Table 3.10-1 Fish Species Collected in the Vicinity of BFN by TVA During BFN Monitoring and Reservoir Monitoring Activities, 1995-2000

Common Name	Fall 2000 Gill Net and Electrofishing TRM 292.5	Fall 2000 Gill Net and Electrofishing TRM 295.9	Cove Rotenone 1995-1997	Fall 1999 Gill Net and Electrofishing TRM 295.9
Chestnut lamprey	-	-	x	-
Spotted gar	-	x	x	-
Longnose gar	-	-	x	-
Bowfin	-	-	x	-
Skipjack herring	x	x	x	x
Gizzard shad	x	x	x	x
Threadfin shad	x	x	x	x
Central stoneroller	-	-	x	-
Grass carp	-	x	-	-
Spotfin shiner	-	-	x	-
Steelcolor shiner	-	-	x	-
Common carp	-	x	x	x
Striped shiner	-	-	x	-
Silver chub	-	-	x	-
Golden shiner	-	-	x	-
Emerald shiner	x	x	x	-
Ghost shiner	-	-	x	-
Mimic shiner	-	-	x	-
Bullhead minnow	-	-	x	-
Northern hog sucker	x	x	x	-
Smallmouth buffalo	x	x	x	x
Bigmouth buffalo	-	-	x	-
Spotted sucker	x	x	x	x
Silver redhorse	-	-	x	-
River redhorse	x	x	-	-
Black redhorse	x	-	-	-
Golden redhorse	-	-	x	x
Shorthead redhorse	-	-	x	-
Black bullhead	-	-	x	-
Yellow bullhead	-	-	x	-
Brown bullhead	-	-	x	-
Blue catfish	x	x	x	x
Channel catfish	x	x	x	x
Flathead catfish	x	x	x	x
Blackstripe topminnow	-	-	x	-
Blackspotted topminnow	-	-	x	-
Western mosquitofish	-	-	x	-
Brook silverside	x	-	x	-
Inland silverside	-	-	x	-
White bass	x	x	x	x
Yellow bass	x	x	x	x
Hybrid striped x white bass	-	x	-	x

Table 3.10-1 Fish Species Collected in the Vicinity of BFN by TVA During BFN Monitoring and Reservoir Monitoring Activities, 1995-2000

Common Name	Fall 2000 Gill Net and Electrofishing TRM 292.5	Fall 2000 Gill Net and Electrofishing TRM 295.9	Cove Rotenone 1995-1997	Fall 1999 Gill Net and Electrofishing TRM 295.9
Striped bass	x	-	-	x
Redbreast sunfish	-	-	x	-
Green sunfish	-	-	x	-
Warmouth	-	x	x	-
Orangespotted sunfish	-	-	x	-
Bluegill	x	x	x	x
Longear sunfish	x	-	x	-
Redear sunfish	x	x	x	x
Hybrid sunfish	-	-	x	-
Smallmouth bass	x	x	x	-
Spotted bass	x	x	x	x
Largemouth bass	x	x	x	x
White crappie	-	-	x	-
Black crappie	-	-	x	-
Stripetail darter	-	-	x	-
Yellow perch	-	x	x	x
Logperch	x	x	x	-
River darter	-	-	x	-
Sauger	x	x	x	x
Freshwater drum	x	x	x	x

3.10.2 Benthic Organisms

As mentioned, BFN is located on Wheeler Reservoir, which TVA classifies as a Run-of-river reservoir. Run-of-river reservoirs typically have short water retention times (one to two weeks) and little winter drawdown. Benthic habitats in the reservoir range from deposits of finely divided silts to river channel cobble and bedrock. The most extensive benthic habitat is composed of fine-grained brown silt, which is deposited both in the old river channel and on the former overbank areas. The overbank areas, on either side of the old river channel, are far more extensive than the channel and are the most productive (TVA, 1972). These overbanks, located directly across from BFN, extend approximately 2 miles downstream. The overbanks support communities of Asiatic and fingernail clams, burrowing mayflies, aquatic worms, and midges. Cobble and bedrock areas, found primarily in the old channel, support Asiatic clams, bryozoa, sponges, caddisflies, snails, and some leeches. The Asiatic clam is nonindigenous to North America and is common in the Tennessee River system.

TVA began a program entitled Vital Signs monitoring to systematically monitor the ecological condition of its reservoirs in 1990. Benthic macroinvertebrates are included in Vital Signs monitoring because of their importance to the aquatic food chain, and because they have limited capability of movement, thereby preventing them from avoiding undesirable conditions. Since 1995, Vital Signs samples have been collected in the late fall/winter (November - December).

Depending on reservoir size, as many as three stations are sampled (i.e., inflow, transition, and forebay).

Benthic macroinvertebrate Vital Signs monitoring data are analyzed using metrics. The number of metrics has varied through the sample years as reservoir benthic analysis has been fine-tuned. The most recent analysis is comprised of nine metrics: taxa richness, EPT taxa, long-lived taxa, non-chironomid and oligochaete density, percent oligochaete, dominance, zero samples, non-chironomid and oligochaete taxa, and chironomid density. The number derived for each metric is totaled and the score is applied to a range of values that identify the overall condition of the benthic community (i.e., very poor, poor, fair, good, or excellent).

BFN is located a short distance downstream from the Vital Signs transition station on Wheeler Reservoir (TRM 295.5). The transition station is the zone considered to be between riverine (the inflow station) and impoundment habitats (the forebay station). Benthic community scores at the transition station ranged from "excellent" in 1994 to "good" in 1995 and "excellent" again in 1997 and 1999 (Dycus and Baker, 2000).

In addition to Vital Signs benthic macroinvertebrate monitoring, benthic community sampling in support of BFN thermal variance monitoring was begun in the fall of 2000 (and will continue at least for the term of the current permit cycle - five years). Station locations are TRM 296 and TRM 292, upstream and downstream of the BFN diffusers respectively. An analysis of the 2000 sample year data indicated the benthic community above BFN diffusers was in "excellent" condition and the community below the diffusers was in "good" condition (Dycus and Baker, 2001).

Freshwater mussel fauna are not assessed as part of TVA's Vital Signs program; however, they are excellent indicators of water quality due to their sessile nature and inability to avoid perturbations impacting water quality. Mussels feed on microorganisms (protozoans, bacteria, diatoms) and organic particles suspended in the water that are brought into the body via siphon action and consumed.

Thirty-eight freshwater mussel species had been documented in Wheeler Reservoir through 1991 (Ahlstedt and McDonough, 1992). Twelve species were identified in the vicinity of BFN during a 1982 survey for a proposed barge facility (Henson and Pryor, 1982). Most recently, Alabama Fish and Game identified 14 species upstream of BFN and 12 species downstream (Jeffrey T. Garner, Alabama Game and Fish Division Malacologist, personal communication 2001). A listing of these species appears in Table 3.10-2.

Table 3.10-2 Mussel Species Collected by Alabama Game and Fish Division Near Browns Ferry Nuclear Plant in 1999	
Common Name	**Scientific Name**
TRM 292, October 13-14, 1999	
Washboard	*Megalonaias nervosa*
Pink heelsplitter	*Potamilus alatus*
Threehorn wartyback	*Obliquaria reflexa*
Mapleleaf	*Quadrula quadrula*
Threeridge	*Amblema plicata*
Pimpleback	*Quadrula pustulosa*
Elephantear	*Elliptio crassidens*
Flat floater	*Anodonta suborbiculata*
Ebonyshell	*Fusconaia ebena*
Fragile papershell	*Leptodea fragilis*
Giant floater	*Pyganondon grandis*
Pistolgrip*	*Tritogonia verrucosa*
TRM 298, August 17 and October 20, 1999	
Washboard	*Megalonaias nervosa*
Pink heelsplitter	*Potamilus alatus*
Pimpleback	*Quadrula pustulosa*
Threehorn wartyback	*Obliquaria reflexa*
Threeridge	*Amblema plicata*
Elephantear	*Elliptio crassidens*
White heelsplitter	*Lasmigona complanata*
Pistolgrip	*Tritogonia verrucosa*
Purple waryback	*Cyclonaias tuberculata*
Mapleleaf	*Quadrula quadrula*
Butterfly*	*Ellipsaria lineolata*
Giant floater*	*Pyganodon grandis*
Pink papershell*	*Potamilus ohiensis*
Flat floater*	*Anodonta suborbiculata*

* = collected as dead shells

3.10.3 Introduced Species

The Asiatic clam (*Corbicula fluminea*) was first documented in the Tennessee River in 1959 below Pickwick Dam and has spread throughout the system (Sinclair and Isome, 1961). No recent data exist on the status of the Asiatic clam near BFN; however, specimens have been collected during Vital Signs monitoring.

A nonindigenous water flea, *Daphnia lumholtzi*, has been documented throughout the Tennessee River system (Tyler Baker, TVA biologist, personal communication 2001). It is therefore expected to occur in Wheeler Reservoir.

Zebra mussel reproduction is monitored at BFN weekly between April and October. Plankton net samples are collected from BFN's raw water system and the number of zebra mussel veligers per cubic meter of water entering the plant is estimated. The proportion of the veligers in samples that are of a size that could settle in the BFN raw water system is estimated. Data from these samples indicate that zebra mussel reproduction near BFN remains at a low level and that the zebra mussel should not pose a threat to the plant in the immediate future.

Grass carp have been introduced to reservoirs in the TVA system, both by individuals seeking to control heavy infestations of aquatic vegetation, and by TVA in Guntersville Reservoir. Grass carp have not been collected in high numbers; they were not included in cove rotenone samples taken through 1997, and have been taken infrequently in reservoir monitoring gill net and electrofishing samples (Table 3-10.1).

