mass and energy release to the drywell, which in turn produces the lower peak drywell pressure and temperature.

For the original analyses at original licensed rated power, including the analyses performed for BFN Units 1, 2, and 3 in support of the Mark I Long-Term Containment Program (NEDO-24580), the break flow rates were calculated internally by the M3CPT code using the vessel blowdown model built into the code. [[

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For the analyses at current rated power and analyses at EPU, the break flow rate and enthalpy are calculated external to the M3CPT code, using the LAMB computer code. The LAMB-generated break flow rate and enthalpy histories are input to the M3CPT computer code. [[

]]

The use of the LAMB code for calculating blowdown flows and enthalpies for use in the M3CPT analyses was identified in ELTR1 (NEDC-32424P). The M3CPT code is still used to calculate the drywell and wetwell pressure and temperature response.

NRC Request ACVB.10

Section 4.1.2.1 of the PUSAR discusses the LOCA loads. Explain why vent thrust loads are less at EPU conditions than those calculated during the Mark I Containment Long Term Program.

TVA Reply to ACVB.10

The vent thrust loads for the Mark I Long-Term Containment Program (LTP) and for the EPU were both calculated using the vent thrust load methodology described in NEDO-21888, using the containment response calculated with M3CPT. The difference in methods between the Mark I LTP and the EPU analysis is in the calculation of the vessel blowdown break flow rate and enthalpy used in the M3CPT calculation.

For the Mark I LTP analyses (NEDO-24580), the break flow rates were calculated internally by the M3CPT code using the vessel blowdown model built into the code. [[

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For the EPU analyses, the break flow rate and enthalpy are calculated external to M3CPT, using the LAMB computer code. The LAMB-generated break flow rate and enthalpy histories are input to the M3CPT computer code. [[

]]

The use of the LAMB code for calculating blowdown flows and enthalpies for use in the M3CPT analyses was identified in ELTR1 (NEDC-32424P). The M3CPT code itself is still used to calculate the drywell and wetwell pressure and temperature response and the vent flow rates.

NRC Request ACVB.11

Section 4.1.2.3 of the PUSAR discusses subcompartment pressurization. Discuss why the 4-inch jet pump instrumentation line is the limiting break for subcompartment pressurization.

TVA Reply to ACVB.11

Section 12.2.2.6 of the BFN UFSAR states, in part, "… Effects of postulated loss-of-coolant accidents occurring within the sacrificial shield area have been investigated. Pipes with nominal diameters of 4 inches or smaller are the only reactor coolant lines investigated, because the reactor vessel safe-end welds for these nozzles are located within the sacrificial shield area. The minimum wall thickness for the various piping systems occurs at the safe-end joint to the piping. All other sections from this joint back to the reactor vessel have thicker wall sections and, therefore, have lower stresses. The largest line which has the safe end located in the annulus is the 4-inch jet pump instrument line nozzle. (For all larger lines, the double-ended line break results in the flow being directed into the drywell volume and not into the annulus.) …"

NRC Request ACVB.12

Verify that, upon a postulated loss of containment accident pressure and the assumed loss of the affected unit's emergency core cooling system (ECCS) pumps, the residual heat removal (RHR) suppression pool cooling function, the low pressure coolant injection function and the core spray function can be maintained by inter-ties with another unit. Describe how the operator accomplishes this. Address whether procedures exist for any unit to crosstie with either of the other units.

TVA Reply to ACVB.12

The RHR system crossties are described in 4.8.6.4 of the BFN UFSAR. By proper valve alignment (see UFSAR Figure 4.8-1), the network created by the RHR crossties permits the circulation of suppression pool water or reactor vessel water for one unit through the RHR pumps and heat exchangers of the adjacent unit. This design feature provides for long term reactor core and primary containment cooling for certain situations which, although unlikely to occur, could jeopardize the functioning of these systems.

This feature would not be useful in the event of inadequate NPSH on a unit due to loss of containment overpressure since it would entail the use of a RHR pump taking suction from the accident unit's suppression pool through a more limiting suction path. Since the suction path is from the same suppression pool through a more limited path, NSPH concerns would not be alleviated.

BFN design does not include a unit crosstie for the Core Spray system.

<u>**NRC Request ACVB.13**</u>
Describe how the secondary containment drawdown time is calculated. Describe the model of secondary containment and the standby gas treatment system. Address how external temperatures are factored into the model in accordance with Information Notice 88-76, Recent Discovery of a Phenomenon Not Previously Considered in the Design of the Secondary Containment Pressure Control, dated September 19, 1988. Provide a curve of pressure vs. time and describe how the EPU affects this calculation.

<u>**TVA Reply to ACVB.13**</u>
The secondary containment drawdown time is verified by the performance of periodic surveillance testing rather than being calculated and modeled. The testing is performed to verify secondary containment drawdown and integrity in compliance with the requirements of the Technical Specifications. This testing isolates the secondary containment and verifies the capability to increase the vacuum to 0.25 inch H_2O column within the allowable time and with reactor building inleakage within the allowable value.

The acceptance criteria are:

- any two of the three standby gas treatment (SGT) trains shall be capable of evacuating the reactor building to equal to or greater than 0.25 inches H_2O column vacuum under calm wind conditions in less than or equal to 120 seconds,
- with SGT in operation on all 3 reactor zones and the refueling zone, secondary containment vacuum shall be greater than or equal to 0.25 inches of water column under calm wind conditions, and
- with a system flow (i.e., reactor building inleakage) of not more than 12,000 cfm.

External ambient temperatures are not required to be factored into the relevant instrument readings. Information Notice 88-76 was reviewed at BFN, and it was determined to be not applicable for this site. The instrumentation for controlling reactor building pressure at BFN is already located high in the building. Locating such instrumentation in the upper building elevations corresponds to the final corrective action stated in the Information Notice. Secondary containment volume is unchanged and bulk area temperatures are within design limits after EPU. The SGT is unchanged by EPU. There is no effect on the secondary containment drawdown since the system flowrate needed to maintain the secondary containment negative pressure requirement is unchanged. Because system flow rate is unchanged and operating temperatures remain below limits for both normal and accident conditions, EPU has no impact on SGT operation, component design, or instrumentation. As stated above, the secondary containment drawdown time is periodically measured by the performance of surveillance testing to ensure the design requirements are being met. Given this testing, which demonstrates the meeting of design requirements, there is no need for a pressure-versus-time curve as part of the design basis. Historically, the typical measured drawdown times are less than 50 seconds. This drawdown time will be unaffected by EPU operation. Based on this evaluation, no adverse impact on system design function occurs as a result of EPU.

NRC Request ACVB.14

Section 4.1.1.1(b) of the PUSAR addresses local pool temperature with main steam relief valve (MSRV) discharge. Explain the conclusion that the local pool temperature and steam ingestion criteria remain valid for EPU conditions.

TVA Reply to ACVB.14

The criterion used for local suppression pool temperature is based on NUREG-0783. The limitation of a maximum local pool temperature of 200°F is based on the configuration of the SRV T-quenchers and actual performance test results. The local pool temperature limit acceptance criterion precludes the occurrence of condensation instability dynamic loads. The SRV flow capacities remain unchanged for EPU conditions; the configuration of BFN's T-quenchers remains unchanged for EPU; and the predicted local pool temperatures remain within the 200°F limitation. Therefore, no changes result from EPU that would invalidate the acceptance criterion for local pool temperatures.

The criterion used for evaluating steam ingestion into the ECCS suction strainers is a function of the geometry between the T-quenchers and the suction strainers. The flowrates from the T-quenchers is unchanged by EPU conditions, and the physical configuration of the T-quenchers in relation to the suction strainers is unchanged by EPU conditions. Therefore, the EPU conditions do not affect the criterion used to address steam ingestion into the suction strainers.

NRC Request ACVB.15

Section 4.1.2.2 of the PUSAR discusses that the load definition for subsequent MSRV actuations in not affected by EPU. Provide the associated analysis (Reference 10).

TVA Reply to ACVB.15

This 481-page report documented the study of BFN Torus Integrity Long-Term Program activities. Copies of this report were formally provided to NRC via a letter from J. A. Domer (TVA) to Harold R. Denton (NRC) on January 25, 1985. To aid in NRC review of EPU, a copy of the report has been provided.

NRC Request ACVB.16

Section 4.1.2.3 of the PUSAR addresses subcompartment pressurization. Provide a description or reference the assumptions and models used for the subcompartment analyses. Explain why the EPU pressure difference is greater than the current license thermal power pressure difference for the annulus pressure load.

TVA Reply to ACVB.16

The structural evaluation in 12.2.2.6 of the BFN UFSAR demonstrates that the shield wall structure can withstand 19 psi pressurization, which is a differential pressure across the shield wall from the annulus to the drywell space. The largest line which has the safe-end located in the annulus is the 4-inch jet pump instrument line nozzle. For all larger lines, the double-ended line break results in the flow being directed into the drywell and not into the annulus. Effects of a postulated loss of coolant accident (LOCA) occurring within the sacrificial shield area have been investigated utilizing EPU conditions.

The EPU analysis evaluates the critical mass flux to determine the pressure increase from the 105% OLTP analysis. The 105% OLTP analysis applied the SAFER/GESTER-LOCA evaluation model and the outputs were used to obtain the break mass flux and break enthalpy. For EPU the critical mass flux is determined using the Moody slip flow model. The following conditions were evaluated for EPU:

Analysis	**Power** (MWt)	**Reactor Steam Dome Pressure** (psia)	**Core Inlet Enthalpy** (Btu/lbm)
Normal Feedwater Temperature	4031 (102% EPU)	1070	525.4
Final Feedwater Temperature Reduction	4031 (102% EPU)	1070	518.7

The EPU analysis evaluates the critical mass flux at 105% OLTP (current values) and 120% OLTP (EPU values) based on the following adjustment to determine the EPU results:

$$\Delta P_2 = \Delta P_1 \left(\frac{G_2}{G_1}\right)^2 \left(\frac{\rho_1}{\rho_2}\right)$$

where:

ΔP_1 is the 105% OLTP pressurization

ΔP_2 is the EPU pressurization

G_1 is the 105% OLTP break flow mass flux

G_2 is the EPU break flow mass flux

ρ_1 is the 105% OLTP break flow density

ρ_2 is the EPU break flow density

The results are shown below.

Analysis	**Annulus Pressurization (psi)**	
	105% OLTP	**EPU**
Normal Feedwater Temperature	2.4	2.3
Final Feedwater Temperature Reduction	NA	2.6

Higher results for EPU occurred due to additional conservatism of Final Feedwater Temperature Reduction (FFTWR) input values (this is an additional evaluation which was not previously performed). The FFTWR used slightly higher subcooling which resulted in a higher critical mass flux. The results demonstrate that the annulus pressurization loads at EPU conditions are still well below the limit of the BFN design basis value of 19 psi.

NRC Request ACVB.17

Section 4.2.5 of the PUSAR addresses ECCS net positive suction head (NPSH). This section states that 157 ft^2 of unqualified paint was assumed in the calculation of ECCS strainer head loss. Discuss when this determination was made and why it is still valid. Include a discussion demonstrating that it bounds the actual unqualified paint for both units. Address how this unqualified paint is distributed between the ECCS suction strainers. Verify that there have been no changes to the ECCS suction strainer calculations, including debris generation, transport and head loss. Additionally discuss what temperature is assumed for the suppression pool water in the head loss calculations.

TVA Reply to ACVB.17

As discussed in the cover letter, the reply to this request will be provided in a future submittal.

NRC Request ACVB.18

Provide a figure showing the minimum wetwell pressure and the pressures required to provide adequate available NPSH for the RHR and core spray pumps as a function of time after accident initiation. Discuss the minimum pressure difference between the pressure required to provide adequate available NPSH and the calculated minimum wetwell accident pressure.

TVA Reply to ACVB.18

As discussed in the cover letter, the reply to this request will be provided in a future submittal.

NRC Request ACVB.19

Discuss the impact of crediting containment accident pressure for NPSH on operator response to the LOCA, ATWS, Appendix R fire and SBO events. Describe what changes to the emergency operating procedures (EOPs) are necessary and any operator actions necessary to ensure preservation of the necessary level of containment accident pressure for these four events. If none, please explain.

TVA Reply to ACVB.19

BFN Units 2 and 3 currently credit available containment accident pressure to maintain adequate NPSH. There are no impacts on operator response to the existing emergency operating instructions (EOIs) associated with the changes to the credit for containment accident overpressure requested for EPU conditions.

The containment overpressure credited for these events is a symptom of the events and does not require active operator action to achieve. The NPSH evaluation assumes operation of the containment sprays. Additionally, the EOIs contain directions for maintaining adequate NPSH (see the reply to NRC Request ACVB.23) and caution that reducing primary containment pressure will reduce the available NPSH for pumps taking suction from the suppression pool (EOI-2, "Primary Containment Control"). These steps will ensure that sufficient containment overpressure is preserved.

NRC Request ACVB.20

Discuss whether Units 2 and 3 are subject to any single failures (e.g., vacuum breakers) that could result in the loss of adequate containment accident pressure.

TVA Reply to ACVB.20

Units 2 and 3 are not subject to any single failures (e.g., vacuum breakers) that could result in the loss of adequate containment accident pressure. This is assured by the fact that the containment penetrations meet applicable electrical and mechanical single failure criteria as discussed in 5.2.3.5 of the BFN UFSAR.

NRC Request ACVB.21

Describe how containment leakage is modeled in the design basis NPSH calculations. Include L_a, MSIV leakage, air lock leakage and equipment hatch leakage.

TVA Reply to ACVB.21

Per 5.2.4.5 of the BFN UFSAR, containment leakage is modeled based on L_a of 2% of the free volume of containment air weight per day throughout the event. L_a includes air lock leakage and equipment hatch leakage but does not include MSIV leakage. Technical Specifications (TS) Surveillance Requirement 3.6.1.3.10 specifies allowable leakage limit for the MSIVs. For

Units 2 and 3, the allowable total MSIV leakage is equal to less than $0.2L_a$ [A request to revise the Unit 1 TS value of 11.5 scfh per MSIV to the Units 2 and 3 total value of 150 scfh was submitted to the NRC via request TS-436 on July 9, 2004 (ML041980222)]. The effect of MSIV leakage is minimal compared to the amount of containment pressure available. At the end of 24 hours, 2% leakage results in an approximate 0.3 psig decrease in the 3.4 psig available containment pressure compared with no leakage.

Testing throughout the service life of the units per TS 5.5.12, "Primary Containment Leakage Rate Testing Program," verifies primary containment integrity.

NRC Request ACVB.22

Provide the design basis and realistic values used in the determination of ECCS pump available NPSH. The discussion should include realistic values from the EPU probabilistic risk analyses. These values should include:

Service water temperature
Initial containment temperature
Initial containment pressure
Initial drywell and wetwell humidity
Initial suppression pool temperature
Drywell and wetwell airspace volume
Suppression pool volume

TVA Reply to ACVB.22

Table ACVB.22-1 shows the values used for the BFN NPSH containment analyses and the corresponding realistic or nominal value. These parameters may not be a direct input to the PSA but are inherent in the determination of available NPSH.

Table ACVB.22-1

PARAMETER	LICENSING BASIS VALUE	REALISTIC VALUE	COMMENT
Service Water (UHS) Temperature (°F)	95	92	Exceedance probability for 92°F is less than 6.0E-2.
Initial Containment Temperature (°F)	150	130	
Initial Containment Pressure (psia)	15.517	15.5	
Initial DW Humidity (%)	100	20	
Initial WW Humidity (%)	100	100	
Initial SP Temperature (°F)	95 (TS maximum)	92	Exceedance probability for 92°F is 8.25E-2.
DW Airspace Free Volume (ft^3)	159,000	171,000	
WW Airspace Free Volume (ft^3)	129,300	129,300	
Suppression Pool Volume (ft^3)	121,500 low level	125,640	Nominal value
Decay Heat Model (Long-Term)	ANS 5.1 (plus 2σ)	ANS 5.1 (w/o 2σ)	
Initial Power	102% (4031 MWt)	100% (3952 MWt)	Probability of 102% power is 5.0E-3
Containment Heat Sinks	Assumes no heat sinks	Include realistic heat sinks	Heat sinks are always present but not normally credited
Heat Exchanger K Value (BTU/ Hr-°F)	223	225 241	1.5% tube plugging only Based on realistic fouling factor of 0.0020 vs 0.0025 and maximum number of tubes plugged (1.5%)

<u>NRC Request ACVB.23</u>

Discuss what indications would be available to the operator during a LOCA which could indicate abnormal ECCS pump performance, especially cavitation due to inadequate NPSH. Discuss what actions an operator would take in response to indications of inadequate ECCS pump NPSH.

TVA Reply to ACVB.23

Applicable Emergency Operating Instruction (EOI) appendices include a precautionary statement warning the operator that continuous operation of the low pressure injection system pumps with inadequate NPSH may result in pump damage or pump inoperability. The operator is instructed to monitor NPSH using an attachment to the EOI appendices that contains a NPSH limit curve, showing pump flow versus suppression pool temperature for various suppression pool pressures. The attachment also lists additional indications of inadequate NPSH. Operators are trained on these procedures as part of their periodic requalification program.

The EOI appendices include the following information:

- Adequate NPSH is assured by maintaining pump flow rates below the curve for the applicable suppression chamber pressure. For suppression chamber pressures between the values on the curves, extrapolation must be used.
- Other indications of inadequate NPSH are:
  - Suppression pool level below 10 ft
  - System flowrate decreasing with constant valve position
  - System flowrate or discharge pressure less than expected for present system conditions
  - Pump discharge pressure lower than expected or fluctuating excessively
  - Pump motor amps lower than expected or fluctuating excessively
  - Pump suction pressure low (local indication)

In response to indications of inadequate ECCS pump NPSH, operators would consider actions as necessary which could include:

- Remove from service or throttle flow from those ECCS systems not needed to restore and maintain Emergency Operating Procedures (EOP) parameters.
- If possible, re-align the suction of the ECCS pumps to the condensate storage tank (CST).
- Use of standby coolant supply (RHRSW pump injection of raw water). This mode of RHR is discussed in 4.8.6.4 of the BFN UFSAR.

NRC Request ACVB.24

Discuss whether reactor vessel isolation events have been considered as possibly more limiting than long term suppression pool heat up following a LOCA for ECCS pump available NPSH. Specifically, address the condition when the reactor vessel is isolated with high-pressure coolant injection unavailable and automatic depressurization system (ADS) is activated to proceed to safe shutdown. Assume that suppression pool cooling is not initiated until after ADS actuation.

TVA Reply to ACVB.24

The DBA LOCA was chosen as the limiting event for evaluation of ECCS pump NPSH because the event involves maximum debris generation for ECCS strainer head loss, maximum ECCS pump flow for computing pump suction losses, and a high peak suppression pool temperature.

For the specific isolation event with HPCI and RCIC unavailable and an ADS actuation, the following differences make the LOCA the bounding event for NPSH:

- The isolation event would not include LOCA induced debris that would load the ECCS suction strainers. Less debris loading on the strainers would improve the NPSH available.
- Failure of both HPCI and RCIC constitutes multiple failures. As such, additional failure affecting RHR pumps in suppression pool cooling in the DBA LOCA case need not be assumed. This provides twice the heat removal capacity and would result in a substantially lower suppression pool temperature.
- During a DBA LOCA where reactor vessel level can only be maintained at 2/3 core height, CS system flow (2 pumps in one loop) through the spray headers is needed to maintain core cooling long term. Core spray pumps are the most limiting for NPSH in the long term DBA LOCA analysis. However, in the isolation event, normal reactor vessel water level can be maintained and long term makeup is limited to that required to remove decay heat. In the timeframe of peak suppression pool temperature, operation of core spray pumps would not be required.

NRC Request ACVB.25

Address whether the recommendations of GE Service Information Letter (SIL) 636 Revision 1 (related to the determination of decay heat) used for the containment calculations and the ECCS pump NPSH calculations.

TVA Reply to ACVB.25

The recommendations of SIL 636 Revision 1, allowances for miscellaneous actinides and activation products, were incorporated in the determination of decay heat for the EPU conditions. Decay heat was calculated based on the ANSI/ANS-5.1-1979 Standard with SIL 636, Revision 1, additional actinides and activation products and the additional conservatism of 2-sigma uncertainty. This decay heat was then used in the EPU containment calculations. The results of the containment calculations were used in the ECCS pump NPSH calculations.

NRC Request ACVB.26

Demonstrate with a "realistic" or best-estimate calculation of available net positive suction head for the RHR or core spray pumps, whichever is most limiting, whether credit for containment accident pressure is needed. All input and assumptions should be, to the extent possible, nominal values.

TVA Reply to ACVB.26

As discussed in the cover letter, the reply to this request will be provided in a future submittal.

NRC Request ACVB.27

List the conservatisms included in the calculation of available NPSH and containment overpressure.

TVA Reply to ACVB.27

Conservatisms in the calculation of available NPSH and containment overpressure include the following:

- No operator action for 10 minutes
- Initial reactor power (102%)
- Initial reactor vessel pressure at TS value
- Decay heat - ANS/ANSI 5.1 with 2σ uncertainty
- Initial drywell temperature at TS limit
- Initial suppression pool temperature at TS limit
- Initial drywell pressure at TS limit
- RHR flow rate - Suppression pool cooling - 2 out of 4 pumps available
- RHRSW inlet temperature at TS limit
- Heat transfer coefficient for the RHR heat exchangers (bounding values based on tube plugging and fouling factor)
- Internal heat sinks not credited
- Suppression pool water level at TS minimum

NRC Request ACVB.28

The Hydraulic Institute recommends margin above the required NPSH to suppress cavitation. Discuss the need for BFN pumps crediting overpressure and how this margin is accounted for in your NPSH calculations. This response should include relevant quantitative information.

TVA Reply to ACVB.28

By Hydraulic Institute definition, the required net positive suction head ($NPSH_R$) of a pump is the NPSH that will cause the total head to be reduced by 3%. The BFN ECCS pump NPSH available ($NPSH_A$) was determined considering the design basis rated flow and the worst case containment analysis conditions with regard to pump NPSH (suppression pool temperature and pressure) that would exist as a result of the DBA LOCA. The analysis considered pump flows credited for reactor vessel makeup as well as for containment cooling and the associated pump suction piping resistances and conditions.

In the determination of NPSH margin, the manufacturer's NPSH curves were used to determine $NPSH_R$. At the limiting statepoints, $NPSH_A$ including containment overpressure (COP) credit equals $NPSH_R$ with no additional margin added to suppress cavitation. However, available COP is significantly greater than the COP credited in NPSH calculations and, thus, represents margin above $NPSH_R$. The only design basis case where available COP approached the required COP is for a short timeframe (<10 minutes). In this short timeframe there would be no pump degradation. This margin is illustrated in response to ACVB.18.

NRC Request ACVB.29

Provide the results of an analysis of the stuck open reactor vessel relief valve that demonstrate that adequate NPSH is available for successful operation of the ECCS pumps.

TVA Reply to ACVB.29

The DBA LOCA was chosen as the limiting event for evaluation of ECCS pump NPSH because the event involves maximum debris generation for ECCS strainer head loss, maximum ECCS pump flow for computing pump suction losses, and a high peak suppression pool temperature.