3.10.4 Entrainment and Impingement of Fish and Shellfish, Heat Shock

Fish eggs and larvae entrained in cooling water may suffer mortality from one or more physical effects of passage through the plant. Consequently, in conjunction with the construction of BFN, TVA investigated the preoperational characteristics and dynamics of the annual Ichthyoplankton populations in Wheeler Reservoir (TVA, 1978a). This investigation was continued through the initiation of commercial operation in 1974, and data from 1971-1977 were reported (TVA, 1978b); 1978 and 1979 data were also reported (TVA, 1980). These studies concluded that estimated plant entrainment under open-cycle, 3-unit operation would not add significantly to expected natural mortality of fish eggs and larvae in the reservoir (TVA, 1980); overall impingement did not appear to represent an adverse environmental impact to the Wheeler fish community (TVA, 1978b).

Response of fish and other aquatic life to elevated temperatures found in power plant discharges can range from acute, which includes immediate disability and death; to chronic or low level, which may include physiological or behavioral responses such as changes in spawning, migration, or feed behaviors. Since the discharge diffusers at BFN are located such that fish do not become trapped in areas of elevated temperatures, acute impacts are highly unlikely. TVA studies have documented that thermal releases from BFN have not had a significant impact on the aquatic community of Wheeler Reservoir (TVA, 1983, Baxter and Buchanan, 1998).

3.10.5 Microbiological Organisms

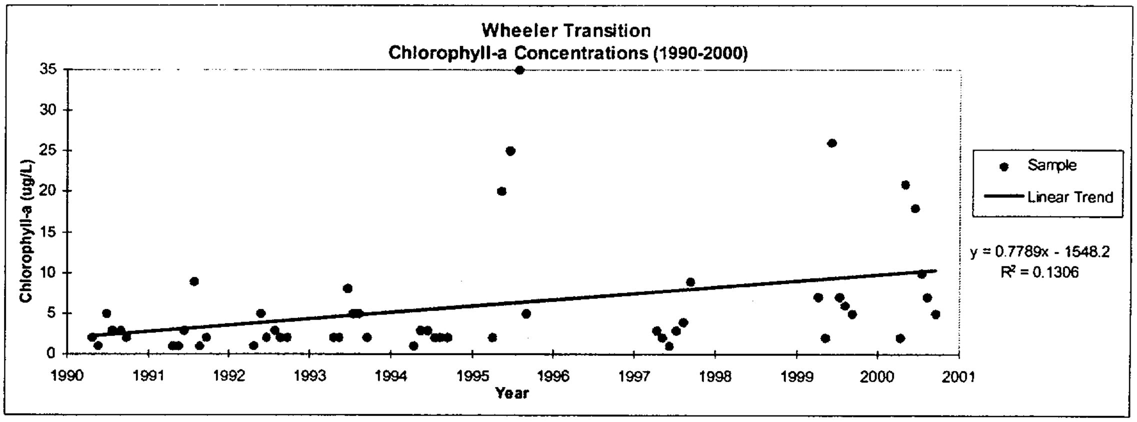
Plankton surveys were conducted during BFN preoperational monitoring in the early 1970s and have been a component of many BFN aquatic community surveys since then. The earliest phytoplankton surveys for Wheeler Reservoir found the assemblage to be quite diverse. As many as 27 Chrysophyta, 52 Chlorophyta, and 17 Cyanophyta taxa have been documented (TVA, 1977). Early zooplankton surveys documented a diverse assemblage as well, with 32 Dladocera, 24 Copepoda, and 47 Rotifera taxa represented (TVA, 1977). More recently, algal dynamics surveys were conducted in 1989 during plant shutdown and again in 1991 when the plant was operational as part of the approved BFN thermal variance monitoring program (Lowery and Poppe, 1992). The objective of this activity was to determine the effect the BFN thermal discharges would have on the phytoplankton community in Wheeler Reservoir. The study was initiated as a result of recommendations made during the operational monitoring reporting process for BFN.

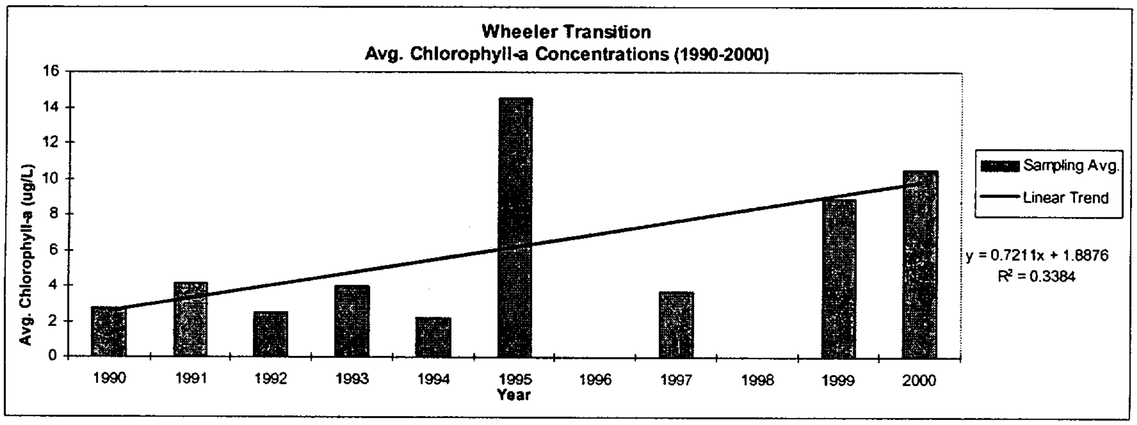
The validity of preoperational and operational BFN algal surveys conducted in the 1970s has been brought into question with advancements in reservoir limnology during the past 18 to 20 years. Considerable research and monitoring, conducted by TVA and others to evaluate phytoplankton/nutrient interactions in reservoirs has found that several factors must be considered to determine cause/effect relationships in reservoirs. These factors include flow-through conditions, overbank/embayment areas, residence time, zonation, and placement of point and non-point pollution sources (Lowery and Poppe, 1992). Erroneous results can occur when using annual "snapshot" surveys to analyze algal communities in reservoirs.

BFN preoperational and operational monitoring collections were typically conducted on an annual basis – once per summer. Vital Signs monitoring is conducted on a monthly schedule, April through September. Plankton data gathered during Vital Signs monitoring is believed to be more reliable. According to Lowery and Poppe (1992), the importance in sampling monthly lies in the fact that algal division rates are such that several generations can be missed in less frequent sampling and hence the chances for observing "boom or bust" situations increase as sampling frequency decreases. Unfortunately, abnormally high densities observed during operational monitoring may have been nothing more than chance collections, during peak densities just as lower numbers in other years may have been underestimates (Lowery and Poppe, 1992). If BFN is having a stimulatory or depressing effect on the plankton community in the near field, numbers should be significantly increased or decreased downstream of the plant in at least some habitats as compared to similar habitats. Examination of the 1989 and 1992 samples and the Vital Signs monitoring network data (far field) showed no consistent changes in either the near field or downstream (Lowery and Poppe, 1992). The only consistent observation that could be made from the 1989 and 1991 surveys and the Vital Signs monitoring data was that plankton communities vary on a daily basis regardless of location or habitat type.

Chlorophyll a is a simple, long-standing, and well-accepted measurement for estimating algal biomass, algal productivity, and trophic condition of a lake or reservoir (Carlson, 1977). Generally, lower chlorophyll concentrations in the oligotrophic range are thought to be indicative of good water quality conditions, and high chlorophyll concentrations are usually considered indicative of cultural eutrophication (Dycus and Baker, 2000). Average chlorophyll a concentrations (μg/L) recorded from Wheeler Reservoir's transition station between 1992 and 1999 are illustrated in Figure 3.10-1. Wheeler Reservoir's chlorophyll levels at the transition station, in the vicinity of BFN, received a "fair" rating in 1992 and 1994, a "good" rating in 1993, 1997, and 1999, and a "poor" rating in 1995 (TVA, 1993, 1994, 1995, 1996, 1998, Dycus and Baker, 2000). Low flow conditions in 1995 are believed to have allowed for longer water retention times in the reservoir contributing to increased algal production and a substantially lower score. For a detailed explanation of how chlorophyll a concentrations are translated into a rating, see Dycus and Baker (2000).

Figure 3.10-1 Chlorophyll a Concentrations from Wheeler Reservoir Transition Station, Vital Signs Monitoring 1990-2000





3.11 Threatened and Endangered Species

3.11.1 Animal

A review of TVA Regional Natural Heritage databases indicates that four federally or state-listed species of animals are reported from Limestone County (Table 3.11-1). No listed species are reported within 5 miles of the BFN.

Table 3.11-1 Rare Terrestrial Animal Species Known from Limestone County, Alabama

Common Name	Scientific Name	Federal Status	State Status
Gray Bat	*(Myotis grisescens)*	Endangered	Protected
Indiana Bat	*(Myotis sodalis)*	Endangered	Protected
Tennessee Cave Salamander	*(Gyrinophilus palleucus)*	none	Protected
Appalachian Bewick's Wren	*(Thryomanes bewickii altus)*	none	Protected

Federally listed endangered gray and Indiana bats are reported from caves along the Elk River. Gray bats are monitored at these caves annually by Alabama Department of Conservation Biologists. Gray bat populations appear to be stable at these sites. Indiana bats have not been reported from these caves in recent years. Although there are no suitable habitats for gray or Indiana bats on the BFN, gray bats likely forage along the Tennessee River adjacent to the project area.