BFN has not performed an ECCS pump NPSH analysis for the stuck open reactor vessel relief valve. As described in 4.1.1.1.(b) of the PUSAR, an evaluation of main steam relief valve (MSRV) discharge as specified in NUREG-0783 was performed. This analysis includes an evaluation of stuck open relief valve.

This evaluation determined a peak bulk suppression pool temperature of 154.3°F and a peak local suppression pool temperature of 183.3°F. Both of these values are lower than the peak suppression pool temperature calculated for the DBA LOCA.

NRC Request ACVB.30

The NRC staff has reviewed Section 4.2.5 of the PUSAR and TVA's responses to NRC Bulletin 96-03, Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling-Water Reactors. Describe how the BFN ECCS suction strainer design is consistent with the NRC staff safety evaluation report on the BWR Owners Group Utility Resolution Guidance (GE report NEDO 32686) dated August 20, 1998.

TVA Reply to ACVB.30

The schedule for installation of the BFN ECCS strainers required completion of the mechanical design prior to completion of the NRC's review of the BWROG guidance document (i.e., the URG) for resolution of the ECCS suction strainer issue. As a result, the guidance used in the design work was provided by the November 1996, revision of the BWROG URG (Reference ACVB.30-1) without benefit of the NRC's SE that was issued later in August of 1998. Nonetheless, the BFN strainer design is considered fully consistent with the staff safety evaluation (SE) report dated August 20, 1998, as the staff's review comments do not directly impact the design assumptions made and the original design basis conditions remain bounding. Specific design areas of potential interest are discussed below.

Debris Source Terms

The BFN units are essentially "all-RMI" (reflective metal insulation) units, with the fibrous insulation limited to insulation material used in certain piping penetrations (10 to 11 penetrations per unit). The following debris generation assumptions are all considered to be consistent with the NRC's SE of the URG.

- Fiber - After considering all potential line break scenarios, the fibrous insulation debris term was conservatively assumed to equal 100% of the fibrous insulation used in the piping penetration with the most insulation volume - 31.7 ft^3. Due to the configuration of the insulation within the penetration (between the process pipe and the guard pipe), and the physical nature of the sample (it had to be broken up with a hammer in order to obtain samples for testing) it is considered conservative to assume that severing of the process pipe within the penetration would result in 100% of the insulation material in the penetration being removed. Also, due to configuration, only one penetration would be affected by a given pipe break. A transport factor of 35%, which yields a max fiber term of 11.1 ft^3 in the suppression pool, is considered very conservative given the nature of the material and the fact that all penetrations are above the lowest grating level. (SE Section 3.2.3)

- RMI - An amount of RMI debris sufficient to form a saturated debris layer around the circumscribed area of each strainer is assumed available for loading on the ECCS strainers. (SE Appendix K)

- Iron Oxide Sludge - A sludge generation rate of 150 pounds per year is assumed. For a desludging interval of 10 years, the assumed quantity of iron oxide sludge available for loading on the ECCS strainers is therefore 1500 lbs. (SE Section 3.2.4)

- Dirt/Dust - A value of 150 lbs of dirt/dust is assumed available for loading on the ECCS strainers. (SE Section 3.2.2)

- Coatings - A value of 85 lbs of paint chips is assumed to be directly removed by the break jet. In addition, the available quantity of unqualified coatings has been determined by BFN to be a maximum of 157 ft^2, providing an additional 18 pounds of coating debris. Conservatively assuming a transport factor of 100%, this yields a total coating debris mass of 103 lbs available for loading on the ECCS strainers. (SE Section 3.2.2)

- Rust Flakes - A value of 150 lbs of rust flakes is assumed available for loading on the ECCS strainers. (SE Section 3.2.2)

Debris Settling

With the exception of RMI, no credit is taken for debris settling in the suppression pool. For RMI, the assumption is made that the debris bed becomes "saturated" (i.e., will not grow thicker) when the approach velocity to the debris bed reaches one-half the settling velocity of the RMI debris. (SE App. K)

Verification of Adequate ECCS Pump NPSH

- Head Loss Model - See response to request ACVB.31 below. (SE Section 3.2.6)

- Consistency of NPSH Calculations With Licensing Basis - NPSH margin is evaluated for the 0 to 10 minute period at full runout flow, and at reduced flow beyond the 10 minute period. (SE Section 3.2.6)

Reference:

ACVB.30-1: NEDO-32686, "Utility Resolution Guidance for ECCS Suction Strainer Blockage" dated November, 1996

NRC Request ACVB.31

Describe the correlation used to determine the head loss due to debris for the ECCS suction strainers. Verify that this correlation is valid for the materials, temperatures and flow rates that will be encountered in the BFN suppression pool during a postulated accident or transient after the EPU.

TVA Reply to ACVB.31

For plants with significant reflective metal insulation (RMI) debris loads, such as the BFN units, GE uses two head loss correlations: one for the RMI-only case, and one for the fiber plus miscellaneous debris case (no RMI). The more limiting result from these two correlations is used in updating the calculation of available NPSH margin.

The details of these correlations are discussed in GE's application methodology document (Reference ACVB.31-1), which was reviewed and approved by NRC staff in two safety evaluation (References ACVB.31-2 and 3). The correlations are summarized briefly below.

- RMI-Only Correlation - As discussed in the response to request ACVB.30, it is assumed that there is sufficient RMI debris available to produce a saturated RMI debris bed around the strainer's circumscribed surface. Saturation of the debris bed is assumed to occur when the approach velocity to the debris bed reaches one-half the settling velocity of the RMI debris. The debris thickness at which this occurs is calculated as follows:

$$tmax = (DL/4)^{1/2} \, [(2U/Us)^{1/2} - 1]$$

Where:

- D = outer diameter of the strainer.
- L = strainer length.
- U = approach velocity at circumscribed area of the strainer.
- Us = RMI settling velocity (RMI material dependent).

For the GE stacked disk optimized strainer, head loss for the calculated RMI debris bed thickness is then calculated with the following equation:

$$Dh = Kp \cdot U^2 \cdot tmax$$

Where:

- Kp = proportionality constant (RMI material dependent).
- U = as defined above.
- tmax = as defined above.

- Fiber and Miscellaneous Debris Correlation - For the GE stacked disk optimized strainer, head loss for a debris bed comprised of fiber and miscellaneous debris is calculated as follows:

$$Dh = Kh \cdot \frac{\mu U t}{\rho g d^2}$$

Where:

- Dh = head loss for debris bed.
- Kh = dimensionless head loss coefficient (discussed in Reference ACVB.31-1).
- μ = the dynamic viscosity of water at the design temperature.
- U = as defined above.
- t = the fiber bed thickness as if all the debris was applied to the circumscribed area of the strainer.
- ρ = the density of water at the design temperature.
- g = gravitational acceleration, 32.2 ft/sec^2.
- d = the interfiber spacing (fiber-type dependent)

- Limiting Correlation - For the BFN ECCS suction strainers, the head loss for fiber and miscellaneous debris is insignificant due to the very small fiber load per strainer (less than 3 ft^3). Thus, the RMI-only head loss term forms the design basis for both short term (0-10 minutes) and long term (>10 minutes) conditions.

- Verification of Validity - For the BFN ECCS suction strainers, the only design input parameter that changes as a result of EPU is the peak suppression pool temperature at DBA-LOCA conditions, which is increased. This results in a slight decrease in the viscosity term of the above-noted fiber and miscellaneous debris head loss correlation, yielding a corresponding reduction in predicted head loss. Thus, the above correlations, and the input variables used in the original design work of the BFN ECCS suction strainers, are verified to remain applicable to the design after EPU for all materials, flow rates and temperatures used in the correlation.

- Available NPSH After EPU - While the above head loss correlations and input variables remain applicable for strainer design after EPU, the available NPSH margin is negatively affected as a result of the increased suppression pool temperatures. This is discussed in Section 4.2.5 of References ACVB.31-4 and 5, wherein additional credit for containment overpressure is requested to maintain adequate NPSH margin after EPU.

References:

ACVB.31-1: GE document NEDC-32721P, Rev. 2, Application Methodology for the General Electric Stacked-Disk ECCS Suction Strainer, dated October 2001

ACVB.31-2: NRC document "Safety Evaluation Concerning General Electric Topical Report NEDC-32721P, Application Methodology for the General Electric Stacked-Disk ECCS Suction Strainer, Part 1 (TAC No. M98500)", dated Feb 3, 1999

ACVB.31-3: NRC document "Review of GE Nuclear Energy Licensing Topical Report, NEDC-32721P, Application Methodology for the General Electric Stacked-Disk ECCS Suction Strainer, Part 11 1 (TAC No. MB3311)", dated June 28, 2002

ACVB.31-4: NEDC-33101P, "Browns Ferry Unit 1 Safety Analysis Report for Extended Power Uprate", dated June, 2004

ACVB.31-5: NEDC-33047P, "Browns Ferry Units 2 and 3 Safety Analysis Report for Extended Power Uprate", dated June, 2004

NRC Request ACVB.32

Provide for staff review the NPSH calculations (including the containment calculations) for the Units 2 and 3 core spray and RHR pumps at EPU conditions.

TVA Reply to ACVB.32

As discussed in the cover letter, the reply to this request will be provided in a future submittal.

NRC Request ACVB.33

Section 4.7 of the PUSAR addresses post-LOCA combustible gas control. Indicate the time (days) for containment to reach the repressurization limit of half the design pressure (28 pounds per square inch gauge (psig)) due to nitrogen addition to the containment at EPU and verify it is within design basis.

TVA Reply to ACVB.33

Per BFN UFSAR 5.2.6.1.c and 5.2.6.1.g, the design basis for the Containment Atmosphere Dilution (CAD) system requires that the system be designed for possible startup 10 hours after a LOCA, and that containment pressure shall not exceed 30 psig as a result of CAD system operation, respectively. Emergency Operating Instruction EOI Appendix-14B (CAD Operation) contains measures to ensure CAD system operation does not result in containment pressure exceeding 30 psig.

Figure 4-3 of the PUSAR shows the drywell pressure response to CAD operation without venting. For normal DBA LOCA conditions, which are bounding for containment pressure, the drywell reaches the 30-psig limit in 15 days, compared to 18 days for current licensed thermal power (CLTP). This reduction in time does not affect any design basis requirements.

NRC Request ACVB.34

Section 4.7 of the PUSAR indicates that following EPU operation, the required 7-day volume of nitrogen increases from 155,000 scf to 197,000 scf, which exceeds the available 191,000 scf supply required by the TSs. The TS Bases of 7-days nitrogen storage requirement is conservative, because additional liquid nitrogen can be delivered within 1-day travel distance from two liquid nitrogen distribution facilities. The TS Bases will be revised to a 4-days nitrogen storage requirement to accommodate EPU.

Please verify that the required nitrogen can be delivered to the site within 4-days time besides any natural phenomena occurring.

TVA Reply to ACVB.34

TVA has confirmed that the two liquid nitrogen distribution facilities are located within 1-day travel distance. While TVA has not had to request nitrogen delivery on an emergency basis, delivery of nitrogen has routinely occurred within 24 hours of order.

SBWB (SRXB-A)

NRC Request SRXB-A.1

On page E1-13 of Enclosure 1 of the June 25, 2004, submittal states that "[n]o increase in allowable peak bundle power is requested for EPU." Specify the peak bundle power.

TVA Reply to SRXB-A.1

The peak bundle power for BFN Units 2 and 3 is 7.7 MWt based on the Framatome Advanced Nuclear Power (FANP) EPU analyses for a reference ATRIUM-10 equilibrium core design used as the basis for the FUSAR analyses. The corresponding value for the first Unit 2 Cycle 15 EPU core design is 7.44 MWt.

Variations in peak bundle power will occur for each cycle based on differences in fuel design, core design, and control rod patterns. It should be noted that peak bundle power is not a limit, but instead is constrained by the allowable fuel thermal limits (Linear Heat Generation Rate (LHGR), Maximum Average LHGR (MAPLHGR), and Critical Power Ratio (CPR)). Variations in peak bundle power from the design value can also occur during operation due to changes in planned operating control rod patterns. However, the adherence to the underlying fuel thermal limits is a license requirement as specified in plant Technical Specifications (TS).

NRC Request SRXB-A.2

The EPU analyses contained in Enclosure 4 of the June 25, 2004, submittal, NEDC-33047, DRF 0000-0011-1328, Revision 2, Browns Ferry Units 2 and 3 Safety Analysis Report for Extended Power Uprate, or the PUSAR, are based on Unit 2 operating conditions. The operating conditions and plant features of Units 2 and 3 may not be identical. Discuss in detail the differences between the units if any and explain in detail why the conclusions given in the topical report are valid for Unit 3. Also, identify all differences in plant design and operating conditions between the units.

TVA Reply to SRXB-A.2

The equilibrium core analysis is a single analysis for BFN Units 1, 2, and 3. There are physical differences among the three BFN units that have the potential to impact licensing analyses. The most significant of these are differences in the main steam line pressure drop that impacts the transient analyses and differences in in-core leakage that impacts the Loss-of-Coolant Accident (LOCA) analyses presented in the PUSAR.

The differences in main steam line pressure drop result from physical differences in the Main Steam Isolation Valve (MSIV) internals design for the three units. The main steam line pressure drop is used in the Abnormal Operating Occurrence (AOO) transient evaluations. To accommodate the physical differences among the three units, the most conservative main steam delta pressure from the three units was used in the PUSAR equilibrium core AOO transient analyses.

There are also some physical differences in the reactor internals configurations among the units due to the history and progression of modifications that have been completed on each individual unit (e.g., bolted versus welded access hole covers). These type differences affect the magnitude of the assumed core leakage and in turn the Emergency Core Cooling System (ECCS) core injection flow credited inside the core shroud for the LOCA analysis. To address these differences, the PUSAR LOCA evaluation (which was performed for all three units at EPU conditions) used the most conservative value of the ECCS flow adjustment irrespective of which unit the physical difference existed on. Therefore, the PUSAR LOCA Peak Clad Temperature (PCT) is the highest that would be expected for any particular unit.

Therefore, the conclusions of the PUSAR, NEDC-33047, are applicable and bounding for both Units 2 and 3.

NRC Request SRXB-A.3

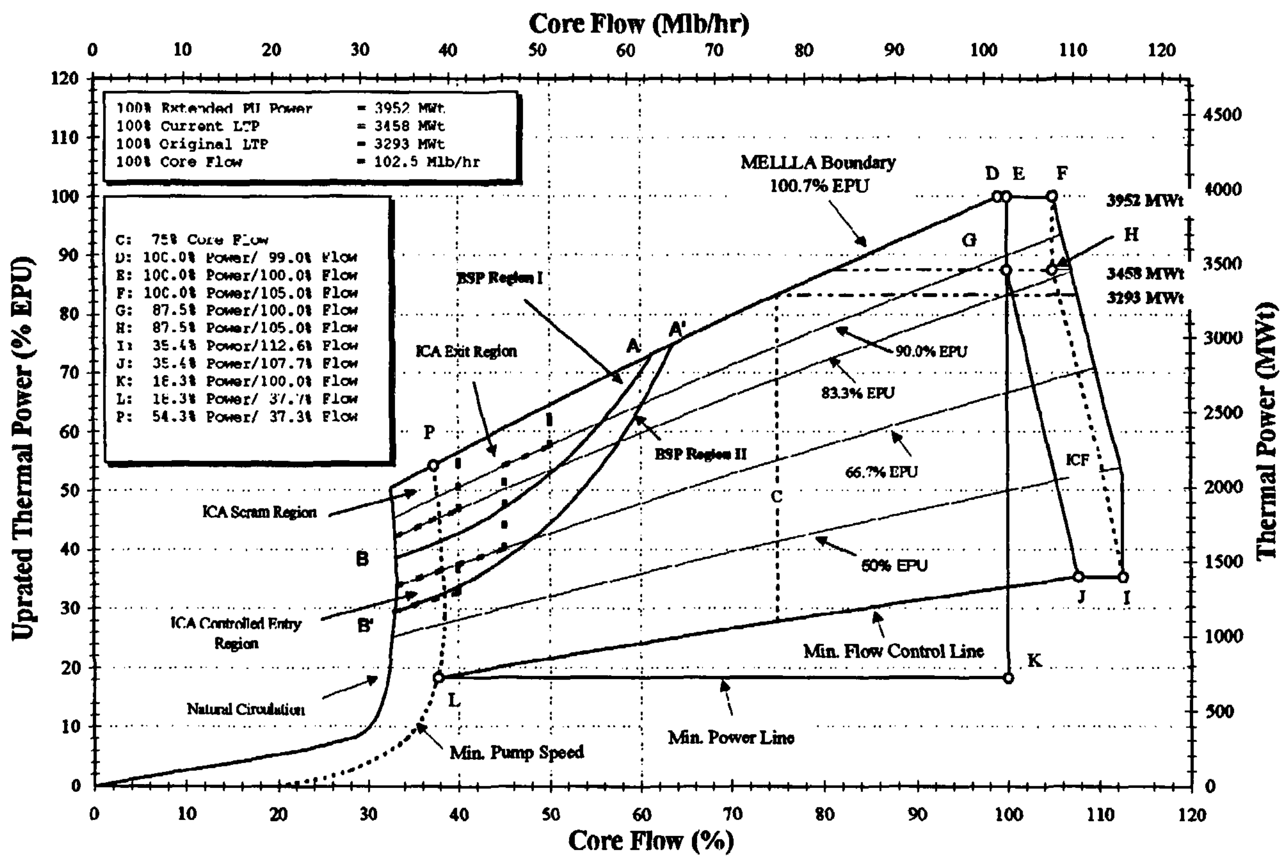
In Section 2.3.1 of the PUSAR, the thermal hydraulic instability exclusion regions are not shown in Figure-2-1. Provide a figure showing the instability exclusion regions.

TVA Reply to SRXB-A.3

The thermal-hydraulic exclusion regions are part of the backup stability method used when the Option III system is not operable. Backup Stability Protection (BSP) regions will be established as part of the reload licensing process on a cycle-specific basis in accordance with the guidance provided in

OG02-0119-260, "Backup Stability Protection (BSP) for Inoperable Option III Solution", dated July 17, 2002. Figure SRXB-A.3-1 provides a representation of the BSP regions for reduced feedwater temperature conditions. The original ICA regions, rescaled for EPU conditions, are also shown on this figure for comparison. Normal feedwater temperature BSP regions are typically smaller and the actual size of the BSP regions will vary for each operating cycle.

Figure SRXB-A.3-1: EPU Power/Flow Map with ICA Regions



NRC Request SRXB-A.4

Section 1.3.2 of the PUSAR, states that there will be no increase in the maximum nominal dome pressure of 1050 pounds per square inch atmosphere (psia) for uprated conditions. Section 2.5.2 of the FUSAR indicates [

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TVA Reply to SRXB-A.4

The EPU is evaluated on the basis of operation at the same dome pressure, but higher core power and steam flow. Therefore, pressures upstream from the dome, such as above the core plate region, should increase slightly (consistent with higher steam flow resistance of approximately 1 psi in the steam dryers and separators). Additionally, pressures downstream from the dome, such as the turbine inlet region, should decrease slightly (consistent with higher steam flow resistance in the steam lines).

NRC Request SRXB-A.5

In the NRC Safety Evaluation for Licensing Topical Report, NEDC-32523P-A, Generic Evaluations of General Electric Boiling Water Reactor Power Uprate, or ELTR2, page 12 it is stated: "In order to reduce the possibility of turbine overspeed trips, plant-specific submittals must address the modifications described in GE SIL [Service Information Letter] No. 480 and GE SIL No. 377 (or equivalent modifications)." Confirm that modification recommended by SIL No. 377 are implemented in Units 2 and 3.

TVA Reply to SRXB-A.5

The turbine control system modifications described in GE Service Information Letter (SIL) 377 restrict steam flow to the turbine until after the turbine is under governor valve control, thereby minimizing the transient peaks in turbine speed, pump discharge pressure, and flow during a quick start. This SIL identifies modifications primarily intended for the larger GS-2 model turbine. Although the same modification would dampen the startup transient observed in the smaller GS-1 turbine used in the BFN plants, operating experience with the GS-1 turbine indicates that it is not as susceptible to a transient overspeed condition during a quick start. The capability of the Reactor Core Isolation Coolant (RCIC) system to startup under EPU conditions, with or without implementation of SIL 377, does not change because the reactor pressure conditions do not change for EPU. Therefore, BFN does not plan to implement the modifications described in SIL 377. SILs are issued for information purposes only and do not impose new requirements for system modifications. EPU does not change the recommendations presented in SIL 377.

NRC Request SRXB-A.6

Section 2.1 of the PUSAR states, that "[t]he additional energy requirements for EPU are met by increase in bundle enrichment, an increase in the reload fuel batch size, and/or changes in fuel loading pattern to maintain the desired plant operating cycle length." Describe how EPU is achieved for BFN Units 2 and 3. Specify the fuel enrichment and the reload batch size before and after EPU.

TVA Reply to SRXB-A.6

To obtain the increase in power while maintaining the same cycle length, an additional 14% of energy is to be produced in the core. This increase in energy is obtained primarily by increasing the reload batch size. The equilibrium core used in the FUSAR analyses had a fresh batch size of 368 ATRIUM-10 fuel assemblies with a batch average enrichment of 4.29 wt% U-235. Analyses for the first Unit 2 Cycle 15 EPU core indicate a fresh batch size of 374 ATRIUM-10 fuel assemblies at a batch average enrichment of 4.13 wt% U-235. For comparison, at current rated power conditions of 105% Original Licensed Thermal Power (OLTP), the Unit 2 Cycle 14 core has a fresh batch size of 280 ATRIUM-10 fuel assemblies with a batch average enrichment of 3.92 wt% U-235 and the Unit 3 Cycle 13 core has a fresh batch size of 296 ATRIUM-10 fuel assemblies with a batch average enrichment of 4.17 wt% U-235. Unit 3 Cycle 14 EPU core specific analyses have not yet been completed, but results are expected to be similar to the Unit 2 Cycle 15 EPU core based on equilibrium core analyses.

NRC Request SRXB-A.7

Section 4.3 of the PUSAR indicates that the [

]. However Table 4-5 indicates that the peak clad temperature (PCT) for GE-13 fuel decrease by 30 degrees °F and for GE-14 fuel, the PCT increases by 70°F. Describe the reasons behind such a difference and why BFN Units 2 and 3 are an exception in this regard.

TVA Reply to SRXB-A.7

The effect of EPU on the large break PCT is typically less than 20°F because the hot bundle is placed on the same thermal limits for peak LHGR and initial Minimum CPR (MCPR), and the effect is reported as the highest change in the nominal and Appendix K PCTs.

Power uprate increases the average bundle power, so the average bundle has a higher void fraction and pressure drop. Since the hot bundle is placed on the same thermal limits at EPU as at pre-uprate, a power uprate results in more flow to the hot bundle because of the higher pressure drop in the average bundle. This can result in a slightly lower PCT in the hot bundle as is seen in the results for GE13 (-30°F). The GE13 limiting break is the full Design Basis Accident (DBA) large break before and after EPU, so the calculated Appendix K PCT decreased because of reduced flow differences between the hot and average bundles at power uprate.

The small break LOCA analyses are more sensitive to decay heat than the large break LOCA analyses. The higher decay heat associated with EPU can result in a longer Automatic Depressurization System (ADS) blowdown and delay the start of makeup flow from the low pressure ECCS for small breaks. [[

]] This is the reason for the 70°F increase in PCT for the GE14 fuel at EPU conditions in the PUSAR.

NRC Request SRXB-A.8

Section 4.3 page 4-10 states that "[t]he EPU effect on PCT for small recirculation line breaks is larger than the EPU effect on PCT for large line breaks." Clarify what TVA considers a "small recirculation line break."

TVA Reply to SRXB-A.8

In the BFN LOCA analysis, the small break is defined as ≤ 1.0 ft^2 in the Recirculation System piping. For these breaks, ECCS injection depends on reactor depressurization due to initiation of the ADS.

NRC Request SRXB-A.9

Section 6.5 of the PUSAR states that, "there is a corresponding increase in the maximum discharge pressure and a decrease in the operating pressure margin for the pump discharge relief valves." The peak calculated peak vessel bottom pressure is 1484 psig as shown in Table 9-4. However, the pump discharge pressure value used for the surveillance test is only 1325 psig. Discuss the reason for specifying 1325 psig when the calculated peak pressure is indicated as 1484 psig.

TVA Reply to SRXB-A.9

The Standby Liquid Control System (SLCS) pump discharge test pressure of 1325 psig is based on the peak reactor pressure that occurs during SLCS operation.

The peak reactor vessel pressure of 1484 psig in PUSAR Table 9.4 occurs early (within 30 seconds) of the ATWS event initiation. By the time the SLCS is initiated (about 2 minutes after ATWS event start), the reactor vessel pressure has decreased significantly. The maximum pressure that occurs during SLCS operation is 1204 psig (lower plenum pressure). This equates to an SLCS pump discharge pressure of 1298 psig for the limiting ATWS. The selected SLCS pump discharge surveillance test pressure of 1325 psig bounds this value.

NRC Request SRXB-A.10

Provide the standby liquid control reactor vessel set point. Discuss the value of the margin after the EPU and provide the pressure at which the relief valve is expected to reclose.

TVA Reply to SRXB-A.10

SLCS is a manually initiated system. SLCS does not contain a reactor vessel relief valve. The SLCS is equipped with two SLCS pump relief valves provided for the function of equipment protection if the SLCS discharge line is blocked after system initiation. The SLCS pump relief valves have a nominal setpoint of 1425 psig. A minimum margin of 97 psi has been determined to provide a reasonable assurance against relief valve lifting. This margin includes allowance for relief valve setpoint drift and SLCS pump pressure pulsations. The actual margin for EPU is 127 psi.

The SLCS relief valve nominal reseat pressure is 1270 psig. The minimum reactor vessel lower plenum pressure prior to SLCS initiation is 1153 psig (all ATWS events). The calculated SLCS pump discharge pressure based on this reactor vessel lower plenum pressure is 1247 psig. The maximum calculated pump discharge pressure that will allow the SLCS relief valves to reclose is 1248 psig.

NRC Request SRXB-A.11

Section 9.3.1, Table 9-4 of the PUSAR shows that the peak calculated suppression pool temperature is decreased from 214.6°F to 214.1°F. Explain why the suppression pool temperature is decreasing due to EPU.

TVA Reply to SRXB-A.11

The suppression pool is heated up by the steam discharged from the safety/relief valves (SRVs) during an isolation ATWS event. The steam generation during the isolation ATWS event is determined by the reactor conditions following the automatic recirculation pump trip (RPT), and operator initiated water level control and boron injection. Because the maximum rod line does not change as a result of EPU, the power/flow history after RPT is similar for both EPU and pre-EPU. Therefore, the peak suppression pool temperature results are expected to be approximately the same between CLTP and EPU conditions. Once the water level is established around top of active fuel or a higher designated level, the power generation is controlled by the amount of boron in the core and the core void fraction regardless of the initial power level. Small differences in power and core flow can yield a slightly higher power and steam generation rate for the EPU versus CLTP condition. Note small differences in core flow can lead to differences in core boron concentration versus time especially if these core flow differences occur near the core flow threshold for boron transport to the core. Since the effect is cumulative, the total steam discharged into the suppression pool can be higher for the CLTP conditions, and hence, a slightly higher suppression pool temperature as is seen for the CLTP analysis results. Other CLTP/EPU studies for plants with lower plenum boron injection show very similar CLTP and EPU peak pool temperature results.

NRC Request SRXB-A.12

Discuss whether the operator actions specified in emergency operating procedures are consistent with the BWR Owners' Group Emergency Procedure Guidelines and Severe Accident Guidelines, Revision 2 insofar as they apply to the operator actions for an ATWS. Specify the time delay used in the ATWS analysis for starting the standby liquid control pump(s).

TVA Reply to SRXB-A.12

The operator actions during ATWS events assumed in the evaluation are lowering water level below the feedwater spargers, initiating boron injection, and raising water level after hot shutdown boron weight is injected. These actions are consistent with BWROG Emergency Procedure Guidelines/Severe Accident Management Guidelines recommendations.

In the analysis, it is assumed that boron injection is initiated approximately two minutes after the dome pressure reaches the ATWS - Recirculation Pump Trip (ATWS-RPT) setpoint.

NRC Request SRXB-A.13

The Executive Summary of the February 23, 2005 submittal states that, "[a]ll analyses are performed for a reference ATRIUM-10 equilibrium core." Define the "equilibrium core," and explain in detail how this analysis meet all the EPU licensing and regulatory requirements for the first Unit 2 core with partial load of GE fuel and Unit 3 with all ATRIUM-10 fuel.

TVA Reply to SRXB-A.13

A reference ATRIUM-10 equilibrium core design was used in the FANP EPU analyses. The equilibrium core design is determined from multi-cycle depletions until convergence is attained based on the following criteria:

- Constant loading plan for shuffling from cycle-to-cycle (same reactivity ranking of irradiated fuel and same placement of fresh fuel)
- Constant set of control rod patterns to deplete each successive cycle to End of Cycle
- The same fresh fuel/lattice designs loaded each cycle; and
- The equilibrium core design meets the specified EPU energy requirements and maintains adequate thermal margins and reactivity margins

Since the equilibrium design is determined to achieve the requirements of the BFN EPU cycle conditions using a full core of ATRIUM-10 fuel, the equilibrium core design is expected to be representative of future EPU cycles at BFN. Analyses in the FUSAR demonstrate that all licensing requirements are met for a full core of ATRIUM-10 fuel at EPU conditions.

The actual core designs used for Unit 2 and Unit 3 EPU implementation will have slightly different power distributions and reactivity characteristics than the equilibrium core. Conclusions from analyses that are dependent on the core design (loading pattern, control rod patterns, fuel types) are reconfirmed as part of the reload licensing analyses performed each cycle. Cycle-specific reload licensing calculations will continue to be performed for all future EPU cycles using NRC-approved methodologies consistent with the current processes.

NRC Request SRXB-A.14

Section 1.2.1 of Enclosure 5, EMF-2982(P), Browns Ferry Units 2 and 3 Safety Analysis Report for Extended Power Uprate ATRIUM™-10 Fuel Supplement, Revision 0, or the FUSAR, states:

> For most of the EPU analyses, the 2 percent power factor discussed in Regulatory Guide 1.49 is accounted for in the analysis methods. Three exceptions are ASME over pressurization, loss of feedwater (LOFW) flow, and LOCA analyses.

However page 3-1, of Section 3.2 states that "[t]he events were analyzed at 102 percent of EPU rated thermal power …" for the overpressure protection analysis. Discuss whether an exception was taken for the overpressure analysis.

Explain in detail why exceptions are taken from the Regulatory Guide 1.49 position of 2-percent power factor for the LOFW and LOCA analyses.

TVA Reply to SRXB-A.14

Exceptions were not taken from Regulatory Guide 1.49 for any analyses presented in the FUSAR. The exception referred to in the report was not an exception to the application of the 2% power factor; the exception referred to two different approaches used to account for the 2% power factor in the analyses. Most of the analyses were performed at 100% power level and the impact of the 2% power factor is accounted for either statistically or through the inherent conservatism of the methodology. For three of the analyses (ASME over-pressurization, loss of feedwater flow, and LOCA-ECCS analyses), the effects of the 2% power factor are not directly included in the methodology used for the analyses; therefore, these three analyses were performed at 102% of EPU rated power to account for the 2% power factor.

NRC Request SRXB-A.15

Table 1.3 of Section 1.2 of the June 6, 2005, submittal lists all the nuclear steam system codes used for the EPU request. Section 1.2.2 indicates that the Unit 1 application of these codes complies with the limitations, restrictions, and conditions specified in the applicable NRC safety evaluation (SE) report that approved each code, with exceptions as noted in Table 1-3.

Provide a review of the fuel vendor's analytical methods and code systems (neutronic, LOCA, transient and accidents, etc.) used to perform the safety analyses supporting the Units 2 and 3 application and provide the following information to confirm that:

a) The steady state and transient neutronic and thermal-hydraulic analytical methods and code systems used to perform the safety analyses supporting the EPU conditions are being applied within the NRC-approved applicability ranges;

b) For the EPU conditions, the calculational and measurement uncertainties applied to the thermal limits analyses are valid for the predicted neutronic and thermal-hydraulic core and fuel conditions; and

c) That the assessment database and the assessed uncertainty of models used in all licensing codes that interface with or are used to simulate the response of Units 2 and 3 during steady state, transient, or accident conditions remain valid and applicable for the EPU conditions.

TVA Reply to SRXB-A.15

FANP licensing analyses are performed to ensure that all fuel design and operating limits are satisfied for the limiting assembly in the core. The first step in determining the applicability of current licensing methods to EPU conditions was a review of FANP current BWR topical reports to identify Safety Evaluation Report (SER) restrictions on the BWR methodology. This review identified that there are no SER restrictions on power level for the FANP topical reports. The review also indicated that there are no SER restrictions on the parameters most impacted by the increased power level: steam flow, feedwater flow, jet pump M-ratio, and core average void fraction.

The second step consisted of an evaluation of the differences between current core and reactor conditions and those experienced under EPU conditions to determine any challenges to the validity of the models. When the reactor power is increased, the resultant impact on operating margin is mitigated to a large extent by a decrease in the limiting assembly radial power factor. This decrease in the limiting assembly radial power factor is necessary since the thermal operating limits (Minimum CPR (MCPR), MAPLHGR and LHGR) are fairly insensitive to the increase in core thermal power. From this fundamental constraint the following observations may be made about the EPU operating conditions:

1. The reduction in the hot assembly radial peaking factor leads to a more uniform radial power distribution and consequently a more uniform core flow distribution. The net result is less flow starvation of the hottest assemblies.

2. With the flatter radial power distribution, more assemblies and fuel rods are near thermal limits.

3. From a system perspective, there will be higher steam flow and feedwater flow rates.

4. With an increase in the average assembly power in the reactor, the core pressure drop will increase slightly resulting in a decrease in the jet pump M-ratio for a given core flow rate.

5. Core average void fraction will increase.

Based on these fundamental characteristics of power uprate, each of the major analysis domains (thermal-hydraulics, core neutronics, transient analysis, LOCA and stability) are assessed to determine any challenges to EPU application.

Thermal-hydraulics

FANP assembly thermal-hydraulic methods are qualified and validated against full-scale heated bundle tests in the KATHY test facility in Karlstein, Germany. The KATHY tests are used to characterize the assembly two-phase pressure drop and Critical Heat Flux (CHF) performance. This allows the hydraulic models to be verified for FANP fuel designs over a wide range of hydraulic conditions prototypical of reactor conditions. The standard matrix of test conditions for KATHY is compared to reactor conditions in Figure SRXB-A.15-1. This figure illustrates that the test conditions bound both uprated (and non-uprated) assembly conditions. The uprate data is for the BFN equilibrium core including maximum extended load line limit analysis plus (MELLLA+). Even though this submittal is for EPU, MELLLA+ conditions are included since they bound EPU void fractions. Figure SRXB-A.15.1 also shows that the key physical phenomena (e.g., heat flux, fluid quality, and assembly flows) for uprated conditions are within the scope of, and bounded, by current reactor experience. This similarity of assembly conditions is further enforced in FANP analysis methodologies by the imposition of SPCB CHF correlation limits and, therefore, both current designs and uprated designs must remain within the same parameter space. Since the bundle operating conditions for

EPU are within the envelope of hydraulic test data used for model qualification and operating experience, the hydraulic models used to compute the core flow distribution and local void content remain valid for EPU conditions.

Core Neutronics

The FANP neutronic methodologies are characterized by technically rigorous treatment of phenomena and are very well benchmarked (>100 cycles of operation plus gamma scan data for ATRIUM-10). Recent operating experience is tabulated in Tables SRXB-A.15-1 and 15-2. These tables present the reactor operating conditions and in particular the average and hot assembly powers for both U.S. and European applications. As can be seen from this information, the average and peak bundle powers in this experience base exceed that associated with the power uprate for BFN. The increased steam flow from power uprate comes from increased power in normally lower power assemblies in the core operating at higher power levels. High powered assemblies in uprated cores will be subject to the same LHGR, MAPLHGR, MCPR, and cold shutdown margin limits and restrictions as high powered assemblies in non-uprated cores. Again, this similarity of operating conditions between current and uprate conditions assures that the neutronic methods used to compute the nodal reactivity and power distributions remain valid. Furthermore, the neutronic characteristics computed by the steady-state simulator and used in safety analysis remain valid.

Transient Analysis

The phenomena of primary interest for limiting transients in BWRs are void fraction/quality relationships, determination of CHF, pressure drop, reactivity feedbacks, and heat transfer correlations. One fundamental validation of the core hydraulic solution is separate effects testing against Karlstein transient CHF measurements. The transient benchmark to time of dryout for prototypical Load Reject with no Bypass (LRNB) and pump trip transients encompass the transient integration of the continuity equations (including the void-quality closure relation), heat transfer, and determination of CHF. Typical benchmarks to Karlstein (Figure SRXB-A.15-2) illustrate that the transient hydraulic solution and application of SPCB result in conservative predictions of the time of dryout.

Outside of the core, the system simulation relies primarily on solutions of the basic conservation equations and equations of state. While there are changes to the feedwater flow rate and jet pump M-ratio associated with power uprate, the most significant change is the steam flow rate and the associated impact on the steamline dynamics for pressurization events. The models associated with predicting the pressure wave are general and have no limitation within the range of variation associated with power uprate.

The reactivity feedbacks are validated by a variety of means including initial qualification of advanced fuel design lattice calculations to Monte Carlo results as required by SER restrictions, steady-state monitoring of reactor operation (power distributions and eigenvalue), and the Peach Bottom 2 turbine trip benchmarks that exhibited a minimum of 5% conservatism in the calculation of integral power.

From these qualifications and the observation that the nodal hydraulic conditions during EPU are expected to be within the current operating experience, the transient analysis methods remain valid.

LOCA Analysis

LOCA results are strongly dependent on local power and are weakly dependent on core averaged power. As discussed in previous sections, maximum local power is not significantly changed due to power uprate because the core is still constrained by the same thermal limits. The parameters associated with power uprate that may impact LOCA results are: increased core average initial stored energy, decreased initial coolant inventory, relative flow distribution between highest power and average power assemblies, and increased core decay heat.

BWR LOCA analyses are not sensitive to initial stored energy. During the blowdown phase the heat transfer remains high and the stored energy is removed prior to the start of the heatup phase. Initial coolant inventory differences may impact LOCA event timing and the minimum inventory during blowdown prior to refill of the reactor vessel. However, any impact on event timing or minimum inventory would be smaller than the impact associated with the different size breaks that are already considered in the break spectrum analyses. At EPU conditions, the difference in flow between the highest power assembly and the average power assembly is reduced relative to pre-EPU conditions. Therefore, these parameters do not change the range of conditions encountered or the capability of the codes to model LOCA at EPU conditions.

The potential impact of power uprate on LOCA analyses is primarily associated with the increase in decay heat levels in the core. Decay heat is conservatively modeled using industry standards applied as specified by regulatory requirements. The models used for decay heat calculations are valid for EPU.

From the above discussion and the observation that nodal thermal-hydraulic conditions during EPU are expected to be within the current operating experience, so the LOCA methods remain valid for EPU conditions.

Stability Analysis

The flatter radial power profile induced by the power uprate will tend to decrease the first azimuthal eigenvalue separation and result in slightly higher regional decay ratios. These effects are computed by STAIF as it directly computes the channel, and global and regional decay ratio, and does not rely on a correlation to protect the regional mode.

STAIF has been benchmarked against full assembly tests (in the KATHY facility) to validate the channel hydraulics from a decay ratio of approximately 0.4 to limit cycles. These tests or benchmarks exceed the bounds of EPU operation. These benchmarks include prototypical ATRIUM-10 fuel assemblies. From a reactor perspective, STAIF is benchmarked to both global and regional reactor data as late as 1998, and, therefore, includes current reactor cycle and fuel design elements. This strong benchmarking qualification and the direct computation of the regional mode assure that the impact of the "flatter" core design for power uprate will be reflected in the stability analysis.

Special Events

FANP performs ATWS analysis to demonstrate compliance with the peak pressurization criteria which occurs very early in the transient. The early system response during an ATWS event is essentially the same as a transient event and the same code is used to calculate the system response. The impact of EPU operation on the ATWS peak pressure analysis is the same as in the transient analysis system response discussed earlier.

The Appendix R analysis is performed using the approved LOCA analysis codes. Similar to LOCA events, the impact of power uprate on the Appendix R analysis is primarily associated with the increase in decay heat in the core. Decay heat is conservatively modeled using industry standards. Use of the Appendix K heat transfer correlations and logic is conservative for Appendix R calculations.

Summary

A review concluded that there are no SER restrictions on FANP methodology that are impacted by EPU. Since the EPU core and assembly conditions for the BFN units are equivalent to core and assembly conditions of other plants for which the methodology was benchmarked, the FANP methodology (including uncertainties) remains applicable for EPU conditions.

More specifically:

a) The steady-state and transient neutronics and thermal-hydraulic analytical methods and code systems supporting EPU are within NRC approved applicability ranges because the conditions for EPU application are equivalent to existing core and assembly condition in other plants for which the FANP methodology was benchmarked.

b) The calculational and measurement uncertainties applied in EPU applications are valid because the conditions for EPU application are equivalent to existing core and assembly conditions for which the FANP methodology was benchmarked.

c) The assessment database and uncertainty of models used to simulate the plant response at EPU conditions are equivalent to core and assembly conditions for which the FANP methodology was benchmarked.

Table SRXB-A.15-1 CASMO-4/MICROBURN-B2 Operating Experience

Reactor	Reactor Size, #FA	Power, MWt (% Uprated)	Ave. Bundle Power, MWt/FA	Approximate Peak Bundle Power, MWt/FA	Fuel/Cycle Licensing**	Uprate Comments
A	592	2570 (0.0)	4.4	--	X	
B	592	2575 (0.0)	4.4	--	(x)	
C	840	3690 (0.0)	4.4	--	(x)	
D	500	2500 (15.7)	5.0	7.6	X	For 3 cycles oper.
E	700	3300 (9.3)	4.7	8.0	X	
F	784	3840 (0.0)	4.8	8.2	(x)	
G	624	2894 (0.0)	4.5	7.7		
H	648	3515 (12.0)	5.4	8.2	X	For 1 cycle operation
I	624	3039* (5.0)	4.9	7.7	X	
J	800	3898* (1.7)	4.9	7.7	X	
K	764	3489* (5.0)	4.6	--	X	
BFN 2/3†	764	3952 (20.0)	5.2	7.7	none	Eq cycle study

* Latest power uprates. (BFN uprated power level only 1.4% higher than current Reactor J).

** (x)=currently fuel licensing only (Europe).

† BFN added for comparison purposes only (i.e., not in the Operating Experience database).

Table SRXB-A.15-2 CASMO-4/MICROBURN-B2 Other Planned Uprate Support

Reactor	Reactor Size, #FA	Power, MWt (% Uprated)	Ave. Bundle Power, MWt/FA	Approximate Peak Bundle Power, MWt/FA	Fuel/Cycle Licensing**	Uprate Comments
A	592	2704 (5.0)	4.6	--	(x)	Uprate planned
F	784	4100* (6.8)	5.2	8.2	(x)	License Applied for
G	624	3184 (10.0)	5.1	7.7	(x)	Operation start in 2002
I	624	3091 (6.7)	5.0	7.7	X	Cycle 12
BFN 2/3	764	3952* (20.0)	5.2	7.7	none	EQ cycle study

* Reactor F power level (4100 MWt is 3.7% higher than BFN uprated power).

** (x)=currently fuel licensing only (Europe).

Figure SRXB-A.15-1: Comparison of Karlstein Two-Phase Pressure Drop Test Matrix and Typical Reactor Conditions

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Figure SRXB-A.15-2 Typical Hydraulic Benchmarks to Karlstein Transient Simulations

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NRC Request SRXB-A.16

Section 2.1 of the FUSAR states that "[t]he NRC-approved exposure limits are not exceeded in the ATRIUM-10 equilibrium core design used in the EPU evaluations." Specify the NRC-approved exposure limits for ATRIUM-10 fuel.

TVA Reply to SRXB-A.16

There are two NRC-approved exposure limits for ATRIUM-10 fuel evaluated with FANP methods as defined in Reference SRXB-46.2. Fuel rods have a [[ ]] maximum limit on a rod average basis, and fuel assemblies have a [[ ]] maximum limit on an assembly average basis.

NRC Request SRXB-A.17

Section 2.1.1 of the FUSAR states that, "[s]ince there is no change in the average bundle power with ATRIUM-10 fuel, there is no change to the thermal margin monitoring threshold." However, the fuel design is changed to achieve EPU and the average power is increased from 4.53 MW/bundle to 5.17 MW/bundle for EPU. Explain the discrepancy stated in the conclusion that a change in fuel design has no impact on average bundle power.

TVA Reply to SRXB-A.17

As indicated in FUSAR Section 1.1, the purpose of the FUSAR is to summarize the impact that operation with ATRIUM-10 fuel at EPU conditions has on the PUSAR evaluations for BFN Units 2 and 3. Section 2.1.1 of the FUSAR states that no change is required in the thermal margin monitoring threshold due to the use of ATRIUM-10 fuel. The change in thermal margin monitoring threshold to 23% RTP in the PUSAR remains valid for ATRIUM-10 fuel.

The change in average assembly power from 4.53 MW/bundle to 5.17 MW/bundle is a result of EPU, not a change in fuel design. Since the core power levels supported in the PUSAR and FUSAR are the same, and the total number of assemblies is the same, the average power per assembly is the same between the PUSAR and FUSAR supporting the conclusion that a change in fuel design has no impact on the average bundle power.

NRC Request SRXB-A.18

Section 3.8 of FUSAR states that, "[l]oss of feedwater flow analyses were performed without reactor isolation since this scenario presents a greater challenge to the system's ability to maintain water level above the level 1 setpoint." This implies that Framatome takes credit for systems other than reactor core isolation coolant for reactor core makeup. Discuss the assumptions and systems used in the analysis.