State-listed Tennessee cave salamanders and Appalachian Bewick's wren have been reported from northern portions of Limestone County. No caves are known from the project area; therefore no suitable habitat for Tennessee cave salamanders exists on the site. Appalachian Bewick's wren prefers nesting in hedgerows or slash piles in early successional habitat. Limited amounts of this habitat exist on the site, however the quality of this habitat is considered marginal.

3.11.2 Aquatic

Five federally listed endangered aquatic species are known to occur in the vicinity of BFN. The rough pigtoe (*Pleurobema plenum*) and the pink mucket (*Lampsilis abrupta*) are freshwater mussels that historically occurred in silt-free, stable gravel and cobble habitats in large river habitats throughout the Tennessee River system (Parmalee and Bogan, 1998). These species are now extremely rare and are primarily found in unimpounded tributary rivers and in the more riverine reaches of the largely impounded mainstem Tennessee River. In Wheeler Reservoir, most of the surviving large river habitat occurs upstream of BFN. All recent records of these two species are from upstream of BFN (Ahlstedt and McDonough, 1993; Colaw and Carroll, 1982; El-Ashry and Lesene, 1979; Jeffrey T. Garner - State Malacologist - Alabama Game and Fish Division, personal communication 1998 and 2001; Gooch, et al., 1979; Henson and Pryor, 1982; TVA Regional Natural Heritage Database, 2001; Yokely, 1998). It is very unlikely that populations of these species exist in Wheeler Reservoir downstream of BFN (Koch, 1999).

Two aquatic snails, restricted to streams entering Wheeler Reservoir in Limestone County, Alabama, were recently listed as endangered by the U.S. Fish and Wildlife Service. The armored snail (*Pyrgulopsis pachyta*) and the slender campeloma (*Campeloma decampi*), as well as the previously listed Anthony's river snail (*Leptoxis* [=*Athearnia*] *anthonyi*), are restricted to tributary creeks to Wheeler Reservoir, located upstream from BFN. No evidence exists to suggest that populations of these species exist in Wheeler Reservoir downstream of BFN.

Other federally-listed species, such as the orange-footed pimpleback mussel (*Plethobasus cooperianusi*), the cracking pearly mussel (*Hemistena lata*), the fine-rayed pigtoe mussel (*Fusconaia cuneolus*), the shiny pigtoe mussel (*F. cor*), Snail darter (*Percina tanasi*), the slackwater darter (*Etheostoma boshungi*), the boulder darter(*E. wapiti*), and the Alabama blind cave shrimp (*Palaemonias alabamae*) are known to occur in the general North Alabama area (i.e., Limestone, Lawrence, and Morgan counties, Alabama). None of these species are presently known to exist within the area affected by the proposed actions.

3.11.3 Plants

A review of the TVA Regional Natural Heritage database indicates that no federally listed and five Alabama state-listed plant species are known from Limestone County, Alabama (Table 3.11-2). A more detailed review of TVA Heritage records indicates that none of these species, or any other rare plant species known from adjacent counties, are known to occur within five miles of the project area. In addition, field inspections of the project area reveal that suitable habitats for these or other rare plant species are not present on lands to be affected by the proposed activities.

Table 3.11-2 Rare Plant Species Known from Limestone County, Alabama

Common Name	Scientific Name	Federal Status	State Status†
Duck River bladderpod	*Lesquerella densipila*	none	NOST
Snow wreath	*Neviusia alabamensis*	none	NOST
Sweetflag	*Acorus calmus*	none	NOST
Toadshade*	*Trillium sessile*	none	NOST
Waterweed	*Elodea canadensis*	none	NOST

† NOST - Alabama Natural Heritage Program does not assign status codes to state-listed species; this designation indicates the species is tracked by the Alabama Natural Heritage Program due to its rarity in the state.

* This common name is often applied to more than one member of this genus.

3.12 Wetlands

Wetland resources in Alabama have suffered a marked decline as the result of channelization of major streams and the clearing of wetlands for agricultural and other purposes. Past land-use changes and stream channelization have resulted in the reduction of total wetland acreage, changes in wetland types, and diminished ecological integrity of many of the remaining wetlands throughout the region. Channelized streams result in less frequent flooding and allow rapid runoff and drainage of the floodplain and adjacent areas. The extensive areas of bottomland forested wetlands that occurred in the major stream bottoms prior to channelization and land clearing are largely absent from the landscape. Overall, Alabama sustained a net loss of 42,000 acres out of 2.7 million acres between 1974 and 1983. The greatest losses were due to the conversion of forested wetlands to non-wetland or other wetland types (Heffner, et al., 1994). Since 1983 wetland losses have slowed, although urbanization and impacts associated with transportation construction projects still impact wetlands in the state (Flynn, 2001).

WETLANDS IN THE PROJECT AREA

Wetlands in the vicinity of BFN are a mix of habitat types, including palustrine forested wetlands, scrub-shrub wetlands, and emergent wetlands associated with the mainstream of the Tennessee River/Wheeler Reservoir. These areas occur primarily along embayments of the main channel. There are also wetlands associated with various tributary streams in the project area, including Douglas Branch, Poplar Creek, Dry Creek, and Round Island Creek. Wetlands in these areas are generally confined to narrow strips of forested or scrub-shrub wetlands along the stream channel, and many have been reduced both in extent and function due to clearing and channelization associated with agricultural activities.

National Wetland Inventory (NWI) maps indicate small areas of palustrine emergent and scrub-shrub wetlands occur within the boundaries of BFN, and in the areas proposed for disposal of spoil materials associated with construction. A field survey verified the presence of a palustrine emergent wetland within the boundaries of an excavated unnamed stream channel draining agricultural fields at the northeast boundary of the plant boundary. This area is within the plant boundaries, but not within the areas proposed for disturbance. Vegetation consists of soft rush (*Juncus effusus*), blunt spike rush (*Eleocharis obtusa*), and fescue (*Festuca* spp.). The NWI also indicates a palustrine emergent/scrub-shrub wetland in low-lying agricultural area in the northeast boundary of the plant, in an area proposed for spoil disposal. However, a field survey indicated that this area has been excavated and cleared by agricultural activities to the extent that wetland characteristics are absent from this area.

3.13 Socioeconomic Conditions

3.13.1 Demography

Estimated 2000 population in Limestone County is 65,676, an increase of 21.3% since 1990 and 57.5% since 1970. This growth is much faster than the labor market area, the state, or the nation. The labor market area includes Colbert and Lauderdale Counties (Florence Metropolitan Area), Lawrence County, Madison County (Huntsville), and Morgan County (Decatur). Total population in the labor market area in 2000 was 631,193, an increase of 13.5% since 1990 and 40.1% since 1970, higher than the state and slightly higher than the national growth rate.

The population of Limestone County is projected to reach more than 80,000 by 2015, with a labor market population of over 748,000 at that time. These projections are based on a continuation of growth rates experienced over the last 3 decades, except for Colbert County, which is projected to continue the growth turnaround experienced since 1990.

Table 3.13-1 Population and Population Projections						
	1970	1980	1990	2000	2010	2015
Limestone Co.	41,699	46,005	54,135	65,676	74,831	80,762
Colbert Co.	49,632	54,519	51,666	54,984	58,515	60,365
Lauderdale Co.	68,111	80,546	79,661	87,966	95,133	98,799
Lawrence Co.	27,281	30,170	31,513	34,803	37,405	38,881
Madison Co.	186,540	196,966	238,912	276,700	313,143	335,444
Morgan Co.	77,306	90,231	100,043	111,064	126,346	134,093
LMA	450,569	498,437	555,930	631,193	705,373	748,344
Alabama (000)	3,444.4	3,894.0	4,040.4	4,447.1	4,816.5	5,014.0
U.S. (000)	203,302.0	226,545.8	248,790.9	281,421.9	311,318.1	328,413.3

Source: Historical data from U. S. Department of Commerce, Bureau of the Census. Projections by TVA.

Table 3.13-2 Population Growth Rates				
	1970-2000	1990-2000	2000-2010	2000-2015
Limestone Co.	57.5	21.3	13.9	23.0
Colbert Co.	10.8	6.4	6.4	9.8
Lauderdale Co.	29.2	10.4	8.1	12.3
Lawrence Co.	27.6	10.4	7.5	11.7
Madison Co.	48.3	15.8	13.2	21.2
Morgan Co.	43.7	11.0	13.8	20.7
LMA	40.1	13.5	11.8	18.6
Alabama (000)	29.1	10.1	8.3	12.7
U.S. (000)	38.4	13.1	10.6	16.7

3.13.2 Economic Conditions

Limestone County had a total labor force of 29,524 persons on average during 2000, while the labor force in the labor market area was almost 316,000. The unemployment rate in the labor market area was 3.9%, below the state average and slightly below the national average. Limestone County, itself, had a lower rate of unemployment, 3.3%, well below the state average. These rates of unemployment meant that almost 1,000 persons in Limestone County and over 12,000 in the labor market area were unemployed.

Table 3.13-3 Labor Force and Unemployment, 2000			
	Civilian Labor Force	Number Unemployed	Unemployment Rate
Limestone Co.	29,524	971	3.3
Colbert Co.	25,531	1,606	6.3
Lauderdale Co.	41,381	2,258	5.5
Lawrence Co.	16,703	906	5.4
Madison Co.	145,450	4,101	2.8
Morgan Co.	57,195	2,338	4.1
LMA	315,784	12,180	3.9
Alabama	2,154,273	99,092	4.6
U.S. (000)	140,863	5,655	4.0

Source: Alabama Department of Industrial Relations, Employment Security Division, and U. S. Department of Labor, Bureau of Labor Statistics.