TVA Reply to SRXB-A.18

The loss of feedwater flow transient analysis only credits the RCIC system for providing makeup water to the reactor vessel. High Pressure Coolant Injection system operation is not credited. Reactor isolation would not normally occur for this transient, and the turbine and pressure control system will continue to take steam mass from the reactor until pressure falls below the turbine inlet pressure setpoint. This is a conservative assumption. Other key assumptions in the analysis are:

- Recirculation pump speed runback commences at water Level 4
- Scram occurs at Level 3
- Recirculation pump trip occurs at Level 2
- Initiate startup of RCIC at Level 2

NRC Request SRXB-A.19

For Figures 3-5, MSIV closure with flux scram, and 3-12, Turbine Trip with bypass failure, of the FUSAR, specify the units for the Y-axis for reactivity.

TVA Reply to SRXB-A.19

The reactivity presented in the FUSAR plots is in terms of $\Delta k/k$ where k is the multiplication factor and Δk is the change in multiplication factor. As a result, there are no units associated with the reactivity plots.

NRC Request SRXB-A.20

In Table 4.1 of the FUSAR, the PCT for ATRIUM-10 fuel at EPU is shown as 1990°F. However, in a letter dated April 8, 2005, providing a report of emergency core cooling system evaluation model changes, TVA informed the NRC staff that the calculated PCT for EPU operation is 2007°F. Discuss the PCT for Units 2 and 3 EPU operation.

TVA Reply to SRXB-A.20

The ATRIUM-10 LOCA analysis performed by FANP supports future operation at EPU power level as well as current operation at the licensed power level for BFN Units 2 and 3. The FANP LOCA/ECCS analysis is composed of an initial application calculation and follow-on reload confirmation calculations. In the initial application of FANP methods, the limiting LOCA/ECCS condition (i.e., break size and equipment failures) is determined in a break spectrum calculation. The limiting case from this analysis is then repeated in a more detailed MAPLHGR calculation to define the licensing basis PCT. One of the inputs used in these analyses is a specific lattice design chosen such that it is bounding for the initial reload.

The PCT of 1990°F reported in Table 4.1 of the FUSAR was calculated using the most limiting lattice design available for BFN at that time, which happened to be from the Unit 3 Cycle 12 reload analysis (Reference SRXB-A.20-1). The lattices considered also included those from the EPU reference cycle (i.e., equilibrium cycle design).

For each reload, a PCT confirmation calculation is performed using the new lattice designs to verify that the PCT remains bounded. If the cycle-specific calculation exceeds the licensing basis PCT, then the MAPLHGR analysis is repeated using the new limiting lattice which results in a new licensing basis PCT. This occurred for the Unit 2 Cycle 14 reload which resulted in the new PCT of 2007°F (Reference SRXB-A.20-2). This was the value reported under 10 CFR 50.46 in the letter dated April 8, 2005. This new value is applicable to both Units 2 and 3 EPU operation and also bounds current rated power operation.

References:

SRXB-A.20-1: EMF-2954(P) Revision 1, "Browns Ferry Units 1, 2, and 3 Extended Power Uprate LOCA-ECCS Analysis MAPLHGR Limit For ATRIUM-10 Fuel," April 2004

SRXB-A.20-2: EMF-3145(P) Revision 0, "Browns Ferry Units 1, 2, and 3 Extended Power Uprate LOCA-ECCS Analysis MAPLHGR Limit For ATRIUM-10 Fuel," December 2004

NRC Request SRXB-A.21

In TVA's response dated June 6, 2005, to NRC Request 11, Table 10 was included listing the EPU Design/Licensing Bases Changes. Change in limiting PCT is identified as one of the licensing bases changes and reference is made to FUSAR Section 4.3. It is not clear from the PUSAR, the limiting event prior to EPU and the limiting event after the EPU. Explain in detail the changes in the limiting event for determining the PCT. Include the impact, if any from the use of ATRIUM-10 fuel.

TVA Reply to SRXB-A.21

The LOCA analysis responsibility remains with the original supplier of the fuel. The PUSAR addresses GE fuel while the FUSAR addresses FANP fuel. The listed licensing basis change

"Change in limiting PCT event" in Table 10 of the response dated June 6, 2005, to NRC Request 11 references the GE BFN PUSAR Section 4.3, not the FANP FUSAR. The change is, therefore, in regard to using GE methodology and refers to the GE14 limiting break size changing from large break LOCA (DBA) to small break LOCA (0.06 ft^2, as described in section 4.3 of the PUSAR) for EPU. This change was not an unexpected result since small breaks are more sensitive to decay heat than the large breaks, and power uprate increases the decay heat. The PCT increase due to higher decay heat is sufficient in the GE methodology to cause the GE14 limiting break to be the small break, and the effect of power uprate on the Licensing Basis PCT becomes much greater than if the limiting break remained the DBA break. The FANP results also indicate that a small break (0.5 ft^2, as described in section 4.3 of the FUSAR) is limiting for ATRIUM-10 fuel at EPU conditions. Both the ATRIUM-10 and GE14 fuel bundles have equivalent decay heat characteristics.

The FANP analyses were performed to support EPU operation and provide a bounding result for current rated power conditions. To accomplish this, FANP analyzed a complete break spectrum at EPU conditions and then repeated the limiting EPU break case at pre-EPU power. The analysis was intended to provide a demonstration of the expected PCT difference between an EPU break and a pre-EPU break of the same size at or near the anticipated limiting break size. As a result, the limiting event for EPU and the event analyzed at pre-EPU are identical accident scenarios with the exception of the thermal power and associated initial core operating conditions. Therefore, both cases are a 0.5 ft^2 split break in the recirculation line pump discharge piping with a single failure of a battery (DC power failure) and a center peaked axial power shape as presented in Section 4.3 of the FUSAR. The only ECCS available for this case is a single low pressure Core Spray loop (2 pumps) and the ADS system.

While a complete break spectrum was not analyzed at pre-EPU conditions for ATRIUM-10 fuel, the same single failure and break location would be limiting due to the minimal ECCS available for pump discharge breaks with the limiting single failure. The limiting break size may change, but the EPU results would continue to bound pre-EPU results.

As indicated above, the LOCA analysis for each fuel type is performed by the supplier of the fuel using an approved LOCA analysis methodology. Neither FANP nor GE LOCA methodologies have been used to perform BFN analyses for both the ATRIUM-10 and GE14 fuel designs. Direct comparisons of FANP and GE LOCA analysis results do not provide a good basis for assessing the impact of fuel design changes on LOCA results. A significant portion (probably most) of the difference in PCT reported for ATRIUM-10 and GE14 fuel is due to differences in analysis methodology rather than differences in fuel design. Although the level of conservatism in results from the two vendor methodologies is different and may vary depending on break characteristics, both methods provide conservative results and the analyses described in the FUSAR and PUSAR demonstrate that all 10 CFR 50.46 criteria are met for both fuel designs at EPU operating conditions.

NRC Request SRXB-A.22

The BFN Units 2 and 3 submittal is the first application of Framatome methods for the transient and accident analysis for EPU. Consistent with Appendix E of Licensing Topical Report, NEDC-32424P-A, Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate, or ELTR1 provide a justification for the use of Framatome transient and accident analyses methods for EPU application. List all transients and accidents analyzed in support of EPU for Sections 2.8.5.1 to 2.8.5.6 of Matrix-8 in RS-01. In addition, explain how the limiting transients were selected and discuss in detail how each transient/accident in Sections 2.8.5 to 2.8.5.6 is dispositioned. Specifically:

a) Confirm that the scenario and sequence of event described in UFSAR is still valid for EPU;

b) Identify the supporting analysis for the event, evaluation model used for the analysis, and identify the topical report which describes the event;

c) Specify whether the disposition is based on a generic analysis or the current analysis in the UFSAR, or plant-specific equilibrium analysis or the reload analysis, and

d) Describe how the acceptance criteria is met.

TVA Reply to SRXB-A.22

The applicability of FANP methodology to transient and accident analysis at EPU conditions is addressed in general terms in the response to SRXB-A.15 with specifics given in the responses to several of the other questions.

A review of the fuel-related events described in the BFN UFSAR was performed to identify events to be evaluated to support use of ATRIUM-10 fuel at EPU conditions. These events were dispositioned as either potentially limiting or non-limiting. Results for the events identified as potentially limiting are included in the FUSAR. The list of potentially limiting events is expanded beyond the events for a typical reload analysis and includes all events that can affect the MCPR operating limit. A list of the events discussed in RS-001 Matrix 8 Sections 2.8.5.1 through 2.8.5.6 that were reviewed is presented in Tables SRXB-A.22-1 and 22-2. Table SRXB-A.22-3 presents additional events from the plant licensing basis that were reviewed. The evaluation models used in the analyses and the basis of the disposition are also presented in the tables. The results of the disposition of the BFN UFSAR events are consistent with the events identified in Appendix E of ELTR1.

The scenario and sequence of the events remain valid for the fuel-related EPU analyses and are consistent with the event descriptions in the BFN UFSAR and the evaluations presented in the PUSAR. While there are differences in the detailed analysis results, the general descriptions of the scenarios and sequence of events presented in the BFN UFSAR remain valid for the fuel related events and are consistent with the evaluations presented in the PUSAR.

Assurance that the fuel-related acceptance criteria for the transient events are met is accomplished by applying power and flow dependent MCPR and LHGR operating limits that are established based on the transient analysis results. This ensures that the calculated fuel failure criterion is met. Results of the transient analyses used to establish the MCPR and LHGR operating limits also demonstrate that the system pressurization criteria are met.

Assurance that the fuel-related acceptance criteria for the recirculation pump seizure event are met is demonstrated by performing an analysis of the EPU core design assuming operation is constrained by thermal limits established from the transient analyses.

Assurance that the fuel-related acceptance criteria for the control rod drop accident are met is demonstrated by performing an analysis of the EPU core design.

Assurance that the fuel-related acceptance criteria for LOCA events are met is accomplished by applying MAPLHGR limits to the ATRIUM-10 fuel based on the LOCA-ECCS analysis results.

FANP also reviewed the GE EPU plant-related analyses that included fuel design dependent inputs to determine the applicability of the PUSAR analysis for ATRIUM-10 fuel. In most cases, the PUSAR analysis remains applicable for ATRIUM-10 fuel. FANP performed analysis for the plant-related analyses with fuel dependent inputs that are negatively impacted by the introduction of ATRIUM-10 fuel. The results of these evaluations are discussed in FUSAR section 4.4.

Table SRXB-A.22-1: RS-001 Matrix 8 Transient Event/Analysis Disposition Basis

RS-01 Matrix 8 Section	Event/Analysis	Disposition Basis	Evaluation Model
2.8.5.1	Loss of feedwater heater	Plant EPU analysis	MICROBURN-B2
	Feedwater controller failure – maximum demand	Plant EPU analysis	Transient Models*
	Pressure regulator failure - open	Current UFSAR - MCPR improves during the event	
2.8.5.2	Generator load rejection	Plant EPU analysis	Transient Models
	Generator load rejection with bypass valve failure	Plant EPU analysis	Transient Models
	Turbine trip with bypass	Generic disposition - Bound by turbine trip with bypass failure	
	Turbine trip with bypass valve failure	Plant EPU analysis	Transient Models
	Loss of condenser vacuum	Plant EPU analysis	Transient Models
	Closure of all main steam isolation valves	Plant EPU analysis	Transient Models
	Closure of one main steam isolation valve	Plant EPU analysis	Transient Models
	Pressure regulator downscale failure	Current UFSAR – No longer classified as an AOT/AOO	
	Loss of auxiliary transformers	Plant EPU analysis	Transient Models
	Loss of auxiliary power grid	Plant EPU analysis	Transient Models
	Loss of feedwater flow	Plant EPU analysis	Transient Models
2.8.5.3	Recirculation flow control failure – decreasing flow	Plant EPU analysis	Transient Models
	Trip of one recirculation pump	Plant EPU analysis	Transient Models
	Trip of two recirculation pumps	Plant EPU analysis	Transient Models
2.8.5.4	Control rod withdrawal error – startup condition	Current UFSAR – Not affected by uprate conditions	
	Control rod withdrawal error – at power	Plant EPU analysis	MICROBURN-B2
	Startup of idle recirculation pump	Plant EPU analysis	Transient Models
	Recirculation flow controller failure – increasing flow (fast)	Plant EPU analysis	Transient Models
	Recirculation flow controller failure – increasing flow (slow)	Plant EPU analysis	XCOBRA/ MICROBURN-B2
2.8.5.5	Inadvertent HPCI pump startup	Plant EPU analysis	Transient Models
2.8.5.6	Inadvertent operation of a main steam relief valve	Plant EPU analysis	Transient Models

* Transient Models signify COTRANSA2, XCOBRA, XCOBRA-T, and RODEX2 analysis codes.
References for the appropriate topical reports are presented in the FUSAR, Table 1.3.

Table SRXB-A.22-2: RS-001 Matrix 8 Accident Analysis Disposition Basis

RS-01 Matrix 8 Section	Event/Analysis	Disposition Basis	Evaluation Model
2.8.5.3	Recirculation pump seizure	Plant EPU analysis	Transient Models*
2.8.5.4	Control rod drop	Plant EPU analysis	CASMO-4/ MICROBURN-B2
2.8.5.6	LOCA-ECCS	Plant EPU analysis	EXEM BWR-2000**

* Transient Models signify COTRANSA2, XCOBRA, XCOBRA-T, and RODEX2 analysis codes.

** EXEM BWR-2000 signifies the RELAX, HUXY, and RODEX2 analysis codes
References for the appropriate topical reports are presented in the FUSAR, Table 1.3.

Table SRXB-A.22-3: Additional Event Analyses

Event/Analysis	Disposition Basis	Evaluation Model
Transients		
Shutdown cooling malfunction – decreasing temperature	Current UFSAR – No fuel damage or measurable pressure increase	
Single feedwater pump trip (operational considerations only)	Plant EPU analysis	COTRANSA2
Accidents		
Fuel Handling Accident	Plant/fuel specific evaluation	Included in TVA AST submittal. Previously approved by NRC
Fuel misload	Plant EPU analysis	MICROBURN-B2
Special Events/Analyses		
MCPR safety limit	Plant EPU analysis	SAFLIM2
ASME Overpressurization (MSIV and TSV closures)	Plant EPU analysis	COTRANSA2
ATWS (pressurization)	Plant EPU analysis	COTRANSA2
ATWS (standby liquid control)	Plant EPU analysis	CASMO-4/ MICROBURN-B2
Stability	Plant EPU analysis	STAIF
Appendix R	Plant EPU analysis	EXEM BWR 2000*

* EXEM BWR-2000 signifies the RELAX, HUXY, and RODEX2 analysis codes
References for the appropriate topical reports are presented in the FUSAR, Table 1.3

NRC Request SRXB-A.23

Matrix 8 of Section 2.1 of RS-001 address new fuel and spent fuel storage. Draft GDC-40 and GDC-66, these GDC require that protection for engineered safety features shall be provided against dynamic effects and missiles that might result from plant equipment failures and criticality in new and spent fuel storage shall be prevented by physical systems or processes. Such means as geometrically safe configurations shall be emphasized over procedural controls. Provide a discussion on criticality of new and spent fuel storage for all intended fuel types.

TVA Reply to SRXB-A.23

At BFN, both new and spent fuel is stored in the spent fuel storage pools. Each unit has its own fuel pool, which is located on the uppermost level (Elevation 664 feet) of the reactor building. In this location, the fuel pools are shielded from plant equipment failures that could result in dynamic effects (for example, pipe whips) and from missiles that could result from plant equipment failures (for example, feedpump missiles) by geometric separation, physical barriers, and compartmentalization of operating equipment.

Due to the size and energy associated with the main turbines, additional analyses were performed for EPU. The three main turbines are separately housed in an adjacent (turbine) building at Elevation 617 feet with about 100 feet of spatial separation between the closest horizontal planes of the fuel pool and the turbine location. All three turbines are laid out in parallel and rotate on an axis perpendicular to the reactor building. This means that the trajectory of any postulated turbine missiles would be square to the reactor buildings (and thus not toward the fuel pools housed in the reactor building). This orientation results in the main turbines being categorized as a "favorable" orientation with regard to turbine missile failure analyses. The elevation and plan drawings of the reactor building, turbine building, and the main turbines are in Chapter 1.6 of the BFN UFSAR, and a summary discussion of BFN turbine missile probability criteria is provided in Chapter 11.2 of the BFN UFSAR.

Main turbine failure probability analyses were reperformed to confirm that the criteria of 11.2 of the BFN UFSAR would continue to be satisfied considering the turbine modifications required for operation at EPU conditions. These analyses confirmed that the licensing bases described in Chapter 11.2 of the BFN UFSAR will continue to be satisfied for EPU configurations and that the probability of turbine missiles remains acceptably low. As such, the spent fuel pool is considered a geometrically safe configuration with regard to main turbine missiles.

Additionally, during the recent installation of on onsite Independent Spent Fuel Storage Installation (ISFSI), TVA performed calculation to demonstrate the acceptability of the ISFSI location with regard to plant generated main turbine missiles using the EPU turbine failure probability analyses. The calculations concluded that there is no credible threat from turbine generated missiles on the dry casks stored on the BFN ISFSI concrete pads.

In summary, EPU does not result in dynamic effects and missiles [draft General Design Criteria (GDC)-40] that could affect fuel storage areas and criticality (draft GDC-66) for new and spent fuel storage are likewise unaffected by EPU on all three BFN units. Additional general information on EPU high energy and missile affects is provided in the replies to RAIs SPLB-A.4, A.5, and A.6. In the reply to SRXB-A.49, a discussion on fuel storage criticality for the EPU fuel is presented.

NRC Request SRXB-A.24

Review Standard RS-001, BWR Template SE for Sections 2.8.5.1, 2.8.5.2.1, 2.8.5.2.2, 2.8.5.2.3, 2.8.5.3.1, 2.8.5.4.3, 2.8.5.5 and 2.8.5.6.1, guides the NRC staff to reach a conclusion regarding reactor coolant pressure boundary (RCPB) pressure limits not being exceeded. However, in Enclosure 13, EPU RS-001 Revised Template Safety Evaluation, the revised template reflecting the BFN licensing basis does not designate acceptance criteria in the "Regulatory Evaluation" portion of each of these sections related to the RCPB. Provide a discussion of the corresponding draft GDC design requirement(s) and acceptance criteria for RCPB, and provide a markup of the SE template accordingly.

TVA Reply to SRXB-A.24

Draft GDC-9, "Reactor Coolant Pressure Boundary," is applicable to Review Standard RS-001, BWR Template SE for Sections 2.8.5.1, 2.8.5.2.1, 2.8.5.2.2, 2.8.5.2.3, 2.8.5.3.1, 2.8.5.4.3, 2.8.5.5, and 2.8.5.6.1. See the SE template markups for these sections in Enclosure 6.

NRC Request SRXB-A.25

Sections 2.8.4.4 of RS-01 provides guidance regarding the RHR system. However in Enclosure 13, EPU RS-001 Revised Template Safety Evaluation, the revised template contained in the letter dated February 23, 2005, reflecting the BFN licensing basis does not designate acceptance criteria in the "Regulatory Evaluation" portion of this section related to the RHR design requirements contained in GDC-34. Provide a discussion of the corresponding draft GDC design requirements and acceptance criteria for RHR and provide a markup of the SE template accordingly.

TVA Reply to SRXB-A.25

Draft GDC-6, "Reactor Core Design," is applicable to Review Standard RS-001, BWR Template SE for Section 2.8.4.4. See the SE template markups for this section in Enclosure 6.

NRC Request SRXB-A.26

Demonstrate quantitatively and qualitatively, that the Lattice/Depletion code systems' is capable of predicting the power peaking distribution at the upper part of the high powered bundles for operation under high void fractions. For example, show that the requirements in Chapter 4 of EMF-2158(P)-A, "Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2," can still be met for EPU core designs.

TVA Reply to SRXB-A.26

CASMO-4 and MCNP calculations have been performed to compare the fission rate distribution statistics to Table 2-1 of the topical report EMF-2158(P)(A) which is shown in Table SRXB-A.26-1.

The fission rate differences at various void fractions demonstrate that CASMO-4 calculations have very similar uncertainties relative to the MCNP results for all void fractions. These fission rate differences also meet the criteria of the topical report EMF-2158(P)(A) for all void fractions.

The response to SRXB-A.27 shows that the maximum exit void fraction anticipated for EPU operation including MELLLA+ operating conditions is not expected to exceed the void fractions observed in the topical report benchmark. This submittal does not include MELLLA+ operation, but these results are conservative to operation without MELLLA+ such that the number of nodes approaching high void fractions would be reduced.

Table SRXB-A.26-1: Comparison of CASMO-4 and MCNP results for ATRIUM-10 Design

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NRC Request SRXB-A.27

Demonstrate quantitatively and qualitatively, that the current uncertainties and biases established in the benchmarkings and presented in Table 9.8 and 9.9 of EMF-2158(P)-A remain valid for the neutronic and thermal-hydraulic conditions predicted for the EPU operation. Specifically, demonstrate the uncertainties and biases used in your reactivity coefficients (e.g., void coefficient) are applicable or remain valid for the neutronic and thermal-hydraulic conditions expected for EPU operation.

TVA Reply to SRXB-A.27

FANP has reviewed the data presented in EMF-2158(P)(A) with regard to the maximum assembly power (Figure SRXB-A.27-1) and maximum exit void fraction (Figure SRXB-A.27-2) to determine the range of data previously benchmarked. This data can be compared to the equivalent data of the analysis performed for BFN operating under EPU and non-EPU conditions (Figures SRXB-A.27-3 and 27-4). It should be noted that the data provided includes actual operating data as well as projections for future operation. The case of BFN Unit 1 Cycle 9 is a hypothetical situation performed as a scoping study. This comparison shows that EPU operation in the standard power/flow map as well as MELLLA+ is within the range of the original methodology approval.

Fuel loading patterns and operating control rod patterns are constrained by the MCPR limit, which consequently limits the assembly power and exit void fraction regardless of the core power level. The axial profile of the power and void fraction of the limiting assembly and core average values are presented in Figures SRXB-A.27-5 and 27-6 for the BFN Unit 3 Cycle 12 design and a hypothetical EPU cycle design. These profiles demonstrate that the core average void fraction increases with EPU, however, the maximum assembly power does not produce any larger void fractions.

Another measure of the thermal-hydraulic conditions is the population distribution of the void fractions. Figures SRXB-A.27-7 and 27-8 present histograms of the void fraction for non-EPU and EPU conditions. These histograms were taken at the point of maximum exit void fraction expected during the cycle. The distribution of voids is shifted toward the 70 to 80% void fraction levels. The population of nodes experiencing 85 to 90% voids is still small.

The EMF-2158(P)(A) data was also re-evaluated by looking at the deviations between measured and calculated Traversing Incore Probe (TIP) response for each axial level. The standard deviation of these deviations at each axial plane are presented in Figure SRXB-A.27-9 and demonstrates that there is no significant trend versus axial position, which indicates no significant trend versus void fraction.

Pin-by-pin gamma scan data is used for verification of the local peaking factor uncertainty. Quad Cities 1 measurements presented in the topical report EMF-2158(P)(A) have been re-evaluated to determine any axial dependency. Figure SRXB-A.27-10 presents the raw data including measurement uncertainty and demonstrates that there is no axial dependency. The more recent gamma scans performed by KWU, presented in the topical report EMF-2158(P)(A) and re-arranged by axial level in Table SRXB-A.27-1, indicate no axial dependency. Full axial scans were performed on 16 fuel rods. Comparisons to calculated data show excellent agreement at all axial levels. The dip in power associated with spacers, observed in the measured data, is not modeled in MICROBURN-B2. There is no indication of reduced accuracy at the higher void fractions.