The number of jobs in Limestone County has more than doubled since 1970, reaching a total of 29,035 jobs in 1999. This 1999 level is 6.8% higher than in 1990. Growth since 1970 has been faster than the labor market area, the state, and the nation. However, since 1990 the rate of growth was much slower than the labor market area, the state, or the nation. On the other hand, as discussed above, population grew faster since 1990 as well as over the longer term. This suggests that over the last several years, Limestone County has become more of a bedroom community to Huntsville as its growth has continued to spread toward the west.

The labor market area grew more slowly from 1990 to 1999 than did the state and the nation, although it grew more rapidly than either during the overall time period since 1970.

Limestone County is more dependent on manufacturing, government, and farm employment than the labor market area, the state, or the nation and less dependent on trade and services employment. The labor market area has an industrial distribution similar to that of the state as a whole, although it is slightly more dependent on manufacturing. The state as well as the labor market area is more dependent on manufacturing and less on trade and services employment than is the nation as a whole.

Based on the population projected above and on the TVA forecasts of employment for the TVA Power Service Area, employment in Limestone County is expected to be around 41,000 at the time of current license expiration, and close to 58,000 by the time a 20-year license extension would expire. The labor market area is projected to exceed 434,000 jobs and 535,000 jobs, respectively, by these dates.

Table 3.13-4 Total Employment (Full-time and Part-time), by Place of Work						
	1970	1980	1990	1999	Percent Change, 1970-99	Percent Change, 1990-99
Limestone Co.	14,056	18,300	27,188	29,035	106.6	6.8
Colbert Co.	25,045	29,775	28,594	29,039	15.9	1.6
Lauderdale Co.	20,518	29,126	36,579	42,978	109.5	17.5
Lawrence Co.	7,289	8,905	11,445	12,102	66.0	5.7
Madison Co.	93,110	108,507	165,710	192,297	106.5	16.0
Morgan Co.	34,144	42,699	54,151	64,397	88.6	18.9
LMA	194,162	237,312	323,667	369,848	90.5	14.3
Alabama	1,412,924	1,735,999	2,061,914	2,409,612	70.5	16.9
U.S. (000)	91,281.6	114,231.2	139,426.9	163,757.9	79.4	17.5

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

Table 3.13-5 Projected Total Employment, 2015 and 2035					
	1999	2015	2035	Percent Change, 1999-2015	Percent Change, 1999-2035
Limestone Co.	29,035	41,469	58,013	42.8	99.8
Colbert Co.	29,039	32,294	36,931	11.2	27.2
Lauderdale Co.	42,978	51,879	61,519	20.7	43.1
Lawrence Co.	12,102	19,047	23,497	57.4	94.2
Madison Co.	192,297	215,961	262,638	12.3	36.3
Morgan Co.	64,397	73,470	93,004	14.1	44.4
LMA	369,848	434,120	535,602	17.4	44.8

Source: Projections by TVA.

Table 3.13-6 Percent Distribution by Industry Employment (Full-time and Part-time), by Place of Work, 1999						
	Total	Farm	Manufac-turing	Trade and Services	Govern-ment	Other
Limestone Co.	29,035	7.7	22.4	37.6	20.3	12.1
Colbert Co.	29,039	3.3	15.7	42.6	20.4	18.0
Lauderdale Co.	42,978	5.1	16.8	48.1	16.9	13.1
Lawrence Co.	12,102	16.4	21.1	29.8	14.0	18.7
Madison Co.	192,297	1.7	15.4	51.6	19.3	12.0
Morgan Co.	64,397	3.2	23.6	43.6	11.8	17.8
LMA	369,848	3.4	17.8	47.3	17.7	13.8
Alabama	2,409,612	3.5	15.7	47.2	16.0	17.6
U.S.	163,757.9	3.2	11.8	52.5	13.6	18.9

Note: Percentages may not add to 100 due to rounding.
Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System.

Per capita income in both Limestone County and the labor market area declined relative to the state and the nation between 1989 and 1999. In 1989, per capita income in Limestone County was 79.3% of the national average, but in 1999 the percentage had declined to 74.6%; in the meantime, the state had grown slightly relative to the nation. In a similar pattern, per capita income in the labor market area was 90.6% of the national average in 1989, but only 85.8% in 1999. None of the counties in the labor market area had average income above the national average in 1999, although Madison County did in 1989. Both Madison and Morgan Counties had average incomes higher than the state average in 1999, as well as in 1989.

Table 3.13-7 Per Capita Personal Income

	Per Capita Personal Income, 1989	Per Capita Personal Income, 1999	Percent of Nation, 1989	Percent of Nation 1999
Limestone Co.	14,714	21,294	79.3	74.6
Colbert Co.	14,260	22,550	76.8	79.0
Lauderdale Co.	14,587	21,036	78.6	73.7
Lawrence Co.	11,952	20,691	64.4	72.5
Madison Co.	19,223	27,049	103.5	94.8
Morgan Co.	16,858	24,585	90.8	86.1
LMA	16,812	24,498	90.6	85.8
Alabama	14,899	22,972	80.2	80.5
U.S.	18,566	28,546	100.0	100.0

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

3.13.3 Community Services and Housing

Limestone County is a fast-growing county and a part of the Huntsville metropolitan area. As such, it has experienced relatively fast growth in housing and in the provision of government and other local services. It is also adjacent to the central metropolitan counties of Madison (Huntsville), Morgan (Decatur), and Lauderdale (Florence). These counties have well-developed community services and housing markets. Schools, fire and police protection, and medical services have all been exposed to growth and change in their communities in recent years, as have the local housing markets.

3.13.4 Environmental Justice

Minority population in Limestone County and in the labor market area is a smaller share of the total than in the state or the nation. Limestone County has a minority population of 11,534, some 17.6% of the total, while the labor market area has a minority population of 139,362, some 22.1% of the total. Poverty levels in both Limestone County and in the labor market area as a whole are below the state average. For the labor market area as a whole, the poverty rate is also lower than the national average, while the rate in Limestone County is about the same as the national average.

Table 3.13-8 Minority Population, 2000, and Percent Below Poverty Level, 1997				
	Total Population	**Minority Population**	**Percent Minority**	**Percent Below Poverty Level**
Limestone Co.	65,676	11,534	17.6	13.5
Colbert Co.	54,984	10,514	19.1	13.5
Lauderdale Co.	87,966	10,726	12.2	13.3
Lawrence Co.	34,803	7,904	22.7	15.7
Madison Co.	276,700	80,204	29.0	11.0
Morgan Co.	111,064	18,480	16.6	11.4
LMA	631,193	139,362	22.1	12.1
Alabama	4,447,100	1,321,281	29.7	16.2
U.S.	281,421,906	86,869,132	30.9	13.3

Source: U.S. Bureau of the Census

BFN is located in Census Tract 211, not far from Census Tract 204.01. According to the 2000 Census of Population, 35.0% of the population in Tract 211 and only 8.6% of the population in Tract 204.01 is minority.

3.14 Transportation

3.14.1 Highways and Roads

The site is located approximately 10 miles southwest of Athens in northern Alabama in Limestone County and is located just south of U.S. Highway 72, which runs from South Pittsburg, Tennessee, west to Memphis, Tennessee. The site is directly accessible from County Road 25. County Road 25 (Shaw Road) intersects U.S. 72 approximately 6 miles north of the site. County Road 25 (Nuclear Plant Road) also intersects U.S. Highway 31 approximately 9 miles east of the site. U. S. Highway 31 intersects U.S. Highway 72 northeast of the site. Browns Ferry Road to County Road 25 just east of the site provides a more direct route to the site from Athens. U.S. Highway 72 and U.S. Highway 31 are both high quality four-lane routes with good lane widths, alignments, turning lanes, and speed limits of 50 miles per hour (mph) through Athens and increasing away from the city. County Road 25 and Browns Ferry Road are medium quality two lane roads with level alignment, some passing zones, and speed limits of 45 mph. Direct accessibility into the plant facility off County Road 25 is good. The large diamond intersection at one entrance allows for smooth turning movements into and out of the plant. Another access road into the plant commonly used by contractors utilizes a traffic light at the intersection with Nuclear Plant Road.

The primary traffic generator in the vicinity of the site is the nuclear plant. BFN currently averages a daily site population of approximately 1,200 persons. The population currently peaks at approximately 2,000 persons during outages, which occur every 24 months (per unit) for approximately 2 months. Current truck deliveries are minimal (less than 10 per week) and include hydrogen trucks, Calgon water chemistry trucks and occasional diesel fuel deliveries during peak months. Rural residences located along the county roads that provide access to the site are also traffic generators in the area.

Figure 3.14-1 shows a map of the local road network for the area. The latest available 1998 Average Daily Traffic (ADT) counts in close proximity to the site indicate approximately 13,440 vehicles per day (vpd) on U.S. Highway 72 north of the site and 16,260 vpd on U.S. Highway 31 south of U.S. 72. There are no available traffic counts on the county roads; however TVA estimates approximately 1,600 vpd on Shaw Road, Browns Ferry Road, and Nuclear Plant Road.