The FANP methodology [[
]] the reactivity coefficients that are used in the transient analysis. Conservatisms in the methodology are used to produce conservative results. Data presented in these referenced figures indicate that there are no significant differences between EPU and non-EPU conditions that have an impact on the reactivity coefficients.

Table SRXB-A.27-1: KWU-S Gamma Scan Benchmark Results from EMF-2158(P)(A)

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Figure SRXB-A.27-1: Maximum Assembly Power in Topical Report EMF-2158(P)(A)

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Figure SRXB-A.27-2: Maximum Exit Void Fraction in Topical Report EMF-2158(P)(A)

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Figure SRXB-A.27-3: Maximum Assembly Power in Browns Ferry Design

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Figure SRXB-A.27-4: Maximum Exit Void Fraction in Browns Ferry Design

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Figure SRXB-A.27-5: Browns Ferry Non-EPU Design Axial Profile of Power and Void Fraction

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Figure SRXB-A.27-6: Browns Ferry EPU Design Axial Profile of Power and Void Fraction

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Figure SRXB-A.27-7: Browns Ferry (Non-EPU) Nodal Void Fraction Histogram

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Figure SRXB-A.27-8: Browns Ferry EPU Nodal Void Fraction Histogram

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Figure SRXB-A.27-9: EMF-2158(P)(A) TIP Statistics by Axial Level

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Figure SRXB-A.27-10: Quad Cities Unit 1 Pin-by-Pin Gamma Scan Results

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NRC Request SRXB-A.28

Demonstrate quantitatively and qualitatively, that the fuel isotopic validations and testing performed in EMF-2158(P)-A remain applicable for prolonged operation under high void conditions for the fuel lattice designs that would be used for the expected EPU core designs.

TVA Reply to SRXB-A.28

The response to SRXB-A.27 indicates that the neutronic and thermal-hydraulic conditions predicted for the EPU operation are bounded by the data provided in the topical report EMF-2158(P)(A). Therefore, the isotopic validation continues to be applicable to EPU operation.

NRC Request SRXB-A.29

Demonstrate qualitatively and quantitatively that the Framatome-ANP neutronic methodology experience base is applicable to EPU conditions at BFN.

TVA Reply to SRXB-A.29

The response to SRXB-A.27 indicates that the neutronic and thermal-hydraulic conditions predicted for the EPU operation are already included in the data provided in the topical report EMF-2158(P)(A). This shows that the experience continues to be applicable to EPU operation.

NRC Request SRXB-A.30

Demonstrate that the Framatome-ANP neutronic methodology prediction capability for current fuel designs operated under the current operating strategies and core conditions. Prediction comparison should be made to gamma scans and traversing incore probe (TIP) core follow data. This demonstration applies to any recent fuel, such as the ATRIUM-9 and ATRIUM-10, in particular for first cycle and second cycle fuel. (Refer to Framatome Handout for August 4, 2005, Meeting; ADAMS Accession No. ML052370230.)

TVA Reply to SRXB-A.30

Operating data from several recent fuel cycle designs have been evaluated and compared to that in the topical report EMF-2158(P)(A). Maximum assembly powers and maximum void fractions similar to that presented in the response to SRXB-A.27 are presented in Figures SRXB-A.30-1 and 30-2.

In order to evaluate some of the details of the void distribution, a current design calculation was reviewed in more detail. Figures SRXB-A.30-3 and 30-4 present the following parameters at the point of the highest exit void fraction (at 9336 MWd/MTU cycle exposure) in cycle core design for a BWR-6 reactor with ATRIUM-10 fuel. These are representative figures for a high power density plant.

- Core average void axial profile
- Axial void profile of the peak assembly
- Histogram of the nodal void fractions in core

Reactor conditions for BFN with power uprate are not significantly different from that of current experience. The range of void fractions in the topical report data exceeds that expected for the power uprate conditions. The distribution of voids is nearly the same as current experience.

Gamma scan comparisons for 9X9-1 and ATRIUM-10 fuel were presented in the topical report, EMF-2158(P)(A), in section 8.2.2. Figures 8.18 through 8.31 show very good comparisons between the calculated and measured relative Ba-140 density distributions for both radial and axial values.

Data presented in these figures and tables demonstrate that the FANP methodology is capable of accurately predicting reactor conditions for fuel designs operated under the current operating strategies and core conditions.

Figure SRXB-A.30-1: Maximum Assembly Power Observed from Recent Operating Experience

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Figure SRXB-A.30-2: Void Fractions Observed from Recent Operating Experience

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Figure SRXB-A.30-3: Axial Power and Void Profile Observed from Recent Design Experience

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Figure SRXB-A.30-4: Nodal Void Fraction Histogram Observed from Recent Design Experience

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NRC Request SRXB-A.31

The first three bullets of slide No. 63 of the CASMO-4/ MICROBURN-B2 Methodology, of the August 4, 2005, presentation, alluded to the average value of the Correlation Coefficient (CC) for the Quad Cities cycles 2 and 4. These values were determined for the 8X8 bundle design. Provide quantitative and qualitative technical justification for the use of 8X8 CC to 10X10 bundle design, specifically, demonstrate that the correlation coefficients are independent of fuel bundle design.

TVA Reply to SRXB-A.31

The purpose of the correlation coefficient is to account for the correspondence between the flux measured by the instrument tube and the assembly power in the neighboring assemblies. This correspondence is quantified by a conservative multiplier to the uncertainty in the TIP measurements. In order to conservatively account for this correspondence, the bundle power uncertainty is increased due to the radial TIP uncertainty by a multiplier based on the correlation coefficient. The correlation coefficient is statistically calculated and shown in Figure 9.1 and Figure 9.2 of EMF-2158(P)(A). It indicates a less than perfect correlation between powers of neighboring bundles. The conservative multiplier is calculated as follows:

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The calculated TIP uncertainty would normally be expected to be slightly larger than the calculated power uncertainty due to the TIP model. The Quad Cities gamma scan comparison shows the 2-D radial power uncertainty of [[ ]] (see Section 9.6 of EMF-2158(P)(A)). The D-Lattice plant calculated radial TIP uncertainty is [[ ]]. The data indicates that the calculated TIP uncertainty is indeed larger than the calculated power uncertainty. The use of the correlation coefficient to increase the calculated power uncertainty is a very conservative approach resulting from the statistical treatment. The types of fuel bundles (8x8, 9x9, or 10x10) loaded in the core have no effect on the reality of the physical model which precludes the possibility of the calculated power uncertainty to be larger than the calculated TIP uncertainty. The accuracy of the MICROBURN-B2 models is demonstrated by comparisons between measured and calculated TIPs as well as comparison of calculated and measured La140 activation. The accuracy of the MICROBURN-B2 models was further validated with detailed axial pin-by-pin gamma scan measurements of 9X9-1 and ATRIUM-10 fuel assemblies in the reactor designated as KWU-S. These measurements demonstrated the continued accuracy of the MICROBURN-B2 models with modern fuel assemblies. Details of these measurements are provided in Section 8.2.2 of the topical report, EMF-2158(P)(A).

A sensitivity study was performed to determine the impact on the thermal limit calculations associated with variations in the correlation coefficient. The extremes of the two Quad Cities assembly gamma scan data sets was used for this sensitivity study and demonstrated a change significantly less than [[ ]] in the MCPR safety limit.

NRC Request SRXB-A.32

The radial peaking factors (RPF) uncertainty presented on slide No. 35 of the Safety Analysis, of the August 4 presentation, point to the conclusion that the safety limit minimum critical power ratio (SLMCPR) is not very sensitive to small increases in RPF uncertainty. Provide quantitative and qualitative technical justification in support of this conclusion. Specifically:

a) Provide statistical information (number of histories, number of bundle or rods, etc.) supporting the 0.0055 value; and

b) Address whether the SLMCPR value of 1.0855 is rounded up to 1.09 as the final TS Value.

TVA Reply to SRXB-A.32

a) The FANP SAFLIM2 code is used to calculate the number of expected rods in boiling transition (BT) for a specified value of the SLMCPR (i.e., SLMCPR is an input, not a calculated result). The value of 0.0055 presented in the August meeting was based on results obtained from two SAFLIM2 analyses. In the first analysis, a SLMCPR of 1.08 and the base RPF uncertainty were input to SAFLIM2. The number of BT rods was calculated to be 60 from this analysis. The second analysis was the final case in a series of SAFLIM2 analyses using the increased RPF uncertainty and performed by iterating on the input value of SLMCPR. Different values for the SLMCPR input were used until the number of BT rods calculated by SAFLIM2 was the same as the base case (60 rods). A SLMCPR input value of 1.0855 resulted in 60 rods in BT when the increased RPF uncertainty was input. The difference in SLMCPR input for the two cases that resulted in the same number of BT rods is a measure of the sensitivity to the increased RPF uncertainty.

The only input parameters changed between the two SAFLIM2 analyses were the SLMCPR and the RPF uncertainty. For each analysis, 1000 Monte Carlo trials were performed. To minimize statistical variations in the sensitivity study, the same random number seed was used and all bundles were analyzed for both analyses. As discussed above, 60 rods were calculated to be in BT in both analyses.

b) The FANP SLMCPR methodology is used to determine what TS SLMCPR value is required to meet the regulatory acceptance criterion (< 0.1% of the rods in the core in BT). The first step in the calculation procedure is to select a value for SLMCPR to two decimal places (usually the current TS SLMCPR). The SAFLIM2 computer code is then used to calculate the number of rods in BT for the selected SLMCPR. If the calculated rods in BT is <0.1%, the selected SLMCPR is supported. If the acceptance criterion is not met, the SLMCPR is increased by 0.01 and the SAFLIM2 calculation is performed again. This iteration is continued until the acceptance criterion is met for the input SLMCPR.

The SLMCPR value of 1.0855 was obtained from the sensitivity study described in response (a). The sensitivity study was performed to quantify the sensitivity of SLMCPR to an increase in RPF uncertainty and did not follow the standard approach used in SLMCPR licensing analyses. In standard licensing calculations, the SLMCPR is not input at a precision greater than the hundredths decimal place. As a result, the increased RPF uncertainty would result in either no change or a 0.01 increase in SLMCPR licensing analyses depending on how close the case was to the acceptance criterion prior to the increase in RPF uncertainty. This process is equivalent to rounding up to the next highest hundredths decimal place.

NRC Request SRXB-A.33

Provide qualitative and quantitative description of the gamma scanning process. Specifically address whether the data is obtained via gamma scanning, transformed mathematically and or chemically into providing isotopic burnup/depletion information.

TVA Reply to SRXB-A.33

The gamma scanning process for irradiated fuel uses germanium semiconductor detectors for gamma radiation energy spectral analysis. Gamma rays deposit their energy in the germanium and produce free electrons and holes (vacancies where the electrons were located in the crystalline germanium). The amount of charge collected is correlated with the amount of energy deposited in the detector and, therefore, with the energy of the gamma ray that caused it. The detectors are used with single channel analyzers to sort the pulses according to pulse height. This means that if multiple gamma-ray energies are being analyzed simultaneously, the germanium detector will separate them cleanly. A single-channel analyzer uses two discriminators. The discriminators are called upper and lower level discriminators. Pulses from the amplifier are fed to the analyzer, and if the pulse height falls between the lower and upper discriminators, the usual logic is to allow such a pulse to be recorded (counted). The voltage levels of the two discriminators are adjustable so that the gap between them corresponds to a group of pulse heights within a fixed energy interval. Even though the gamma rays from a specific decay transition are of a discrete energy, there is a statistical spread of pulses coming from the detector and associated electronics so that the gap between the discriminators must be large enough to include most of such pulses. By varying the voltage levels of each of the discriminators, it is possible to measure gamma rays of different energies.

Power measurements for irradiated fuel target the gamma spectrum associated with La140. La140 is a decay product of Ba140 which is a direct fission product. The half-life of Ba140 is 12.8 days and the half-life of La140 is 40 hours. La140 activity is, therefore, directly related to the density of Ba140. The Ba140 density is representative of the integrated fissions over the last 25 days due to its short half-life. Gamma scan measurements are taken shortly after reactor shutdown (within 25 days) before the Ba140 decays to undetectable levels. Gamma scan measurements may be performed on individual fuel rods removed from assemblies using a high-purity germanium detector and an underwater collimator assembly or on entire fuel assemblies where the collimator has a broad opening to capture the gamma radiation from all of the pins in the assembly.

Gamma scanning provides data on the relative gamma flux from the particular spectrum associated with La140 gamma activity. The relative gamma flux corresponds to the relative La140 concentration. Based upon the time of shutdown and the time of the gamma scan, the Ba140 relative distribution at the time of shutdown is determined. This Ba140 relative distribution is thus correlated to the pin or assembly power during the last few weeks of operation. The data presented in the topical report, EMF-2158(P)(A), includes both pin and assembly Ba140 relative density data. The assembly gamma scan data was taken at Quad Cities after the operation of cycles 2, 3, and 4. Some of this data also included individual pin data. This data was from 7X7 and 8X8 fuel types. Additional fuel pin gamma scan data was taken at the Gundremingen plant for ATRIUM-9 and ATRIUM-10 fuel. This data is also presented in the topical report.

To compare core physics models to the gamma scan results, the calculated pin power distribution is converted into a Ba140 density distribution. A rigorous mathematical process using CASMO-4 pin nuclide inventory and MICROBURN-B2 nodal nuclide inventory is used.

NRC Request SRXB-A.34

Describe qualitatively the cross-section reconstruction process incorporated in CASMO-4 and MICROBURN-B2. The response should reflect the information provided in the slides (1-35) of the August 4 presentations, including high void fraction effects and accuracy. Provide flow chart(s), road map(s) and any other means to demonstrate the process, starting from the gathered raw void fraction data, how that data is used by CASMO-4 to generate the required cross-sections. In addition, briefly describe the development of the void fraction correlation and associated uncertainties.

TVA Reply to SRXB-A.34

CASMO-4 performs a multi-group [[ ]] spectrum calculation using a detailed heterogeneous description of the fuel lattice components. Fuel rods, absorber rods, water rods/channels and structural components are modeled explicitly. The library has cross sections for [[ ]] materials including [[ ]] heavy metals. Depletion is performed with a predictor-corrector approach in each fuel or absorber rod. The two-dimensional transport solution is based upon the [[ ]]. The solution provides pin-by-pin power and exposure distributions, homogeneous multi-group (2) microscopic cross sections, as well as macroscopic cross sections. Discontinuity factors are determined from the solution. [[ ]] gamma transport calculation are performed. The code has the ability to perform [[ ]] calculations with different mesh spacings. Reflector calculations are easily performed.

MICROBURN-B2 performs microscopic fuel depletion on a nodal basis. The neutron diffusion equation is solved with a full two energy group method. Modern nodal method solution using discontinuity factors is used along with a [[ ]]. The flux discontinuity factors are [[ ]]. A multilevel iteration technique is employed for efficiency. MICROBURN-B2 treats a total of [[ ]] heavy metal nuclides to account for the primary reactivity components. Models for nodal [[ ]] are used to improve the accurate representation of the in-reactor configuration. Full three dimensional pin power reconstruction method is utilized. TIP (neutron and gamma) and Local Power Range Monitor (LPRM) response models are included to compare calculated and measured instrument responses. Modern steady state thermal hydraulics models define the flow distribution among the assemblies. [[ ]] based upon CASMO-4 calculations are used for the in-channel fluid conditions as well as in the bypass and water rod regions. Modules for the calculation of CPR, LHGR and MAPLHGR are implemented for direct comparisons to the operating limits.

MICROBURN-B2 determines the nodal macroscopic cross sections by summing the contribution of the various nuclides.

$$\Sigma_x(\rho,\Pi,E,R)=\sum_{i=1}^{I}N_i\sigma_x^i(\rho,\Pi,E,R)+\Delta\Sigma_x^b(\rho,\Pi,E,R)$$

where:

Σ_x = nodal macroscopic cross section

$\Delta\Sigma_x^b$ = background nodal macroscopic cross section $(D,\Sigma_f,\Sigma_a,\Sigma_r)$

N_i = nodal number density of nuclide "i"

σ_x^i = microscopic cross section of nuclide "i"

I = total number of explicitly modeled nuclides

ρ = nodal instantaneous coolant density

Π = nodal spectral history

E = nodal exposure

R = control fraction

Functional representation of σ_x^i and $\Delta\Sigma_x^b$ comes from 3 void depletion calculations with CASMO-4. Instantaneous branch calculations at alternate conditions of void and control state are also performed. The result is a multi-dimensional table of microscopic and macroscopic cross sections. Figures SRXB-A.34-1 and 34-2 illustrate this with the thermal and fast microscopic cross sections for U235.

At Beginning of Life (BOL) the relationship is fairly simple, the cross section is only a function of void fraction (water density) and the reason for the variation is the change in the spectrum due to the water density variations. At any exposure point, a quadratic fit of the three CASMO-4 data points is used to represent the continuous cross section over instantaneous variation of void or water density. This fit is shown in Figures SRXB-A.34-3 and 34-4.

Detailed CASMO-4 calculations confirm that a quadratic fit accurately represents the cross sections as shown in Figures SRXB-A.34-5, 34-6, and 34-7.

With depletion the isotopic changes cause other spectral changes. Cross sections change due to the spectrum changes. Cross sections also change due to self-shielding as the concentrations change. These are accounted for by the void (spectral) history and exposure parameters. Exposure variations utilize a piecewise linear interpolation over tabulated values at [[ ]] exposure points. The four dimensional representation can be reduced to three dimensions (see Figure SRXB-A.34-8) by looking at a single exposure.

[[ ]] interpolation is performed in each direction independently for the most accurate representation. Considering the case at 70 GWd/MTU with an instantaneous void fraction of 70% and a historical void fraction of 60% Figures SRXB-A.34-9 and 34-10 illustrate the interpolation process. The table values from the library at 0.0, 0.4, and 0.8 void fractions are used to generate 3 quadratic curves representing the behavior of the cross section as a function of the historical void fraction for each of the tabular instantaneous void fractions (0.0, 0.4, and 0.8).

The intersection of the [[ ]] lines with the historical void fraction of interest are then used to create another [[ ]] fit in order to obtain the resultant cross section as shown in Figure SRXB-A.34-10.

The results of this process for all isotopes and all cross sections in MICROBURN-B2 were compared for an independent CASMO-4 calculation with continuous operation at 40% void (40% void history) and branch calculations at 90% void for multiple exposures. The results show very good agreement for the whole exposure range as shown in Figures SRXB-A.34-11 and 34-12.

At the peak reactivity point multiple comparisons were made (Figure SRXB-A.34-13) to show the results for various instantaneous void fractions.

Use of higher void fractions in CASMO-4 (for example 0,45,90) introduces more error for intermediate void fractions. Figure SRXB-A.34-14 shows the difference between a [[ ]] and a 0,45,90 interpolation method. Considering the better accuracy of the [[ ]] methodology for the majority of assemblies (less than 85% void), the current methodology [[ ]] is considered appropriate for current and EPU conditions.

Void fraction has been used for the previous illustrations; however, MICROBURN-B2 uses water density rather than void fraction in order to account for pressure changes as well as subcooled density changes. This transformation does not change the basic behavior as water density is proportional to void fraction. MICROBURN-B2 uses spectral history rather than void history in order to account for other spectral influences due to actual core conditions (fuel loading, control rod inventory, leakage, etc.) The doppler feedback due to the fuel temperature is modeled by accumulating the Doppler broadening of microscopic cross sections of each nuclide.

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The partial derivatives are determined from branch calculations performed with CASMO-4 at various exposures and void fractions for each void history depletion. The tables of cross sections include data for [[ ]] states. The process is the same for [[ ]] states. Other important feedbacks to nodal cross sections are lattice [[ ]] and instantaneous [[ ]] between lattices of different [[ ]]. These feedbacks are modeled in detail.

The methods used in CASMO-4 are state of the art. The methods used in MICROBURN-B2 are state of the art. The methodology accurately models a wide range of thermal-hydraulic conditions including EPU and MELLLA+ conditions.

The development of the void fraction correlation and the associated uncertainties are described in the response to SRXB-A.35.

Figure SRXB-A.34-1: Microscopic Thermal Cross Section of U-235 from Base Depletion and Branches

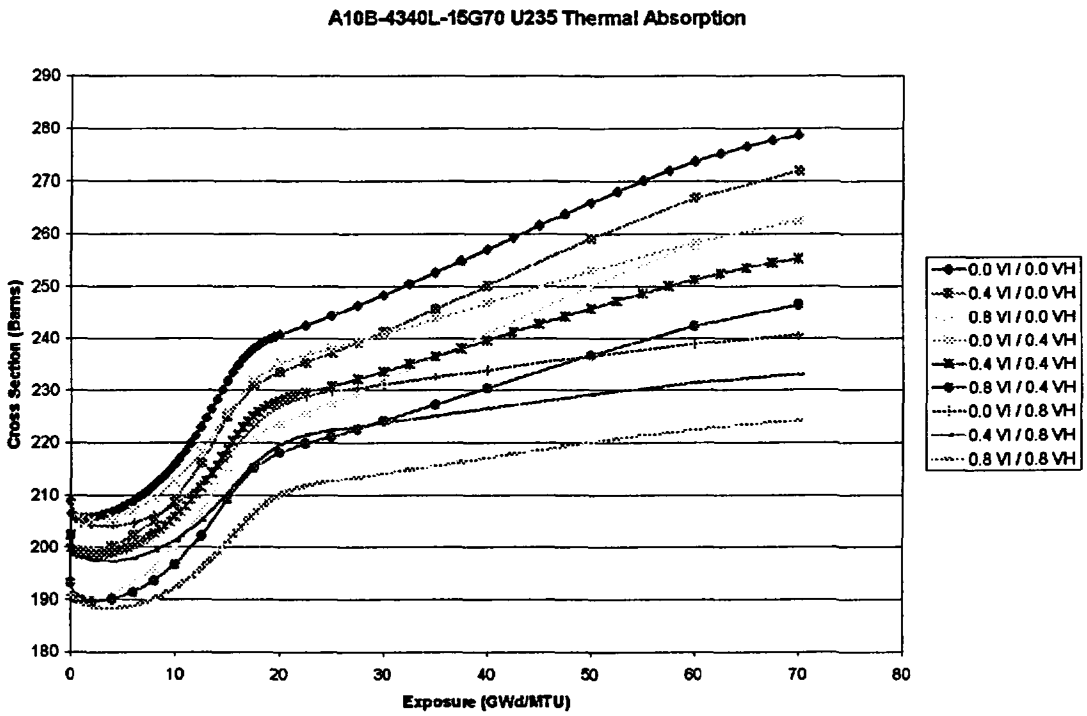

Figure SRXB-A.34-2: Microscopic Fast Cross Section of U-235 from Base Depletion and Branches

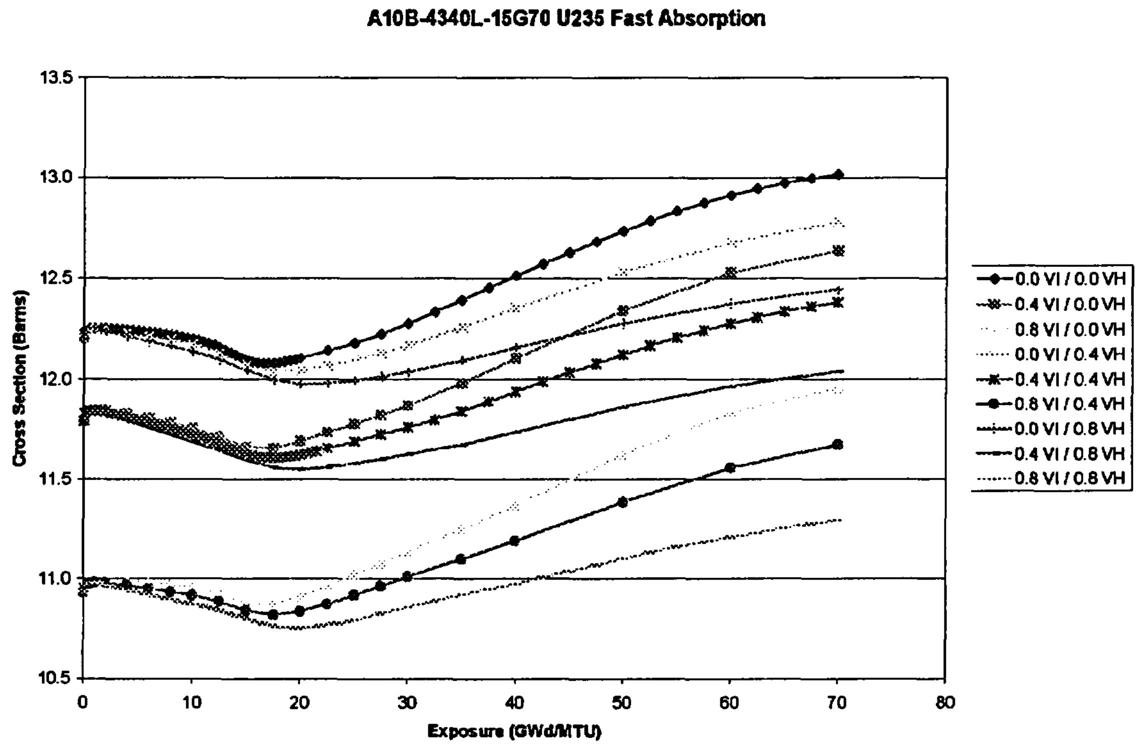

Figure SRXB-A.34-3: Microscopic Thermal Cross Section of U-235 at Beginning of Life

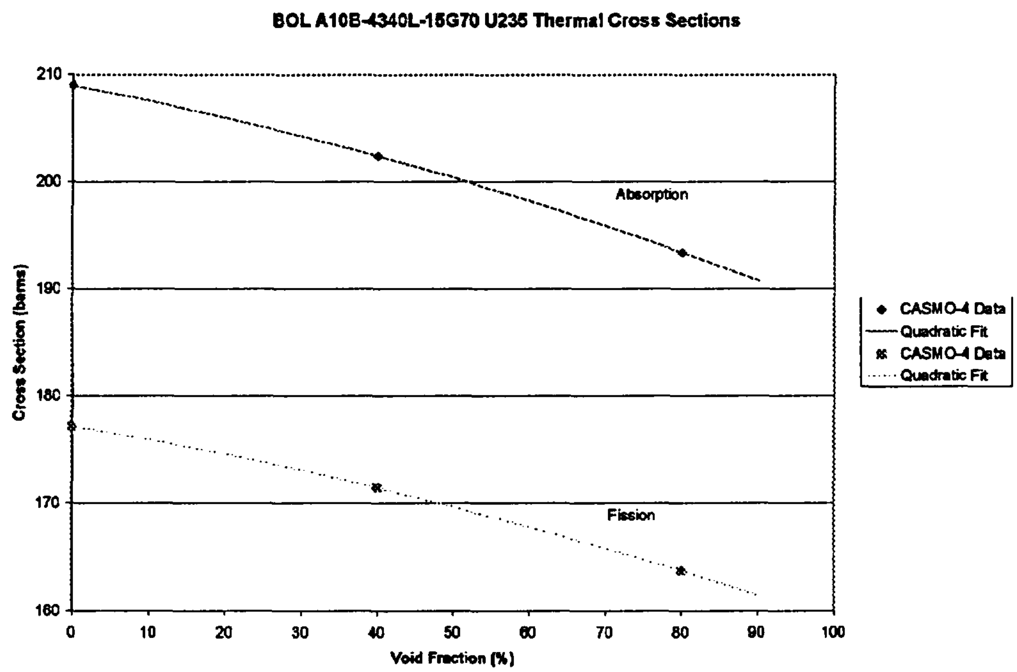

Figure SRXB-A.34-4: Microscopic Fast Cross Section of U-235 at Beginning of Life

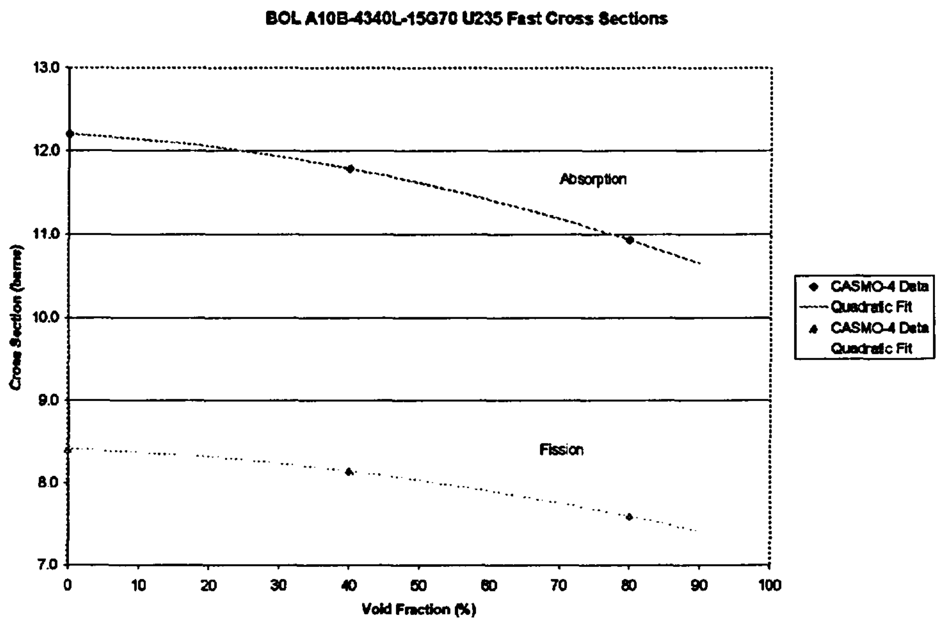

Figure SRXB-A.34-5: Microscopic Thermal Cross Section of U-235 Comparison of Quadratic Fit with Explicit Calculations at Various Void Fractions

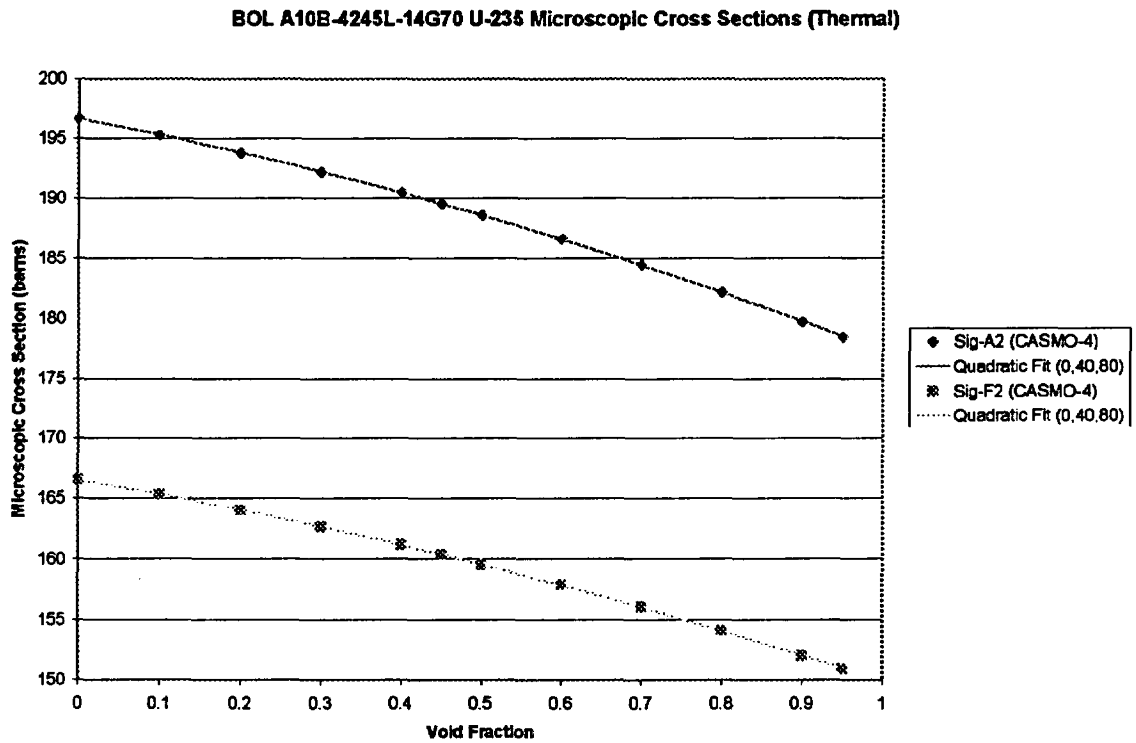

Figure SRXB-A.34-6: Microscopic Fast Cross Section of U-235 Comparison of Quadratic Fit with Explicit Calculations at Various Void Fractions

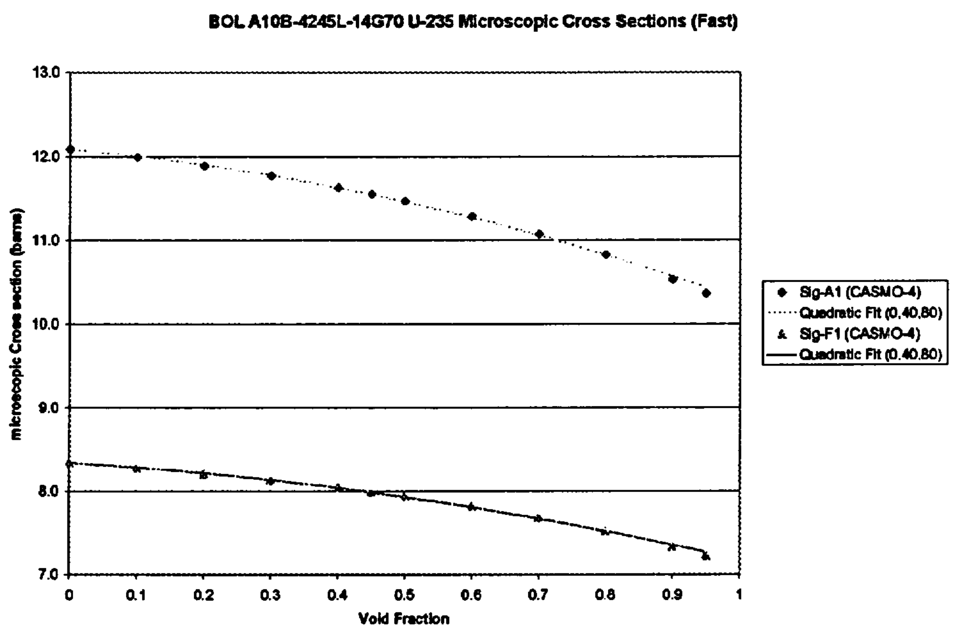

Figure SRXB-A.34-7: Macroscopic Diffusion Coefficient (Fast and Thermal) Comparison of Quadratic Fit with Explicit Calculations at Various Void Fractions

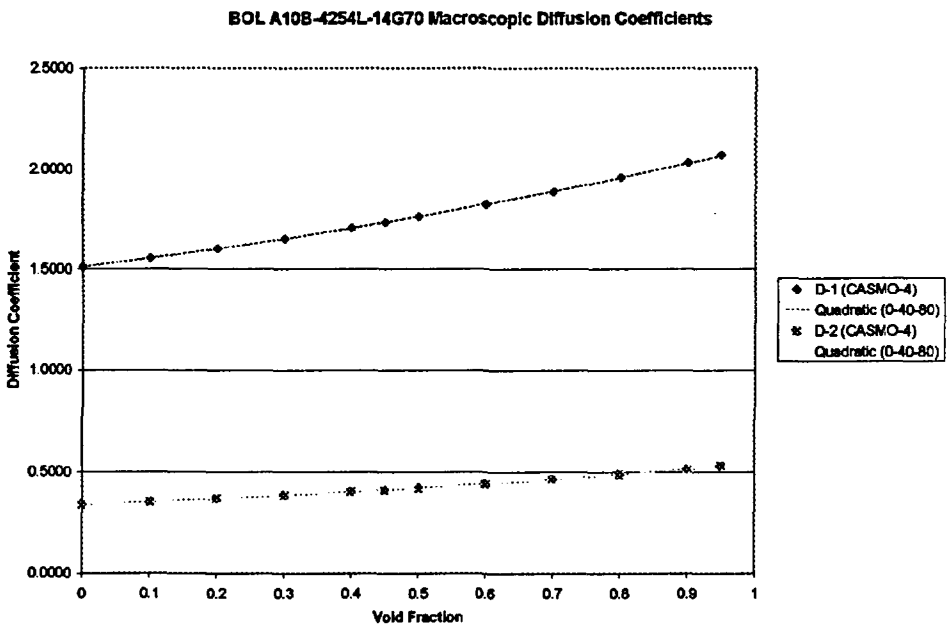

Figure SRXB-A.34-8: Microscopic Thermal Cross Section of U-235 at 70 GWd/MTU

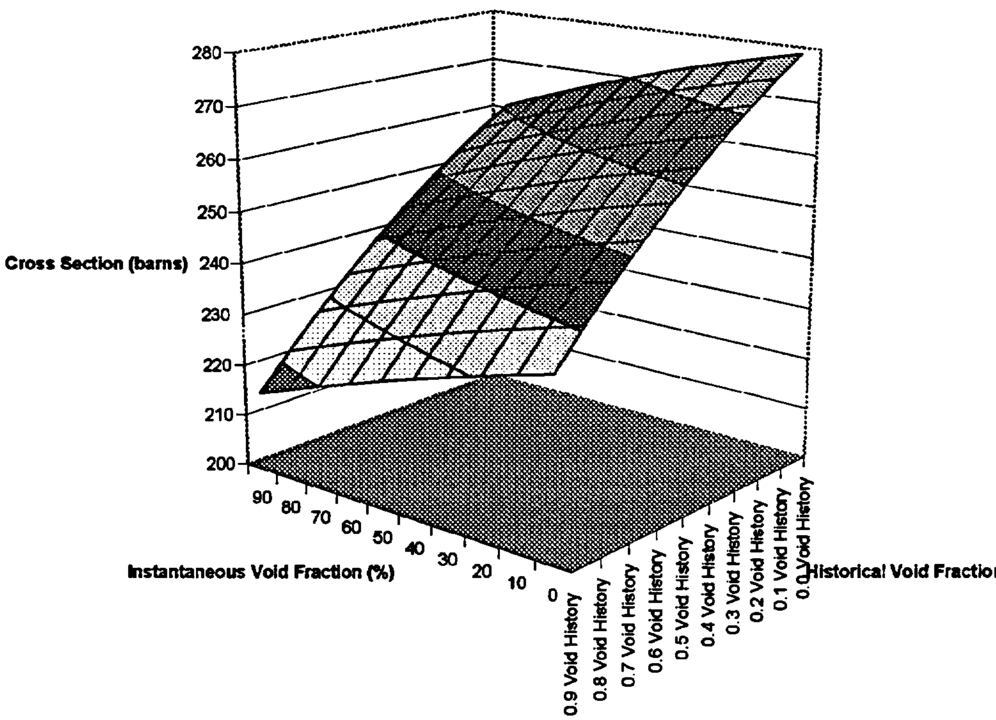

Figure SRXB-A.34-9: Quadratic Interpolation Illustration of Microscopic Thermal Cross Section of U-235

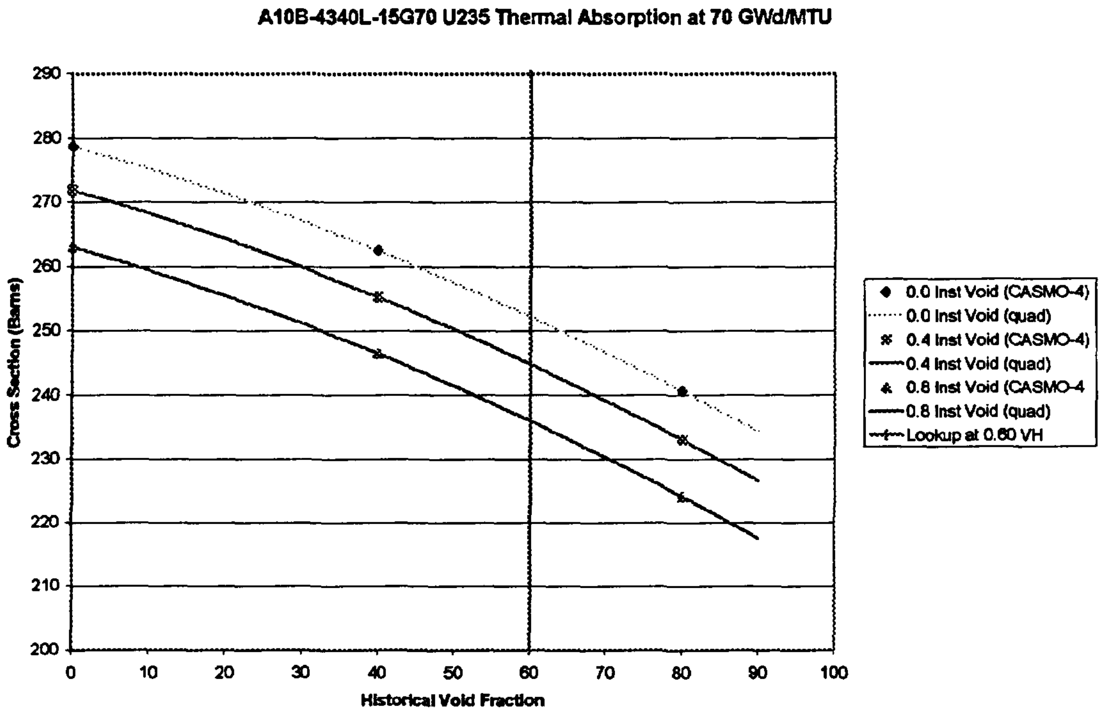

Figure SRXB-A.34-10: Illustration of Final Quadratic Interpolation for Microscopic Thermal Cross Section of U-235

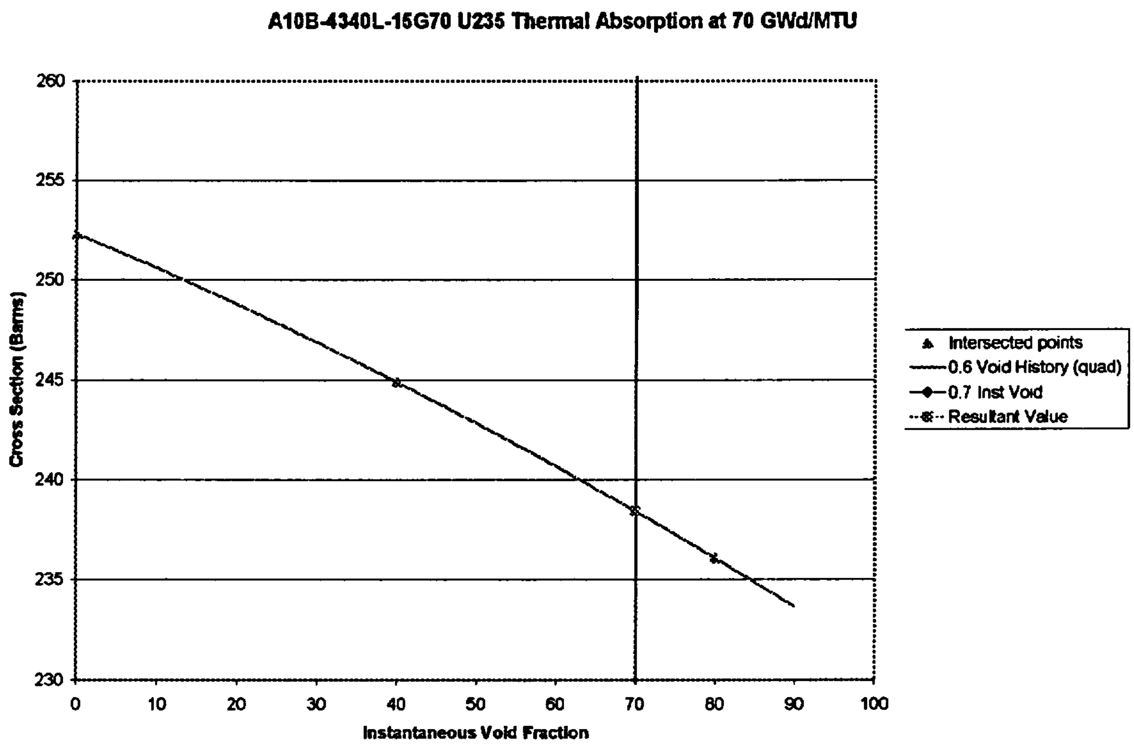

Figure SRXB-A.34-11: Comparison of k-infinity from MICROBURN-B2 Interpolation Process with CASMO-4 Calculations at Intermediate Void Fractions of 0.2, 0.6 and 0.9

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Figure SRXB-A.34-12: Comparison of k-infinity from MICROBURN-B2 Interpolation Process with CASMO-4 Calculations at 0.4 Historical Void Fractions and 0.9 Instantaneous Void Fraction

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Figure SRXB-A.34-13: Delta k-infinity from MICROBURN-B2 Interpolation Process with CASMO-4 Calculations at 0.4 Historical Void Fraction and 0.9 Instantaneous Void

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Figure SRXB-A.34-14: Comparison of Interpolation Process Using Void Fractions of 0.0, 0.4 and 0.9 and Void Fractions of 0.0, 0.45 and 0.9

[[

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NRC Request SRXB-A.35

Provide qualitative description of the void data base and the associated correlation. Specifically, describe the uncertainty associated with the data gathering, identifying the uncertainties currently applied to the void fraction correlation and justify its applicability for EPU conditions.

TVA Reply to SRXB-A.35

The Zuber-Findlay drift flux model (Reference SRXB-A.35-1) is utilized in the FANP nuclear and safety analysis methods for predicting vapor void fraction in the BWR system. The model has a generalized form that may be applied to two phase flow by defining an appropriate correlation for the void concentration parameter, Co, and the drift flux, Vgj. The model parameters account for the radially non-uniform distribution of velocity and density and the local relative velocity between the phases, respectively. This model has received broad acceptance in the nuclear industry and has been successfully applied to a host of different applications, geometries, and fluid conditions through the application of different parameter correlations (Reference SRXB-A.35-2).