3.14.2 Railroads

Direct rail access does not serve BFN. A railway spur track and unloading area is located off the CSX mainline which runs north and south in Tanner, Alabama, approximately 8 miles east of BFN. TVA leased this small parcel of land from CSX (Louisville and Nashville Railroad) and used it for offloading during construction of the plant; however, TVA has not used this area for offloading and transporting materials to the plant since then. After offloading, heavy items were transported on heavy trucks via a "hardened" pathway to the site that included shallow fords through creek beds along the way. At the site itself a short railroad spur runs into the turbine building for transport into the plant.

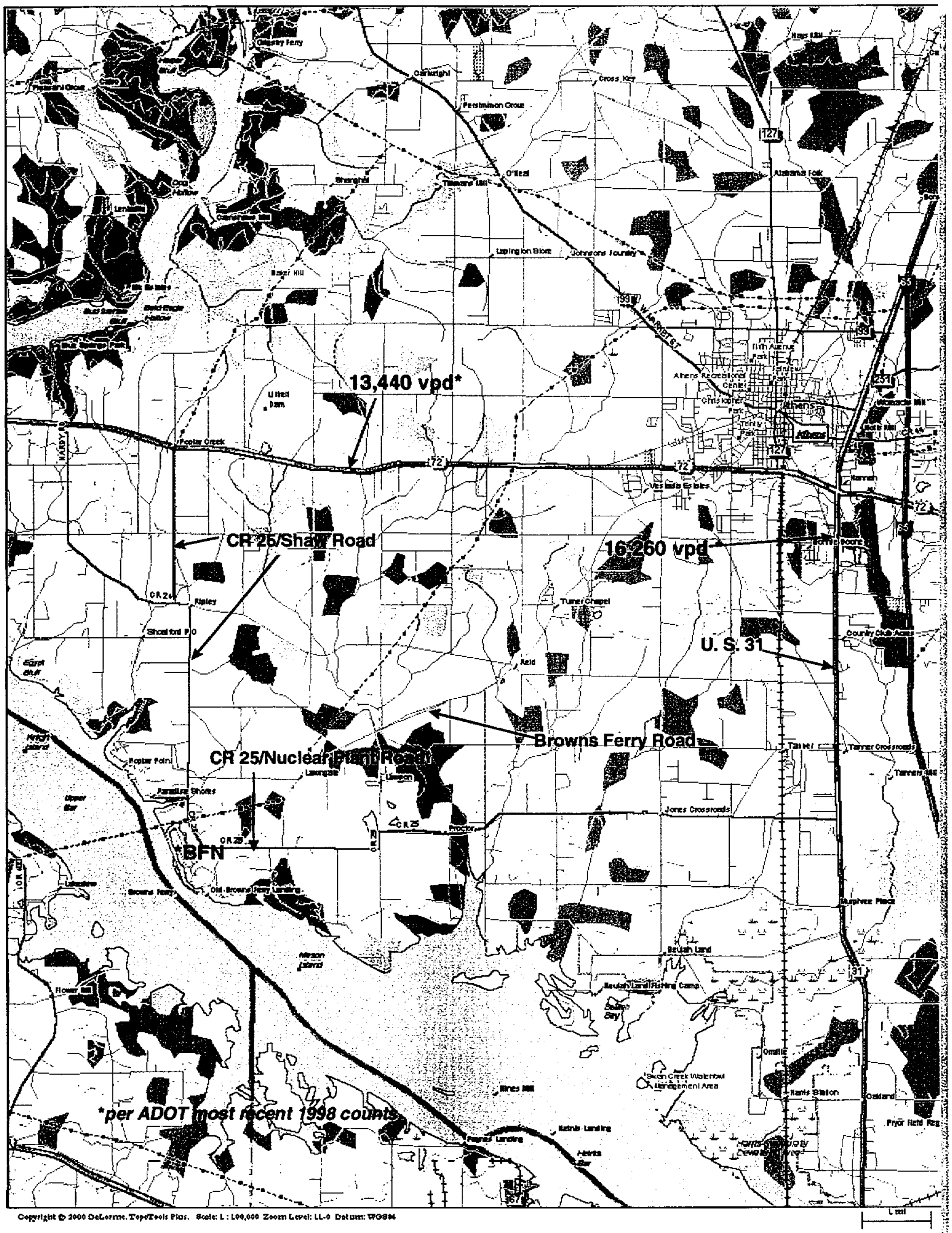
The railroad spur track and unloading area is currently planned for future removal off site of dry cask spent fuel storage canisters. There are no plans to use it for Unit 1 refurbishment or regular plant operations.

3.14.3 River Transport

BFN is located along the Tennessee River at approximately TRM 294. Guntersville Lock and Dam are located 55 miles upstream from the site and Wheeler Lock and Dam are located 20 miles downstream from the site. Traffic on the Tennessee River near BFN includes both commercial and recreational vessels. The locks and channels are more than adequate in handling river traffic. Both Guntersville Lock and Wheeler Lock are operating below their utilization capacity.

BFN has a qualified barge facility near the northwest corner of the site. Currently it consists of barge tie points and a wide ramp going down into the water. The ramp was used during initial plant construction for very heavy loads such as reactor vessels. The barge facility is currently used several times per year, but each usage requires a temporary crane. The roadbed from the plant to the barge facility is "hardened" for heavy loads. Future work is contemplated to upgrade the barge facility by stabilizing the riverbank and installing anchoring cells and a permanent dock (so that the facility will no longer require use of a temporary crane). An upgraded barge facility could eventually be used to transport spent fuel canisters offsite for disposal in a national repository. The barge facility would likely be used for some heavy items during Unit 1 refurbishment; however, this upgrade is independent of any decision on refurbishing Unit 1. Appropriate environmental analyses would be done if TVA decides to propose upgrading the barge facility.

Figure 3.14-1 Local Road Network for BFN



3.14.4 Pipelines

Three pipelines pass within five miles of the center of the BFN plant site. One is an 8-inch line carrying xylene at a maximum pressure of 175 pounds per square inch (psi); it runs north and south and passes about 2.4 miles east of the plant. The other two carry natural gas in a common right-of-way about 3.8 miles south-southwest of the plant. They run generally east-west. One line is 8-inch and the other 12-inch and both have a maximum pressure of 600 psi.

The only pipeline crossing the BFN site boundary is a 10-inch potable water line from the Athens Water District. There are no plans to install or connect to any pipelines in the foreseeable future.

3.14.5 Transmission Lines

The BFN is connected into the TVA system network by seven 500-Kilovolt (kV) lines. One line is to Madison substation, two to Trinity substation, one line each to the West Point, Maury, and Union substations, and one line to the Limestone 500-kV Substation. Any three lines excluding more than one Trinity line can transmit the entire station output into the TVA system network.

Normal station power is from the unit station service transformers connected between the generator breaker and main transformer of each unit. Startup power is from the TVA 500-kV system network through the 500- to 20.7-kV main and 20.7- to 4.16-kV unit station service transformers. Auxiliary power is available through the two common station service transformers that are fed from two 161-kV lines supplying the 161-kV switchyard, one line each from the Athens and Trinity substations.

3.15 Soil and Land Uses

3.15.1 BFN Environs

Limestone County is part of the Highland Rim section of the Interior Low Plateaus physiographic province. It is comprised of three physiographic subdivisions: The Limestone Valleys, the Plateau, and the Alluvial Plains. The Limestone Valleys, locally called the red lands, include the southeastern part of the county. The Alluvial Plains include the nearly level to undulating first bottoms and stream terraces along the Tennessee and Elk Rivers. BFN is located in the Limestone Valleys and Alluvial Plains (USDA, 1953).

The soils that have developed in the Limestone Valleys and Alluvial Plains are inherently productive for growing crops. Those that developed from high-grade limestone originally contained a relatively high quantity of organic matter, and the depth of soil over bedrock is 15 to 20 feet in most places. Drainage is good and the acidity is moderate. The alluvial soils are fairly well supplied with lime, organic matter, and plant materials, which provide fertility needed to obtain high crop yields (USDA, 1953).

There are about 279,229 acres (73.5%) of soils in the county classified as prime and/or statewide important farmland (USDA-NRCS, 1979). These are soils that have the chemical and physical properties to economically sustain high yields of crop production.

Soils comprising the majority of the region immediately surrounding the BFN and including the site are Abernathy, Cumberland, and Decatur soils. Phases of these soils that occur on slopes less than 6% are classified as prime farmland. The Abernathy soils have developed from colluvial material washed from surrounding soils of high-grade limestone. This well-drained soil occupies mainly basins or depressions. The Cumberland soils are located on the river and stream banks and have developed from alluvium material washed from soils underlain by limestone and to a small extent by shale and sandstone. This soil is well adapted to cultivated crops because of its fertility and physical characteristics. The Decatur soils have developed from residual material weathered from high-grade limestone of the Tuscumbia formation. It is well suited for cropping and is one of the most extensively cropped soils in the county. (USDA, 1953).

Most of the soil on the BFN site was disturbed when the plant was constructed and is no longer considered as prime farmland. The entire site is classified as urban built-up land.