Two different correlations are utilized at FANP to describe the drift flux parameters for the analysis of a BWR core. The correlations and treatment of uncertainties are as follows:

- The nuclear design, frequency domain stability, nuclear AOO transient, and accident analysis methods use the [[ ]] void correlation (Reference SRXB-A.35-3) to predict nuclear parameters. Uncertainties are addressed at the overall methodology and application level rather than individually for the individual correlations of each method. The overall uncertainties are determined statistically by comparing predictions using the methods against measured operating data for the reactors operating throughout the world.

- The thermal-hydraulic design, system AOO transient and accident analysis, and loss of coolant accident (only at specified junctions) methods use the Ohkawa-Lahey void correlation (Reference SRXB-A.35-4). This correlation is not used in the direct computation of nuclear parameters in any of the methods. Uncertainties are addressed at the overall methodology level through the use of conservative assumptions and biases to assure uncertainties are bounded.

The [[ ]] void correlation was developed for application to multi-rod geometries operating at typical BWR operating conditions using multi-rod data and was also validated against simple geometry data available in the public domain. The correlation was defined to be functionally dependent on the mass flux, hydraulic diameter, quality, and fluid properties.

The multi-rod database used in the [[

]]. As a result, the multi-rod database and prediction uncertainties are not available to FANP. However, the correlation has been independently validated by FANP against public domain multi-rod data and proprietary data collected for a prototypical ATRIUM-10 test assembly. Selected results for the ATRIUM-10 test assembly are reported in the public domain in Reference SRXB-A.35-5.

The Ohkawa-Lahey void correlation was developed for application in BWR transient calculations. In particular, the correlation was carefully designed to predict the onset of counter-current flow limit characteristics during the occurrence of a sudden inlet flow blockage. The correlation was defined to be functionally dependent on the mass flux, quality, and fluid properties.

Independent validation of the correlation was performed by FANP at the request of the NRC during the Licensing Topical Report review of the XCOBRA-T code. The NRC staff subsequently reviewed and approved Reference SRXB-A.35-6, which compared the code to a selected test from the FRIGG experiments (Reference SRXB-A.35-7). More recently the correlation has been independently validated by FANP against additional public domain multi-rod data and proprietary data collected for a prototypical ATRIUM-10 test assembly.

The characteristics of the FANP multi-rod void fraction validation database are listed in Table SRXB-A.35-1.

The FRIGG experiments have been included in the validating database because of the broad industry use of these experiments in benchmarking activities, including TRAC, RETRAN, and S-RELAP5. The experiments include a wide range of pressure, subcooling, and quality from which to validate the general applicability of a void correlation. However, the experiments do not contain features found in modern rod bundles such as part length fuel rods and mixing vane grids. The lack of such features makes the data less useful in validating correlations for modern fuel designs. Also, the reported instrument uncertainty for these tests is provided in Table SRXB-A.35-1 based on mockup testing. However, the total uncertainty of the measurements (including power and flow uncertainties) is larger than the indicated values.

Because of its prototypical geometry, the ATRIUM-10 void data collected at KATHY was useful in validating void correlation performance in modern rod bundles that include part length fuel rods, mixing vane grids, and prototypic axial/radial power distributions. Void measurements were made at one of three different elevations in the bundle for each test point: just before the end of the part length fuel rods, midway between the last two spacers, and just before the last spacer.

As shown in Figure SRXB-A.35-1, the range of conditions for the ATRIUM-10 void data is valid for typical reactor conditions. This figure compares the equilibrium quality at the plane of measurement for the ATRIUM-10 void data with the exit quality of bundles in the EMF-2158 benchmarks and BFN operating at EPU (including MELLLA+) conditions. As seen in the figure, the data at the measurement plane covers nearly the entire range of reactor conditions. However, calculations of the exit quality from the void tests show the overall test conditions actually envelope the reactor conditions. (Note, the ATRIUM-10 data shown in Figure SRXB-A.35-1 is not from the same database as illustrated in Figure SRXB-A.15-1.)

Figures SRXB-A.35-2 and 35-3 provide comparisons of predicted versus measured void fractions for the FANP multi-rod void fraction validation database using the [[ ]] correlation. These figures show the predictions fall within ±0.05 (predicted - measured) error bands with good reliability and with very little bias. Also, there is no observable trend of uncertainty as a function of void fraction.

Figures SRXB-A.35-4 and 35-5 provide comparisons of predicted versus measured void fractions for the FANP multi-rod void fraction validation database using the Ohkawa-Lahey correlation. In general, the correlation predicts the void data with a scatter of about ±0.05 (predicted - measured), but a bias in the prediction is evident for voids between 0.5 and 0.8. The observed under prediction is consistent with the observations made in Reference SRXB-A.35-6.

In conclusion, validation using the FANP multi-rod void fraction validation database has shown that both drift flux correlations remain valid for modern fuel designs. Furthermore, there is no observable trend of uncertainty as a function of void fraction. This shows there is no increased uncertainty in the prediction of nuclear parameters at EPU (including MELLLA+) conditions within the nuclear methods as a result of changes to the population distribution of the nodal void fractions with respect to pre EPU conditions (See response to SRXB-A.27 for the pre-EPU and EPU void distributions.).

References:

SRXB-A.35-1: N. Zuber and J. A. Findlay, "Average Volumetric Concentration in Two-Phase Flow Systems," J. Heat Transfer, 1965

SRXB-A.35-2: P. Coddington and R. Macian, A Study of the Performance of Void Fraction Correlations Used in the Context of Drift-Flux Two-Phase Flow Models," Nuclear Engineering and Design, 215, 199-216

SRXB-A.35-3: [[

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SRXB-A.35-4: K. Ohkawa and R. T. Lahey, Jr., "The Analysis of CCFL Using Drift-Flux Models,"Nuclear Engineering and Design, 61, 1980

SRXB-A.35-5: S. Misu et al., "The Comprehensive Methodology for Challenging BWR Fuel Assembly and Core Design used at FANP," proceedings on CD-ROM, PHYSOR 2002, Seoul, Korea, October 7-10, 2002

SRXB-A.35-6: XN-NF-84-105(P)(A) Volume 1 Supplement 4, "XCOBRA-T: A Computer Code For BWR Transient Thermal-Hydraulic Core Analysis, Void Fraction Model Comparison to Experimental Data," Advanced Nuclear Fuels Corporation, June 1988

SRXB-A.35-7: O. Nylund et al., "Hydrodynamic and Heat Transfer Measurements on a Full-Scale Simulated 36-Rod Marviken Fuel Element with Non-Uniform Radial Heat Flux Distribution," FRIGG-3, R 494/RL-1154, November 1969

SRXB-A.35-8: J. Skaug et al., "FT-36b, Results of Void Measurements," FRIGG-PM-15, May 1968

SRXB-A.35-9: O. Nylund et al., "Hydrodynamic and Heat Transfer Measurements on a Full-Scale Simulated 36-Rod Marviken Fuel Element with Eniform Heat Flux Distribution," FRIGG-2, R 447/RTL-1007, May 1968

SRXB-A.35-10: A1C-1308656-1, "Initial Void Measurements at the Karlstein Thermal Hydraulic Test Loop," FANP, April 2003

Table 35-1: FANP Multi-Rod Void Fraction Validation Database

	FRIGG-2 (Reference SRXB-A.35-9)	FRIGG-3 (Reference SRXB-A.35-7 and -8)	ATRIUM-10-KATHY (Reference SRXB-A.35-10)
Axial Power Shape	uniform	uniform	[[ ]]
Radial Power Peaking	uniform	mild peaking	[[ ]]
Bundle Design	circular array with 36 rods + central thimble	circular array with 36 rods + central thimble	prototypical ATRIUM-10 CHF bundle
Pressure (psi)	725	725, 1000, and 1260	[[ ]]
Inlet Subcooling (^{0}F)	4.3 to 40.3	4.1 to 54.7	[[ ]]
Mass Flow Rate (lbm/s) *(calculated from mass flux assuming ATRIUM-10 inlet flow area)*	14.3 to 31.0	10.1 to 42.5	[[ ]]
Equilibrium Quality at Measurement Plane (fraction)	-0.036 to 0.203	-0.058 to 0.330	[[ ]]
Max Void at Measurement Plane (fraction)	0.828	0.848	[[ ]]
Reported Instrument Uncertainty (fraction)	0.025	0.016	[[ ]]
Number of Data	27 tests, 174 points	39 tests, 157 points	[[ ]]

Figure SRXB-A.35-1: Comparison of the Measured Local Quality for ATRIUM-10 Void Data and Exit Quality for Typical Reactor Conditions

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Figure SRXB-A.35-2: Validation of [[ ]] using FRIGG-2 and FRIGG-3 Void Data

[[

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Figure SRXB-A.353: Validation of [[ ]] using ATRIUM-10 Void Data

[[

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Figure SRXB-A.35-4: Validation of Ohkawa-Lahey using FRIGG-2 and FRIGG-3 Void Data

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Figure SRXB-A.35-5: Validation of Ohkawa-Lahey using ATRIUM-10 Void Data

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NRC Request SRXB-A.36

Demonstrate that the database used to establish the two phase pressure drop for the fuel designs used for the EPU include predicted EPU channel and fuel assembly design conditions. Specifically, demonstrate that current normal power pertinent two-phase flow/pressure drop ranges are still applicable to EPU anticipated ranges of operations.

TVA Reply to SRXB-A.36

The FANP assembly pressure drop methodology is validated against full-scale tests in the KATHY test facility in Karlstein, Germany. The KATHY tests are used to characterize the assembly two-phase pressure drop and CHF performance. This full-scale testing allows the hydraulic models to be verified for FANP fuel designs over a wide range of hydraulic conditions prototypical of reactor operation. The ATRIUM-10 measured conditions from KATHY are compared to reactor conditions in Figure SRXB-A.15-1 (see SRXB-A.15). This figure illustrates that the ATRIUM-10 two-phase pressure drop measurements bound both uprated and non-uprated assembly conditions. In addition, the key physical phenomena (e.g., heat flux, fluid quality, and assembly flows) for EPU conditions are within the scope of current reactor experience. This similarity of assembly conditions is enforced in FANP analysis methodologies by the imposition of CHF correlation limits, therefore, both current core designs and uprated core designs must remain within the same parameter space.

NRC Request SRXB-A.37

Describe that the methods used in the licensing codes to model the bypass water (e.g., core simulator, steady state and transient codes, LOCA codes).

TVA Reply to SRXB-A.37

The core bypass water is modeled in the FANP steady-state core simulator, transient simulator, LOCA, and stability codes as [[
]].

The steady-state core simulator, MICROBURN-B2, explicitly models the assembly specific flow paths through the lower tie-plate flow holes and the channel seals in addition to a [[
]] through the core support plate. The numerical solution for the individual flow paths is computed based on a general parallel channel hydraulic solution that imposes a constant pressure drop across the core fuel assemblies and the bypass region. This solution scheme incorporates [[

]] that is dependent on the [[ ]].

The MICROBURN-B2 state point specific solution for bypass flow rate and [[ ]] is then used as initial conditions in the transient and LOCA analyses. When the reactor operates on high rod lines at low flow conditions, the in-channel pressure drop decreases to a point where a solid column of water cannot be supported in the bypass region, and voiding occurs in the core bypass. For these conditions (in the region of core stability concerns) the neutronic feedback of bypass voiding [[

]].

NRC Request SRXB-A.38

State the bypass voiding criteria (if any) or specification that applies to the TIP and the LPRM.

TVA Reply to SRXB-A.38

[[

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Reference:

SRXB-A.38-1: ANF-89-98(P)(A) Revision 1 and Supplement 1, "Generic Mechanical Design Criteria for BWR Fuel Designs," Advanced Nuclear Fuels Corporation, May 1995

NRC Request SRXB-A.39

Demonstrate that the capability of the licensing code systems, including the core simulator, to determine the potential for bypass voiding.

TVA Reply to SRXB-A.39

The level of bypass boiling for a given state point is a direct result of the hydraulic solution. The potential for boiling increases as the power/flow ratio increases or the inlet subcooling decreases. While the licensing methodology utilizes a lumped core bypass model (as explained in response to SRXB-A.37), the MICROBURN-B2 core simulator does have a conservative multi-channel model to estimate the potential for localized bypass boiling. This multi-channel model uses one bypass channel per fuel assembly to specifically determine a bounding local void distribution in the core. The model is conservative in that it assumes that there is no cross-flow between bypass channels. Thus, the direct bypass energy from the hottest assembly is deposited in the surrounding 1/2 width water gaps and there is no mixing with the adjacent 1/2 width water gaps from its neighbors. The capability of this model to predict localized bypass boiling is demonstrated in Figure SRXB-A.39-1 for a hypothetical case where the inlet subcooling was artificially decreased to induce bypass boiling.

Bypass voiding is of greatest concern for stability analysis due to its direct impact on the fuel channel flow rates and the axial power distributions. The reduced density head in the core bypass due to boiling results in a higher bypass flow rate and consequently a lower hot channel flow rate. This lower hot channel flow rate and a more bottom peaked power distribution (due to lower reactivity in the top of the core due to boiling in the bypass region) destabilize the core through higher channel decay ratios. FANP stability methods directly model these phenomena to assure that the core stability is accurately predicted.

Figure SRXB-A.39-1: Hypothetical MICROBURN-B2 Multi-Channel Average Bypass Void Distribution

EDIT OF VOID FRACTION IN BYPASS CHANNEL IN UNITS OF %

J:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
I:																
1 [[																
2																
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NRC Request SRXB-A.40

Provide an evaluation and discussion of the lattice/depletion code (CASMO-4) capability to generate the cross-section with voiding in the in-channel water rods and bypass.

TVA Reply to SRXB-A.40

CASMO-4 has the capability to specify the density of the moderator in the bypass and in-channel water rods, [[ ]] the FANP methodology [[ ]] during operation are not significant. As noted in the response to SRXB-A.41, bypass voiding is not encountered during steady-state EPU operation for BFN so there is no impact on steady-state analyses. For transient conditions, it is conservative to ignore the density changes as additional voiding aids in shutting down the power generation.

NRC Request SRXB-A.41

Evaluate EPU core neutronic and thermal-hydraulic conditions and state if for EPU core designs and operating conditions, if bypass voiding can occur during steady state or transient events. Consider operation at all limiting statepoints in the maximum extended load line limit analysis (MELLLA) domain.

TVA Reply to SRXB-A.41

The expanded operating domain on the power/flow map associated with EPU and MELLLA+ were examined. For BFN, the entire 100% power boundary (120% of the original licensed thermal power) was assessed. Even with the conservative multi-channel model discussed in the response to SRXB-A.39, there was no localized bypass boiling at the EPU power level. While this may not have been anticipated, the increased power/flow ratio of the core bypass was more than compensated by the increased inlet subcooling associated with the uprated operating conditions. When the core power is uprated, the steam and feedwater flows increase and the internal recirculation ratio decreases. With a larger fraction of the core flow coming from feedwater, the inlet subcooling increases. This assessment assures that the limiting transients at uprated thermal power are not adversely affected by bypass boiling. As the flow is reduced along the highest rod line in the MELLLA+ operating domain, the propensity for bypass boiling increases and becomes significant for two pump trip events.

Two pump trip transients are analyzed as part of the long-term stability solutions as they result in operation at high rod lines and natural recirculation flow. For stability analysis, the impact of bypass boiling is directly accounted for in the active channel flow rates, axial power distributions, and dynamic reactivity changes during the oscillations. While these calculations use a [[ ]] bypass model, and may underpredict localized bypass boiling, it is important to note that the methodology was benchmarked to global and regional oscillations for internal pump plants that exhibit much higher levels of bypass boiling than jet pump plants for MELLLA and even MELLLA+ operation due to the extremely low natural recirculation flow rates (~15% for internal pump plants compared to ~30% for jet pump plants). Uncertainties associated with localized bypass boiling are captured in the decay ratio uncertainties in the MICROBURN-B2/STAIF stability methodology.

NRC Request SRXB-A.42

In August 30, 2004, General Electric Nuclear Energy (GENE) issued a 10 CFR Part 21 report (ADAMS ML042720293), stating that using limiting control rod blade patterns developed for less than rated flow at rated power conditions could sometimes yield more limiting bundle-by-bundle MCPR distributions and/or more limiting bundle axial power shapes than using limiting control rod patterns developed for rated flow/rated power in the SLMCPR calculation. The affected plants submitted amendment requests increasing their SLMCPR value. The staff understand that Framatome did not issue a Part 21 reporting on the SLMCPR methodology that addresses the calculation of the SLMCPR at minimum core flow and off-rated conditions similar to GENE's Part 21 report.

Reference the applicable sections of the ANF-524P-A SLMCPR methodology that specify the requirement to calculate the SLMCPR at the worst case conditions for minimum core flow conditions for rated power. Demonstrate that the SLMCPR is calculated at different statepoints of the licensed operating domain, including the minimum core flow statepoint and that the calculation is performed for different exposure points.

TVA Reply to SRXB-A.42

FANP calculates the SLMCPR on a cycle-specific basis to protect all allowed reactor operating conditions. The analysis incorporates the cycle-specific fuel and core designs. [[

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In August 2004, FANP initiated an internal condition report relative to the subject GE Part 21 notification. The condition report was evaluated per FANP's corrective action program and was determined to be specific to the procedures used by GE and did not impact SLMCPR analyses performed by FANP.

Licensing analyses performed by FANP previously recognized that SLMCPR is dependent on core flow. [[

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Reference:

SRXB-A.42-1: ANF-524(P)(A) Revision 2 and Supplements 1 and 2, "ANF Critical Power Methodology for Boiling Water Reactors," Advanced Nuclear Fuels Corporation, November 1990

NRC Request SRXB-A.43

Discuss or reference the applicable sections/chapters of ANF-524P-A that addresses what rod patterns are assumed in performing the nonrated flow SLMCPR calculations. State how it is established that the rod patterns assumed in the SLMCPR calculations for rated power, flow, and minimum core flow conditions, would reasonably bound the planned rod pattern that Units 2 and 3 would operate under EPU conditions.

TVA Reply to SRXB-A.43

Control rod patterns are not a direct input to the SLMCPR analysis; the primary impact of control rod patterns is on the power distribution used in the SLMCPR analysis. [[

]] The power distributions considered in the SLMCPR analysis reflect the control rod patterns planned for the range of core flow expected at EPU rated power during the entire cycle.

NRC Request SRXB-A.44

For implementation of Average Power Range Monitor, Rod Block Monitor, Technical Specifications Improvement Program (ARTS)/MELLLA using Framatome methods, show that Units 2 and 3 can operate at all statepoints, including the minimum core flow statepoint, without violating their SLMCPR in the event of an abnormal operating occurrence. The minimum core flow statepoint SLMCPR calculations should demonstrate that Units 2 and 3 can operate at the minimum flow statepoint with some margin.

TVA Reply to SRXB-A.44

The primary impact of ARTS/MELLLA operation on the SLMCPR analysis is the lower minimum allowed core flow at rated power. [[

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NRC Request SRXB-A.45

Regarding SAFLIM2 calculations, slides 27-31, please provide qualitative description of this process, including the termination of the process if the EPSBTR Criterion is satisfied.

TVA Reply to SRXB-A.45

The slides referred to in SRXB-A.45 were presented in an NRC-FANP meeting held in Richland, Washington on August 4, 2005. Slides 27 through 31 described the steps performed in each Monte Carlo trial in the SAFLIM2 calculation. The information presented in the slides is summarized below:

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NRC Request SRXB-A.46

Describe the process for establishing the design limit curves for the linear heat generation rate (LHGR) and the maximum average planar LHGR (MAPLHGR). In addition, discuss what impact (if any) high void fractions have on this process.

TVA Reply to SRXB-A.46

The LHGR limit is established to support plant operation while satisfying the fuel mechanical design criteria. The LHGR limit is translated into power history inputs as described in the topical report (Reference SRXB-A.46-1; see the response to RAI, Question 3). Then, the power histories are used as input to the RODEX2A, RAMPEX, and COLAPX codes in evaluating the fuel rod thermal-mechanical criteria (References SRXB-A.46-2 and SRXB-A.46-3). Higher voiding can have the effect of further offsetting the axial power and fast neutron flux profiles during operation. Because the power history methodology makes use of established axial profiles, changes to the power history due to higher voiding are not explicitly taken into account in the analyses. However, the profiles selected for the analyses are conservatively peaked to result in higher rod average power levels while attaining the LHGR limit. Separate studies (Reference SRXB-A.46-4) have shown the current methodology, which makes use of a bounding power history, to be conservative for EPU conditions.

The MAPLHGR is generally selected to be slightly less restrictive than the LHGR limit. The adequacy of the selected MAPLHGR limit is demonstrated by performing analyses to confirm that all 10 CFR 50.46 acceptance criteria are satisfied during a postulated LOCA. If all acceptance criteria are not satisfied, a more restrictive MAPLHGR limit is selected.

High void fractions occur during the blowdown, refill, and reflood phases of a LOCA. The thermal-hydraulic models used in the LOCA Appendix K evaluation model (Reference SRXB-A.46-5) are appropriate for the range of void conditions encountered during a LOCA. Initial fuel rod local peaking factors are calculated for void characteristics representative for reactor conditions prior to the start of the accident. The effect of initial void on local peaking factor is less important than the lattice designs and exposure ranges considered in the analysis.

References:

SRXB-A.46-1: XN-NF-85-67(P)(A) Revision 1, "Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel," Exxon Nuclear Company, September 1986

SRXB-A.46-2: EMF-85-74(P) Revision 0, Supplement 1(P)(A) and Supplement 2(P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model," Siemens Power Corporation, February 1998

SRXB-A.46-3: ANF-89-98(P)(A) Revision 1 and Supplement 1, "Generic Mechanical Design Criteria for BWR Designs," Advanced Nuclear Fuels Corporation, May 1995

SRXB-A.46-4: BAW-10247(P) Revision 0, "Realistic Thermal Mechanical Fuel Rod Methodology for Boiling Water Reactors," FANP, Inc., August 2004

SRXB-A.46-5: EMF-2361(P)(A), "EXEM BWR-2000 ECCS Evaluation Model," Framatome ANP, May 2001

NRC Request SRXB-A.47

The Siemens Power Corporation-B (SPCB) CHF correlation was approved by the NRC staff to be applicable over specified ranges of mass flow, pressure, and inlet subcooling. Discuss whether the utilization of the SPCB Correlation to EPU take the Correlation beyond its approved applicable ranges?

TVA Reply to SRXB-A.47

The SPCB CHF correlation was approved by the NRC staff (in Reference SRXB-A.47-1) to be applicable over specified ranges of mass flow, pressure, inlet subcooling, and BT enthalpy. The NRC staff also approved specific corrective actions when the computed conditions fall outside of the approved range to assure that conservative calculations are obtained. For both EPU and pre-EPU conditions, some analyses can predict assembly conditions to be outside the approved range of specified conditions for the CHF correlations. Consequently, the FANP licensing methods are programmed to determine whether the computed assembly conditions fall outside of the approved range of applicability for the CHF correlation; if so, the methodology imposes approved corrective actions to conservatively assess the critical power margin for the assembly.