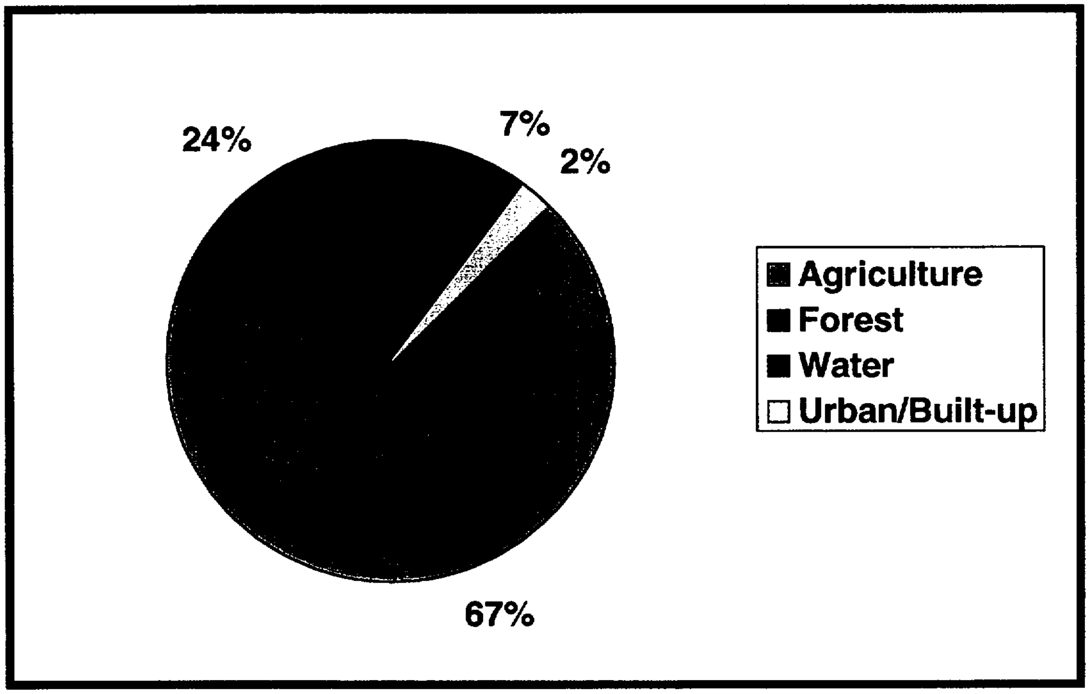
3.15.2 Past and Existing Land Uses (Including Offsite)

BFN is located in an agricultural area, surrounded by cropland planted with cotton. About 66.8% of the total acreage in the county is used for agriculture, the highest in Alabama (Figure 3.15-1). There are an estimated 78,900 acres (23.9%) of land in forest. The majority of the forestland is located in the northern two-thirds of the county. Trends show that land used for forest has been declining since the early sixties. During the sixties, thousands of acres were cleared for agriculture and other land uses associated with population growth (Limestone County Comprehensive Plan, 1985). Cropland has increased from 166,841 acres in 1987 to 181,292 acres in 1997 (USDA-NRCS).

Limestone County is ranked first in Alabama for the most cotton grown. In 1999, 69,200 acres of cotton were harvested, a total production yield of 79,000 bales. There were 6,400 acres of corn harvested, 16,500 acres of soybeans, 10,000 acres of wheat, and 24,000 acres of hay. Agriculture Census data for the county lists crop production cash receipts at $31,614,000. Livestock and poultry receipts were $21,905,000. Agriculture is, and will continue to be, a major economic component in the county.

From the 1994 EPA land use database (Figure 3.15-1); only about 2% of the county is urban built-up land. The current trend in population growth will promote a larger amount of land to become urbanized. Population growth for Limestone County from 1980 to 1990 was 17.7%. Athens City had a population increase of 17% from 1990 to 1998. These trends are attributable to the increased employment opportunity in the county as well as in nearby Huntsville and Decatur. During the last part of the 1980's, unprecedented growth in industrial employment occurred in each of the four outlying counties. Madison County also added thousands of new manufacturing jobs, but the change was most noticeable in the predominantly rural counties, such as Limestone. This trend in Limestone County suggests that a new era of economic development has already begun. Most of the residential development is occurring in the eastern portion of the county in the Capshaw French Mill area. There is also a significant number of new dwellings in the Browns Ferry Road area. It is expected that the majority of residential growth will occur around the City of Athens and the Elkmont Village area (Limestone County Comprehensive Plan, 1985). Development of commercial property is rapidly occurring in the area of intersection of Highway 72 and U.S. 65 and along the Highway 72 corridor to Huntsville.

Figure 3.15-1 Land Use in Limestone County



Source: EPA 1994

3.15.3 Land Use Planning and Controls

Limestone County, as part of Top of Alabama Regional Council of Governments, developed a Comprehensive Plan in 1985 to cover the period to year 2000 (Limestone County Comprehensive Plan, 1985). The vision of the Plan includes goals for land use, community facilities, transportation, and a capital improvements program and budget. The Plan has not been updated, but the same vision is reflected in the "Vision 2000, Strategic Agenda" document prepared by the Limestone County Vision 2000 Quality Council in March 2000.

The goal of the Land Use Plan was to achieve a balance among various land uses to accommodate a diversity of total life styles which will fulfill the requirements of county residents. The Plan has three objectives. The first is to promote a variety of housing types and a high level of efficiency in residential development patterns. The second is to promote the spatial distribution of various land uses that will result in a compatible relationship of land use activities. The third objective is to provide land for a wide variety of employment opportunities for the residents. The implementation of these objectives would provide utilities, services, and transportation to achieve the desired land use developments.

3.16 Visual Resources

The physical, biological, and cultural features seen in the landscape give a geographic area its distinct visual character and sense of place. Varied combinations of these elements make the visual resources of an area identifiable and unique. Scenic integrity indicates the degree of intactness, unity, or wholeness of the visible landscape. Aesthetic considerations include scenic beauty, scale, contrast, harmony, color, density, noise, and other qualities that affect the sense of place. Views of the affected landscape are described in terms of foreground, middleground, and background distances. Foreground is considered the area within a half-mile of the observer where details of objects are easily distinguished in the landscape. Middleground is the zone between foreground and background, normally between a mile and four miles from the observer. The objects may be distinguishable, but their details are weak and they tend to merge into larger patterns. Background is the distant part of the landscape, where objects are not normally discernible unless they are especially large and standing alone. Details are generally not visible and colors are lighter.

BFN is located off of County Road 25 (Nuclear Plant Road) approximately twelve miles south of Athens, Alabama. The site is surrounded to the north and east by rural countryside. It includes open pasturelands, scattered farmsteads, few residents, and little industry within several miles. The terrain is gently rolling with open views to higher elevations to the north. Little traffic is seen along the roadway except at plant shift changes and during deliveries. The south and west side of the plant site abuts Wheeler Reservoir, which is a wide expanse of open river used for an array of recreational purposes. Elevations across the plant site and in the surrounding areas rise gradually from 558 feet above sea level at the north shore of Wheeler Lake to around 800 feet above sea level 10 miles north in the vicinity of Athens. The average elevation of the plant site is 575 feet above sea level. Scenic integrity is moderate, contrasting occasionally with homes that have lake views from across the river.

Access to the plant site is from Browns Ferry Road to County Road 25 from State Route (SR) 72 in Athens. The 600-foot high off gas stack comes into view over existing tree lines while traveling along Browns Ferry Road. Closer to the plant site, near County Road 25, the plant site comes into view. The site has remarkable contrast to the mostly rural countryside that surrounds it. From this viewpoint, clusters of transmission lines and associated steel pole and tower structures can be seen in the foreground and near middleground. These features identify the power plant and its associated architecture and infrastructure as predominately industrial facilities with little transition from rural countryside.

There are no homes within foreground viewing distance to the north and east. However, there is a small residential development to the northwest, across Wheeler Reservoir southwest, and Mallard Creek public use area that has partial views of the plant site. The views from the homes northwest off of County Road 25 are of the existing mechanical draft cooling towers (approximately 60 feet in height), a portion of the 500-kV switchyard and the turbine and reactor building. A berm, graded during the initial construction of the plant site and containing approximately 3.3 million cubic yards of earth, lies adjacent to the hot and cool water channels and blocks views of the northern and eastern plant areas. The homes to the southwest and from the Mallard Creek area have views of the off gas stack, the cooling towers, and the turbine and reactor building. These views may be somewhat obscured in the early morning hours, particularly in the fall and winter, as heavy fogs rise from the warmer waters of the lake.

3.17 Recreation

There are no developed public recreation facilities located at the BFN site. Located directly across the Tennessee River from the site is Mallard Creek Recreation Area. This is a TVA-developed and operated area. It includes camping, picnicking, swimming beach, and a boat launch area. Approximately 3.5 miles upstream of BFN is Round Island Recreation Area also developed and operated by TVA. It features facilities for camping, swimming, picnicking and boat launching. The reservoir in the vicinity of the plant site is moderately utilized by recreational boaters and fishermen.

Two managed areas are known to occur within three miles of the site. These areas have been recognized and are protected, to varying degrees, because they contain unique natural resources, scenic values, or public use opportunities. These areas are owned by TVA and presently managed by the Alabama Department of Conservation.

SWAN CREEK STATE WILDLIFE MANAGEMENT AREA

This wildlife management area includes over 3,000 acres of land and over 5,000 acres of water surrounded by numerous industrial facilities. Wooded lands and grassy pastures, occasionally interrupted by railroad tracts and transmission lines, provide one of the most important waterfowl management areas in the state of Alabama. Although the primary management focus is for waterfowl and small game hunting, this area is becoming increasingly important for migrating bird species. In addition, the area is increasingly utilized by bird watchers and other outdoor enthusiasts.

MALLARD-FOX CREEK STATE WILDLIFE MANAGEMENT AREA

Encompassing approximately 700 acres of land and 1,700 acres of water this wildlife management area is primarily utilized for small game hunting.

3.18 Cultural Resources

3.18.1 Archeological Resources

HISTORIC BACKGROUND OF THE PROJECT AREA

<u>Prehistoric Period</u>

Archaeological research has indicated prehistoric human occupation in north central Alabama has occurred from the Paleo-Indian to the Mississippian period. Archaeological periods are based on changing settlement and land use patterns and artifact styles. In Alabama, prehistoric chronology is divided 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 further broken down into sub-periods (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 (12000-8500 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 hunter/gatherers. Following the Paleo-Indian period, the Archaic period (8500-1200 B.C.) continued to represent a hunter/gatherer lifestyle. An increase in social complexity and the appearance of horticulture characterized the later part of 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 (1200-400 B.C.) when pottery first appears in north central Alabama. The Early Gulf Formational Period is a transitional period from the Late Archaic during which there is a continuance of Archaic Period settlement patterns but there are also influences from the Gulf Coastal area to the south. The Gulf Formational period in the lower Tennessee Valley begins with the Middle Gulf Formational period and is associated with Wheeler series, fiber-tempered pottery. The Late Gulf Formational Phase is associated with Alexander series, fiber- and sand-tempered pottery, and correlates with Early Woodland Period cultures elsewhere. Increased social complexity, reliance on horticulture and agriculture, and a continuation and fluorescence of ceramic technology characterize the Woodland Period (600 B.C. - 1000 A.D.). The increased importance of horticulture is associated with a less mobile lifestyle as suggested by semi-permanent structures. Residential base camps were located on flood plains and alluvial terraces with specialized procurement sites in the adjoining uplands. The Middle Woodland Period is classified by various Colbert and Copena components. The Late Woodland is associated with the Flint River and Baytown cultures. The Mississippian Period (A.D. 900-1700), the last prehistoric period in north central Mississippi, is associated with the pinnacle of social complexity in the Southeastern United States. In north central Alabama this period is characterized by permanent settlements, maize agriculture, and chiefdom level societies.

Historic Period

The Historic Period is represented by the settlement of Europeans, Euro-Americans, and African-Americans in the region and the subsequent removal of Native American tribes. The first recorded European encounter with Native American groups in northern Mississippi by Europeans was Hernado de Soto's expedition in 1540. Continued expeditions into the area by French, Spanish and English traders and explorers occurred during the 16th, 17th, and 18th centuries. Clashes between the native Creeks and Europeans continued through the 18th century. By the early 19th century, the Creeks were defeated by Jackson and forced to surrender their lands and leave the area. The first permanent Euro-American settlements occurred in the early 19th century and the area was predominately occupied by Euro-Americans and African-Americans. Subsistence and cotton farming characterized the region from the Antebellum period to the early 20th century. Industrialization and urbanization has characterized the region in the late 20th century.

TVA is mandated, under the National Historic Preservation Act (NHPA) of 1966, to protect significant archaeological resources and historic structures located on land affected by TVA undertakings. NHPA Section 106 [16 U.S.C. 470f] requires Federal agencies prior to taking action that implements an undertaking to:

1) Take into account the effects of their undertaking on historic properties; and

2) Afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment regarding such undertaking.

The State Historic Preservation Office (SHPO) serves as a proxy to the ACHP and consultation has been initiated with the Tennessee SHPO concerning the project alternatives and any potential affect to historic properties.

The determination that an action is an undertaking does not require knowledge that historic properties are present. An agency determines that a given proposal is an undertaking based solely on that proposal's inherent ability to directly or indirectly affect historic properties. The area of potential effects (APE) for an undertaking is usually defined for archaeological resources as any area where facilities would be situated and for historic structures as any area from which those facilities would be visible.

At the initiation of this proposal, TVA Cultural Resources staff considered the nature of the undertaking and determined that the project had the potential to affect historic properties should those be present in the area. The APE for archaeological resources was determined as the three areas designated as soil disposal or spoil pile locations. The APE for historic structures was determined as those areas from which the disposal locations would be visible.

A Phase I survey was conducted at the three disposal site/spoil pile locations. This survey identified two historic properties. The survey of Area 1 (see Figure 2.2-7) identified a prehistoric archaeological site with an Early to Middle Woodland occupation. This site is considered potentially eligible for listing in the National Register of Historic Places. Cox Cemetery was identified in Area 2. This cemetery was relocated during the initial construction of the BFN. No historic properties were identified in Area 3.

3.18.2 Historical Structures

An architectural survey was conducted within the visual APE of the proposed project area. No historic structures were identified.

3.19 Environmental Noise

3.19.1 Introduction

Areas that are potentially affected by environmental noise from typical industrial operations are usually within a mile radius of the noise source(s). Sometimes effected areas can reach to 2 miles under special conditions that are favorable to outdoor sound propagation. This evaluation is primarily concerned with the potential environmental noise effects of the addition and replacement of cooling towers in Alternatives 2A, 2B, and 2C. Although there are only a couple of residences within the one-mile radius of the center of the main-plant building, there are many residences within a mile of the cooling tower area. Also, within 2 miles is the Lakeview community across the river. The open path across water is favorable to sound propagation toward Lakeview. The following sections present a more detailed description of the potentially affected areas; the regulations, standards, and guidelines concerning environmental noise; the possible effects that environmental noise might have on people; and the current noise environment in the area.

3.19.2 Potentially Affected Areas

As anticipated, there has been substantial change in the character of some of the areas surrounding BFN subsequent to the release of the original EIS. Generally, the number of residences and population along the waterfront have increased and the industrial activity on and along the river has also increased.

Upstream and adjacent to the BFN property are new developments of waterfront homes. (Pointe Westmoreland and Lookingbill subdivisions). There are about 40 residences along approximately 4,400 feet of riverfront. The nearest house is within 100 feet of the BFN property line on the east side. These residences are more than a mile from the closest cooling towers 1 and 6, and there is a small hill and the main plant in between this residential area and the cooling towers. Also, there are no favorable conditions for sound propagation in this direction. For these reasons, this residential area is not considered sensitive to environmental noise.

Downstream and adjacent to the BFN property and adjacent to cooling tower area is an older waterfront community, Paradise Shores. This area had few residences in-place when the plant was built, and it is currently a mix of year-around and recreational homes. There are about 100 residences within one mile of the closest cooling towers, and some are as close as 1,500 feet. Paradise Shores is a medium to high density suburban area. This is an area that could be sensitive to environmental noise.

The Lakeview community is across the river and approximately 8,500 feet from the center of the cooling tower area. It is primarily year-around homes with a few recreation residences. Most of these were built after BFN was constructed. As mentioned in the Introduction, this area could be sensitive to environmental noise because of the favorable sound propagation characteristics across water.

The areas northeast of BFN are still agricultural as they were when the plant was built. There are no residential developments within a mile of the cooling tower, and these areas are not considered sensitive to environmental noise.

3.19.3 Noise Regulations, Ordinances, Guidelines, and Other Useful Criteria

Generally, environmental noise regulations, ordinances, guidelines, and other criteria are set for two reasons. First, to protect the existing residents from the potential impact of new noise sources; and second, to protect new residents from the existing noise sources. The guidelines from the U.S. EPA found in its "levels" document (EPA, 1974) and most municipal noise ordinances (Gatley, 1979) address the first reason. Also, the Federal Interagency Committee on Noise (FICON, 1992) recommends using potential noise impact analysis as a criterion in possible mitigation of sensitive areas when siting airports. Whereas, guidelines from the U.S. Department of Housing and Urban Development (HUD, 1983) and the Federal Interagency Committee on Urban Noise (FICUN), a predecessor to Federal Interagency Committee on Noise (FICON), (FICUN, 1980) concentrate on the second reason to protect new residents from moving into an incompatible noise environment.

The guideline from EPA recommends an average annual equivalent sound level day/night (DNL) of 55 dBA to protect the health and well being of the public with an adequate margin of safety. Guidelines and recommendations from HUD and FICUN also use DNL as their measurement metric and give tables of compatible use categories based on the existing DNL levels. For example, both HUD and FICUN use 65 DNL as their upper limit for acceptable residential development without added noise reduction construction. FICON also uses DNL as its metric.

There are no Federal, State of Alabama, or local municipal noise standards, regulations, or ordinances that apply to the action alternatives evaluated in this SEIS.

TVA uses the EPA guideline of 55 dBA DNL as a design goal when feasible if the nearest receptor is residential, and the equivalent sound level (L_{eq}) of 60 dBA at the property line in industrial and commercial areas. In addition, TVA uses the FICON (FICON, 1992) recommendation that a 3 dB increase indicates possible impact and the need for further analysis when the background DNL is 60 dBA or less. These guidelines were developed and published since the original BFN EIS. At that time, TVA used the HUD guideline of 65 dBA DNL (HUD, 1971) as normally acceptable for adjacent residential areas.

3.19.4 Potential Effects of Environmental Noise

3.19.4.1 Hearing Loss

Exposure to high noise and sound levels can cause hearing loss. The Occupational Safety and Health Administration (OSHA) regulates noise exposure in the workplace and EPA gives guidance for exposure to environmental noise to prevent hearing loss. For environmental noise, EPA recommends an average annual exposure limit of 70 dBA equivalent sound level for 24 hours [L_{eq}(24)] over 40 years to prevent hearing loss (EPA, 1974). The Occupational Safety and Health Administration (OSHA) exposure standard is 90 dBA for 8-hour exposure over a working lifetime (OSHA, 1984).