References:

SRXB-A.47-1: EMF-2209(P)(A) Revision 2, "SPCB Critical Power Correlation," Framatone ANP, September 2003

NRC Request SRXB-A.48

Table 1-3 of the FUSAR, lists computer codes used for EPU transient analyses. Please clarify which code was used for the over-pressure protection analysis, and was the code approved by the NRC specifically for this transient.

TVA Reply to SRXB-A.48

The system transient analysis code COTRANSA2 was used for the ASME over-pressurization analysis. The Safety Evaluation Report (SER) for COTRANSA2 (Reference SRXB-A.48-1) explicitly states that the code is approved for MSIV closure and turbine trip without bypass events, which are the over-pressurization events evaluated in the FUSAR.

Reference:

SRXB-A.48-1: ANF-913(P)(A) Volume 1 Revision 1 and Volume 1 Supplements 2, 3, and 4, "COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analysis," Advanced Nuclear Fuels Corporation, August 1990

NRC Request SRXB-A.49

Section 2.3 of the FUSAR states that, "[c]ycle length and hot excess reactivity are maintained by appropriate selection of initial enrichment, fresh batch size, and burnable neutron absorber design. Sufficient design flexibility exists with the ATRIUM-10 fuel to accommodate operation at EPU conditions while maintaining adequate power distribution control." In order to obtain the additional 14-percent power (roughly 500 MWt) at EPU condition, discuss whether the maximum enrichment level of fuel assembles is increased compared to the pre-EPU enrichment level. If so, by how much, and address the impact this has in fuel storage facility.

TVA Reply to SRXB-A.49

The core power level is set by the reactivity of the core, which can be increased by core flow or control rod positions. For EPU conditions, to obtain the additional 14% in power and maintain the same cycle length (in time), an additional 14% of energy is to be produced in the core. The 14% increase in energy is obtained primarily by increasing the reload batch size and not the fuel maximum lattice enrichments; see Table SRXB-A.49-1 for comparison for representative fuel lattice enrichments between pre-EPU and EPU cycles. As noted in Table SRXB-A.49-1, the maximum lattice enrichments of the reload batches for pre-EPU and equilibrium EPU cycles is not significantly different, i.e., pre-EPU is [[ ]] U-235 and EPU is [[ ]] U-235. The maximum allowed pellet enrichment is the same [[ ]] for both pre-EPU and EPU conditions.

All new and spent fuel at BFN is stored in the spent fuel storage pool and in accordance with TS 4.3.1.1 must maintain a subcritical multiplication factor (keff) of less than 0.95 when flooded with non-borated water. A spent fuel storage pool criticality analysis has been performed for BFN that confirms that this requirement is met for ATRIUM-10 fuel designs. This analysis applies to all three units which have the same high density storage rack configuration as detailed in 10.3 of the BFN UFSAR. A reload specific evaluation is performed to verify that the specific bundle designs being loaded remain bounded by the criticality analysis. The fuel lattice enrichment limits for fuel to be stored are given in Table SRXB-A.49-1. For both the pre-EPU and EPU cases given in Table SRXB-A.49-1, the fuel storage criticality safety limits are met.

Table SRXB-A.49-1 presents data for the new fuel storage vault; however, this area is not used at BFN for fuel storage.

Table SRXB-A.49-1: Fuel Enrichment Comparisons Between Pre-EPU and EPU ATRIUM-10 Fuel Cycles

	Fuel Lattice Types			
Fuel Type	Pre-EPU (BFN 3 Cycle 13, 296 FA, batch-average enrichment-4.17 wt% U-235, 3458 MWt, 680 EFPd)	EPU (BFN 3 Cycle 20, 368 FA, batch-average enrichment-4.29 wt% U-235, 3902 MWt, 696 EFPd)	Enrichment Limits for New Fuel Storage	Enrichment limits for Spent Fuel Storage
1	Max. lattice 4.48 wt% U-235 Bundle average 4.17 wt% U-235 for 64 assemblies	Max. lattice 4.43 wt% U-235 Bundle average 4.29 wt% U-235 for 200 assemblies	All fuel lattices $\leq$5 wt% U-235 --or-- All fuel lattices $\leq$4.5 wt% and $\geq$8 Gd rods with $\geq$4 wt% Gd_2O_3 (See Note 1)	All fuel lattices $\leq$4.5 wt% U-235, and there are $\geq$8 Gd rods with $\geq$4 wt% Gd_2O_3. (See Note 2)
2	Max. lattice 4.48 wt% U-235 Bundle average 4.16 wt% U-235 for 168 assemblies	Max. lattice 4.44 wt% U-235 Bundle average 4.29 wt% U-235 for 168 assemblies		
3	Max. lattice 4.50 wt% U-235 Bundle average 4.18 wt% U-235 for 64 assemblies			

NOTES:

1. Allowed number of fuel assemblies and configuration in the new fuel storage vault differs depending on which limit is applied.

2. If this limit is not met, a CASMO in-rack k-eff calculation can be performed. If k-eff is <0.872, then fuel may be stored.

NRC Request SRXB-A.50

In Section 4.3 of the FUSAR, the limiting LBLOCA was discussed for EPU with ATRIUM-10 fuel for Units 2 and 3. Provide the following additional information regarding the Units 2 and 3 LBLOCA analysis:

a) Describe the Units 2 and 3 limiting single failure LBLOCA event for the current licensing basis. Typically, the events are same for EPU and pre-EPU conditions. But if the events are different for Units 2 and 3, provide an explanation.

b) The peak cladding temperature (PCT) changes have been [ ]. Discuss whether this is also true for Units 2 and 3. If not, then indicate by how much the PCT increased, and why Units 2 and 3 is an exception in this regard.

TVA Reply to SRXB-A.50

Section 4.3 of the FUSAR discusses the LOCA analysis for FANP fuel.

a) The limiting break for ATRIUM-10 fuel at EPU conditions is a 0.5 ft^2 break in the recirculation discharge pipe with a single failure of the DC power supply. A break spectrum analysis has not been performed for pre-EPU conditions as discussed further in the response to SRXB-A.21.

b) The PCT increase between the limiting EPU break and the same break at pre-EPU power level is 130°F as noted in the response to SRXB-A.21. This is representative of the PCT difference between the limiting break at EPU conditions and the limiting break at pre-EPU conditions. This representative value indicates that the difference in PCT would be greater than 20°F if a break spectrum at pre-EPU power were analyzed to determine the limiting pre-EPU break.

There are several contributing factors for the larger increase. The FANP EXEM BWR-2000 LOCA methodology is an Appendix K LOCA methodology that incorporates inherent conservatisms to ensure that the overall analysis results are conservative. Some aspects of the methodology that ensure conservatism in PCT calculations can result in relatively large PCT sensitivity to analysis changes, such as power level under some conditions. Specifically, as discussed below, the conservative Appendix K reflood criteria approved for use in the EXEM BWR-2000 methodology combined with the minimal BFN ECCS capability assumed for the limiting case are major contributing factors leading to the large PCT difference between EPU and pre-EPU conditions.

For BFN, the limiting ECCS scenario is a single available Core Spray loop (2 pumps) combined with conservative ADS timer assumptions. The minimal assumed ECCS results in the limiting LOCA being a small break case. When a small break LOCA case becomes limiting, one notable characteristic is a long pre-end-of-blowdown heat-up period. As a result of the long heat-up period prior to end-of-blowdown, the small break LOCA results become more sensitive to the core heat-up rate during this period. One effect of increased power on a LOCA analysis is an earlier degradation of fluid conditions that result in an earlier beginning of heat-up and an increased heat-up rate during blowdown. Due to these factors, the difference in maximum cladding temperature between pre-EPU and EPU at end-of-blowdown is about 40°F.

In addition to the long blowdown period, the minimal ECCS availability assumed for the limiting case results in a long refill period and a correspondingly long heat-up period between the end-of-blowdown and core reflood. With only a single Core Spray loop available to refill and reflood the core, it is a challenge to achieve the conservative sustained upward liquid flow rate criteria required by the approved reflood model in the EXEM BWR-2000 methodology. Combined with the minimal available ECCS assumptions, the increased power results in degraded fluid conditions that persist longer than those associated with the pre-EPU case. Ultimately, the degraded conditions combined with the very conservative reflood criteria result in reflood for the EPU case occurring more than 25 seconds later than the pre-EPU case. Therefore, the EXEM BWR-2000 methodology reflood criteria is the primary contributor to the increased PCT sensitivity for changes in core power under the minimal ECCS availability assumed for the limiting LOCA case.

Experience with other plant LOCA analyses that assume greater ECCS availability indicates that the EXEM BWR-2000 methodology produces PCT differences between pre-EPU and EPU conditions that are on the order of 20°F to 30°F.

NRC Request SRXB-A.51

Discuss whether there is any modification in the fuel design of ATRIUM-10 for EPU operation. If so, please describe that in detail, including any changes in the maximum enrichment level.

TVA Reply to SRXB-A.51

No fuel design modifications have been made for EPU operation, neither mechanical nor thermal-hydraulic. The maximum allowed enrichment level of any fuel pellet for either pre-EPU or EPU is 4.95 wt% U-235. A comparison of fuel enrichments on both a lattice basis and an assembly basis for both pre-EPU or EPU is given in Table SRXB-A.49-1. As indicated in the table, the average and peak enrichment levels of the pre-EPU and EPU fuel assemblies are nearly the same.

NRC Request SRXB-A.52

Section 3.9.1 of the PUSAR discusses the shutdown cooling (SDC) analysis for EPU. It indicates that it takes [ ] for cooling down the reactor with two RHR pumps and heat exchangers in service. Furthermore, in Section 4.2.5 of the PUSAR, it was stated, "One RHR pump is required to operate during either the SBO or an Appendix R fire event." The staff, however, notes that shutdown cooling with single SDC loop operation was not discussed in the PUSAR. Obviously, it is expected that SDC with one RHR pump and heat exchanger in service will take [ ]. Clarify which criteria apply to SDC with single SDC loop operation, and whether the criteria are satisfied at EPU conditions. The response should also include whether EPU conditions will comply with the safe shutdown requirements of 10 CFR 50.63, Loss of all alternating current power, 10 CFR 50.48, Fire protection, GDC-3, Fire protection of Appendix A, General Design Criteria for Nuclear Power Plants to 10 CFR Part 50 and III.G, III.J, and III.L of Appendix R, Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979, to 10 CFR Part 50, which may require a unit to achieve cold shutdown conditions within a given time.

TVA Reply to SRXB-A.52

The licensing basis for BFN does not include specific criteria regarding the ability to achieve cold shutdown conditions within a given time using the SDC system (single or dual loop). Similarly, BFN does not have criteria for achieving cold shutdown conditions in a given time for design basis accident analyses or for other special events (including ATWS, Station Blackout, and Appendix R).

NRC Request SRXB-A.53

Browns Ferry Units 2 and 3 currently operate under Option III solution. Provide a clarification for the following areas:

a) Describe the expected effects of EPU operation on Option III.

b) Describe any alternative method to provide detection and suppression of any mode of instability other than through the current (Oscillation Power Range Monitor (OPRM) scram (e.g., interim corrective actions).

c) Provide a summary of the Browns Ferry Technical Specifications affected by the Option III implementation and future EPU operation.

d) Provide the approved methodologies used to calculate the OPRM setpoint for the current operation and future Browns Ferry EPU operation.

TVA Reply to SRXB-A.53

a) The plant- and cycle-specific Option III OPRM system amplitude setpoint will offer the same SLMCPR protection for EPU operation. While an EPU operation might potentially result in a lower OPRM system amplitude setpoint, the reactor will be adequately protected in case of a thermal-hydraulic instability (THI) event. Response "d)" to this question provides details on the methodologies used in establishing the Option III setpoints. The cycle-specific portions that will capture the impact of EPU are the initial MCPR and the plant-specific Delta over Initial CPR versus Oscillation Magnitude (DIVOM) calculations. As noted in response "b)" to this question, the BSP regions will be used if the Oscillation Power Range Monitoring (OPRM) system is declared inoperable. The plant- and cycle-specific BSP evaluation will ensure that adequate stability margins are maintained for EPU operation with an inoperable OPRM system by expanding the BSP regions as needed. These calculations are also used to confirm the adequacy of the OPRM armed region on a cycle-specific basis.

b) The BSP methodology (OG 02-0119-260, GE to BWR Owners' Group Detect and Suppress II Committee: "Backup Stability Protection (BSP) for Inoperable Option III Solution," July 17, 2002) will be used if the OPRM system is declared inoperable. A power/flow map with representative BSP regions has been provided in response to SRXB-A.3.

c) BFN Units 2 and 3 are already licensed to use the Option III detect and suppress solution. The current Option III related TS are not impacted by the EPU.

d) There are three parts to the Option III licensed methodology as outlined in the Option III licensing topical (NEDO-32465-A).

1. A determination of the MCPR margin that exists prior to the onset of the oscillation. This part of the methodology is cycle-specific and will be evaluated for each cycle. For BFN Units 2 and 3, this calculation is performed with the FANP-ANP CASMO4/MICROBURN-B2 code, a successor to the MICROBURN-B code identified in NEDO-32465-A.

2. A statistical treatment of various parameters that influence the magnitude of the peak channel power oscillation. For a given combination of LPRM assignments to OPRM cells and trip setpoint, this statistical analysis calculates the hot channel oscillation magnitude (HCOM) prior to termination of the instability. This part of the methodology is unchanged since it is based on relative powers.

3. A conservative relationship between the change in channel CPR and channel power oscillation magnitude. This relationship is defined as the DIVOM curve. This part of the methodology used to rely on a generic regional mode DIVOM slope. This generic slope was determined to be potentially non-conservative as reported in 10 CFR Part 21 communications from GE to the NRC (letters MFN 01-25 dated June 29, 2001, and MFN 01-046 dated August 31, 2001). Because of this DIVOM Part 21 issue, the use of the generic regional mode DIVOM curve has been replaced with a plant- and cycle-specific DIVOM evaluation as documented in GE letter to the NRC BWROG-03049, dated September 30, 2003. The plant- and cycle- specific calculation is performed in accordance with the BWROG Regional DIVOM Guideline (GE-NE-0000-0028-9714-R1, "Plant-Specific Regional Mode DIVOM Procedure Guideline," June 2005). For BFN Units 2 and 3, this plant-specific DIVOM calculation is performed by FANP using the RAMONA5-FA system transient code.

   The FANP CASMO4/MICROBURN-B2 and RAMONA5-FA codes are the same methodology identified by the Susquehanna plant (PP&L) in a request for information response (Reference SRXB-A.53-1) in support of their Option III TS submittal. The NRC subsequently approved the Susquehanna Option III TS. An audit of the FANP plant-specific DIVOM calculation identified in the Susquehanna SER (Reference SRXB-A.53-2) was subsequently completed by the NRC. BFN plant-specific DIVOM analyses are performed using the same codes and procedures, used in the same manner, as previously reviewed by the NRC for Susquehanna.

References:

SRXB-A.53-1: Susquehanna Letter to NRC, "Susquehanna Steam Electric Station Response to NRC Request for Additional Information (RAI) Relative to Susquehanna Steam Electric Station, Units 1 and 2 Revised Response to Generic Letter 94-02: Long-Term Stability Solution (TAC Nos. MC1659 and MC1660) PLA-5771", dated June 18, 2004 (ADAMS Accession No. ML041760273)

SRXB-A.53-2: NRC Letter, "Susquehanna Steam Electric Station, Units 1 and 2 - Issuance of Amendments Re: Revised Response to Generic Letter 94-02, Long-Term Stability Solution (TAC Nos. MC1659 and MC1660), dated November 9, 2004 (ADAMS Accession No. ML043140420)

NRC Request SRXB-A.54

Provide the technical basis that supports the position that the hot channel oscillation magnitude portion of the Option III calculation is not affected by EPU and does not need to be recalculated because the OPRM hardware does not change.

TVA Reply to SRXB-A.54

HCOM is calculated based on normalized power response, and not on absolute power response. The OPRM system amplitude setpoint is defined as a peak over average value for the OPRM cell signal. The HCOM quantifies the normalized size of the hot bundle power oscillation prior to oscillation suppression. Hence, the HCOM is still applicable for the EPU as long as the key inputs to the OPRM system (e.g., LPRM to OPRM assignments, Reactor Protection System trip logic, scram delay time, LPRM failure rate, and minimum number of LPRMs required for an OPRM cell to be operable) remain unchanged for EPU.

NRC Request SRXB-A.55

Provide the Browns Ferry Delta CPR/Initial CPR Versus Oscillation Magnitude, or DIVOM, curve used for the last three cycles and the next EPU cycle. The purpose is to evaluate the impact of EPU on the safety margins in case of instabilities.

TVA Reply to SRXB-A.55

The DIVOM for Option III plants was initially defined as a constant regional oscillation mode slope of 0.45 in licensing topical report NEDO-32465-A, "BWR Owners' Group Long-Term Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications." An earlier GE 10 CFR part 21 report dated August 31, 2001 (ADAMS Accession No. ML012490522) determined that this generic slope may not bound all current core and fuel designs. Closure of this part 21 issue was accomplished with the implementation of plant/cycle-specific DIVOM calculations as discussed in BWROG communications BWROG-03047 and -03048. The basis of these calculations is the BWROG's guideline, OG04-0153-260, "Plant-Specific Regional Mode DIVOM Procedure Guideline," dated June 15, 2004.

SRXB-A.55 asks for the results of the cycle-specific DIVOM calculation for the last three cycles and the next EPU cycle. Since the application of cycle-specific DIVOM has only been in place since near the end of 2004, three cycles of results are not available for any single operating unit. However, it has been applied to a total of three BFN operating cycles (Unit 2 Cycle 14, Unit 3 Cycle 12, and Unit 3 Cycle 13, which is the next planned operating cycle for Unit 3 with a planned startup date in March 2006). The results are shown in Figure SRXB-A.55-1. All three cycles were designed as 24-month operating cycles at current rated power conditions (3458 MWt or 105% OLTP). These core designs contain fresh ATRIUM-10 with various combinations of exposed GE13, GE14, and ATRIUM-10 exposed fuel as shown below:

Unit	Cycle	%OLTP	Fresh Fuel	Exposed Fuel
3	12	105%	A10	GE13/GE14
2	14	105%	A10	GE13/GE14
3	13	105%	A10	GE14/A10

At this time, a cycle-specific DIVOM has not been completed for the first EPU core (120% OLTP) conditions. This analysis is in progress and is being performed to support the calculation of Option III setpoints for the BFN Unit 2 Cycle 15 Reload Analysis report.

A cycle-specific setpoint calculation is performed to ensure that cycle-specific variations in parameters that have the potential to impact the protection of the MCPR Safety Limit are explicitly included. The part 21 dated August 31, 2001, and its associated closure, in essence, redefined DIVOM as one of the parameters that need to be calculated on a cycle-specific basis. An increase in DIVOM value for a specific operating cycle does not imply that the core is less stable or more likely to experience an oscillation, but rather means that the MCPR response for a specified oscillation magnitude is larger. Since the larger cycle-specific DIVOM value is explicitly included in the Option III setpoint calculation, no degradation in the margin of safety occurs.

Figure SRXB-A.55-1: Comparison of Browns Ferry Units 2/3 DIVOM Data

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NRC Request SRXB-A.56

Confirm that TVA did not take any deviations from Licensing Topical Report, NEDC-32424P-A, Generic Guidelines for General Electric Boiling Water Reactor Extended Power Uprate, or ELTR1 and ELTR2. Also, confirm that TVA performed or will perform all the analyses required by the guidelines of ELTR1 and ELTR2. Identify the analyses which are to be performed before the EPU operation. Especially confirm that the transients listed in Appendix E of ELTR1 will be performed for the first EPU core.

TVA Reply to SRXB-A.56

TVA previously provided a comparison of the BFN EPU analyses and the ELTRs in the original June 25, 2004, EPU submittal (ML041840301) and the February 23, 2005, submittal (ML050560337). In the foreword of Enclosure 4 of the June 25, 2004, EPU submittal TVA identified where the BFN Units 2 and 3 EPU application was based upon ELTR1 or ELTR2 generic evaluations. In response to NRC Request 1 in the February 23, 2005, submittal, a revised table specific to BFN Units 2 and 3 was provided.

Additionally, in February 23, 2005, submittal, BFN identified and justified all the areas where BFN Units 2 and 3 do not satisfy the ELTR criteria. As stated therein, BFN has satisfied the criteria of the ELTR but in some cases has conducted the evaluation in an alternate manner specified by the ELTR.

As provided in the PUSAR, the transients listed in Appendix E of ELTR1 were analyzed using an equilibrium core of GE 14 fuel (See PUSAR Table 9-2.). Additionally, as provided in the FUSAR, the transients listed in Appendix E of ELTR1 were analyzed based on an equilibrium core of ATRIUM-10 fuel (See FUSAR Table 9.2.).

All of the transients listed in Appendix E of ELTR1 are addressed in the FUSAR for ATRIUM-10 fuel. The following cycle-specific analyses for the transients identified in ELTR1 Appendix E will be performed for the initial EPU cycle:

1. Fuel Thermal Margin Events
    - Generator load rejection with bypass failure
    - Turbine trip with bypass failure
    - Feedwater controller failure - maximum demand
    - Loss of feedwater heater
    - Rod withdrawal error
    - Slow recirculation flow increase

2. Limiting Transient Overpressure Events

   - Main steam isolation valve closure with scram on high flux (failure of direct scram)
   - Turbine trip with bypass valve failure and scram on high flux (failure of direct scram)

The EPU transient analyses reported in the FUSAR demonstrate that the other Fuel Thermal Margin Events listed in Appendix E of ELTR1 are non-limiting and are bounded by the consequences of the events identified above.

The EPU analyses reported in the FUSAR for the loss of feedwater flow transient event show that the water level remains significantly above the top of active fuel, thereby ensuring adequate core cooling. The single feedwater pump trip analysis reported in the FUSAR shows that the water remains above the Level 3 setpoint. The conclusions of these Loss of Water Level Transients remain valid for future cycles using ATRIUM-10 fuel at EPU conditions.

NRC Request SRXB-A.57

In Section 9.3.1.1 of the FUSAR, Framatome claims that "[o]peration with ATRIUM-10 fuel results in small changes to parameters important to determining stability."

Assuming the core power distribution is changed as a result of the EPU, provide the following information:

a) Provide the results of the analysis and compare the consequences of reactor instability during ATWS before and after the EPU for both mitigated and unmitigated cases;

b) Quantify the potential core damage percentage before and after the EPU;

c) Provide the NRC staff approved evaluation model used for the thermal hydraulic stability analyses during ATWS;

d) Identify any deviation from the methodology stated in the approved BWR Owners Group topical report, NEDO-32047-A, ATWS Rule Issues Relative to BWR Core Thermal-Hydraulic Stability, and NEDO-32164, Mitigation of BWR Core Thermal-Hydraulic Instabilities in ATWS, and provide justification for its applicability to this analysis if there is a deviation.

TVA Reply to SRXB-A.57

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References:

SRXB-A.57-1: NEDO-32047-A, "ATWS Rule Issues Relative to BWR Core Thermal-Hydraulic Stability," GE Nuclear Energy, June 1995

SRXB-A.57-2: W. Wolf et al., "BWR Stability Analysis with the BNL Engineering Plant Analyzer," NUREG/CR-5816, October 1992