3.19.4.2 Annoyance and Complaints

Along with the physical, hearing loss response from exposure to prolonged, high levels of environmental noise, there can be annoyance and complaints from the disturbance of social and personal activities caused by moderate levels of environmental noise exposure. Noise can interfere with communications, relaxation and sleep, and concentration. In the FICON analysis of noise effects, annoyance was identified as the summary of the general adverse reactions that people have to noise. Specifically, it states that the best measure of this adverse response is the percentage of the effected population that is characterized as "highly annoyed as a function of DNL (FICON, 1992). FICON recommends using the updated "Schultz curve" to define the relationship between highly annoyed and DNL. The Schultz curve relationship was originally recommended by EPA in its 1982 guidance document (EPA, 1982), and it was updated by the U.S. Air Force Armstrong Laboratory (FICON, 1992). The updated relationship is:

$$\%\ \text{Highly Annoyed} = \frac{100}{1 + e^{[11.13-0.141(DNL)]}} \qquad \textbf{Eq. 3.19-1}$$

This relationship is shown in Table 3.19-1 in tabular form below.

Table 3.19-1 Percentage Highly Annoyed Based on DNL

DNL, dBA	40	45	50	55	60	65	70	75	80	85	90
Percent Highly Annoyed	0.4	0.8	2	3	6	12	22	36	54	70	83

The discussion in the FICON document goes on to state that complaints are not an absolute measure of the impact of environmental noise on a community. It explains that annoyance can exist without complaints and the converse is also possible.

3.19.4.3 Communication Interference

Sentence intelligibility is one method of determining communication interference when background or intruding noise is broad spectrum. This is usually the case when there are multiple noise sources. In the EPA "levels" document (EPA, 1974), it estimates that there is 99% sentence intelligibility for normal voice communications when the background noise is 54 dBA or less and 100% at 45 dBA or less. This correlates very well with another presentation found in Harris (Harris, 1991) that shows that "just-reliable" normal voice communication can occur at background noise levels as high as 58 dBA when the speaker and listener are 1 meter apart.

Typical residential construction provides about 20 dB of noise reduction from the outside to the inside with the windows closed. This is factored into the FICUN category of "compatible" at 65 dBA DNL to give an indoor level of 45 dBA or less (FICUN, 1980) in the minimal or moderate noise exposure zones. A 20 dB noise reduction for residential construction also falls within the range of noise reduction given by EPA (EPA, 1974). The HUD guidelines state that common building construction will make the indoor noise environment acceptable when the DNL is 65 dBA or less. In higher noise exposure zones, residential structures need to be constructed with higher noise reduction to prevent potential communication interference.

3.19.5 Current Noise Environment

The current noise environment is different than prior to the construction and operation of BFN. Since that time, the residential population adjacent to BFN has grown (see section 3.19.2), the industrial park about 2 miles upstream and across the river has expanded, and barge traffic has increased. All of these have some effect on the noise environment. The background noise measurements presented in the original BFN EIS are not applicable to the action alternatives evaluated in this SEIS. The environmental noise evaluation of these action alternatives is concerned with the potential effects of additional cooling tower(s) and the replacement of the current cooling towers which operate during the peak of the summer. The original background noise was measured in November, 1971. A 24-hour background noise survey was conducted June 11-12, 2001, in the Paradise Shores and Lakeview communities. The survey location at Paradise Shores was about 1,500 feet from cooling tower 3 along its major axis. In Lakeview, the survey location was in a vacant lot in the center of the community. The 15 hour daytime (0700-2200) average noise was 45.7 dBA, and the 9 hour nighttime average was 43.1 dBA at Paradise Shores and 44.1 dBA and 38.7 dBA at Lakeview. Predominant noise sources were typical of suburban life, and included traffic, lawn mowing, home air-conditioning units, and children. At night, insects, frogs, air-conditioning, and traffic were dominant, although Lakeview had less traffic because of a posted restriction.

A daytime noise survey of 3 of the current operating cooling towers was conducted July 30, 2001. Towers 2, 3, and 5 were operating, and these are the towers closest to Paradise Shores. The noise from the towers was audible at 1,500 feet in the Paradise Shores area, but it was not audible in the Lakeview Community. Measurements were taken at the same location in Paradise Shores as the background measurements, and another set of measurements was taken at 520 feet off the northwest end of tower 3 inline with the Paradise Shores measurement location. The total noise in Paradise Shores was 45.8 dBA, and at 520 feet it was 47.6 dBA. Based on the 520-foot measurements, the calculated intruding noise from the cooling towers at the 1,500-foot location in Paradise Shores is 38.4 dBA. By adding this calculated intruding noise to the daytime background noise level measured in June, the calculated total noise level is 46.4 dBA, which is similar to the total noise measurement of 45.8 dBA. The operation of towers 1 and 6 would cause a negligible increase, less than 1 dB to the total noise in Paradise Shores because the towers are an additional 1,800 feet away and partially blocked by other towers. Also, operating a cooling tower of similar design at the number 4 tower location would add about 3 dBA to the intruding noise and about 1 dBA to the total noise in Paradise Shores.

Noise from the 3 operating cooling towers was not detectable in the Lakeview community on the day of the survey. The calculated intruding noise from the current towers would be 38 dBA based on measured data taken broadside to the towers on July 30. This intruding noise is about 6 dBA less than the daytime background noise level taken in June.

These measured and calculated noise levels, along with the number of operating days of the cooling towers, can be used to calculate the average annual DNL. In the past five years when both BFN units 2 and 3 operated, the cooling towers ran an average of 17 days per year. The range of operating days was from 7 to 27 during this time and included 12-hour start-up and 12-hour shutdown periods. The measured and calculated intruding noise at Paradise Shores, 1,500 feet from the current cooling towers, is about 42 dBA, and the 24-hour and average annual DNLs are 52 and 50 dBA, respectively. At the Lakeview community across the river, the intruding noise from the cooling towers is not detectable, but the calculated intruding noise is 38 dBA and the 24-hour and average annual DNLs are 48 and 46 dBA, respectively. The maximum average annual DNL for the largest number of operating days, 27, is 50 dBA at Paradise Shores, and 46 dBA at Lakeview. These levels assume that all cooling towers operated the entire periods. Frequently, fewer towers operated which makes these calculated levels the maximum. Table 3.19-2 presents the current noise levels at Paradise Shores and Lakeview communities.

Table 3.19-2 Current Noise Environment*					
Location	Background Leq	Total Leq	DNL 24 hrs	Ave. Annual DNL 17 days op.	Ave. Annual DNL 27 days op.
Paradise Shores	45	47	52	50	50
Lakeview	43	44**	48**	46**	46**

*All data are dBA.

**Noise from current operating cooling towers was not detectable, these are calculated values.

3.20 Public and Occupational Safety & Health (Non-Radiological)

3.20.1 Site Safety and Health Plan

The TVA nuclear work force has achieved recordable injury rates that are among the lowest in the utility industry. Employees are required to be trained in the safe handling of chemicals that they use in the work environment. Additionally, numerous other safety-related training courses are conducted to respond to OSHA requirements for workers. Operation and construction (i.e., refurbishment and restoration) activities are required to meet or exceed Federal regulatory requirements for safety design, inspection and OSHA regulations. BFN has a 24-hour fire and rescue staff that are Certified Emergency Medical Technicians (EMTs). Emergency medical response procedures are outlined in various Rad/Chem and Emergency Preparedness procedures. Professional medical treatment and testing is available on site with a permanent medical staff that includes a physician. The TVAN Safety and Health Manual contains requirements designed to assure that management administers a strong safety program.

Included in the Safety and Health Manual are provisions for:

Personal protective equipment use,
Safety training requirements for workers,
Accident reporting and investigative requirements,
Hazard communication and right to know,
Heat stress management,
Confined spaces,
Electrical work practices,
Use of chemicals,
Industrial hygiene,
Lead and asbestos abatement,
Fall protection, and
Job safety planning

Employees are trained in applicable safety procedures and methods prior to the start of work at the facility.

3.20.2 TVA's Employee Safety Program

There exists the potential for workers to be exposed to health and safety hazards while constructing and operating the facilities. Construction activities are conducted in accordance with OSHA Construction Industry Standards (29 CFR 1926). All other activities are conducted in accordance with OSHA General Industry Standards (29 CFR 1910) and OSHA Federal Safety and Health Program Requirements (29 CFR 1960). These standards establish practices, chemical and physical exposure limits, and equipment specifications to preserve employees' health and safety. Standards and requirements also apply to TVA contractors and vendors. Contractor operations are monitored to ensure operations are conducted in a safe and healthful manner and that they meet contract requirements.

The TVA Hazard Communication Program ensures that Material Safety Data Sheets (MSDSs) are available and appropriate labels are visible to employees for all products to which they might be exposed in the course of their workday.

TVA's Safety and Occupational Hygiene Program is designed to help the agency conduct its operations in a manner which protects the safety and health of employees. The Safety and Occupational Hygiene Program, headed by a Designated Agency Safety and Health Official (DASHO), defines the activities necessary to prevent on-the-job accidents and occupational illnesses and diseases. This program is implemented by a joint effort among TVA's managers, labor organizations, and employees with guidance and assistance from the DASHO and a professional staff. The program's highlights include:

Workplace Standards - Standards, work rules, and other practices developed by regulatory agencies and by TVA provide employees direction on safe work practices and working conditions.

Job Safety Planning - All jobs undertaken are planned by those involved in sufficient detail to ensure that hazards are identified and eliminated or controlled to an acceptable level.

Training - Each organization provides for job training to improve the safety knowledge and skills of employees and enable them to perform their jobs in a safe and healthful manner.

Employee Involvement - TVA's success in protecting people and property from accidental harm depends on the involvement of all employees in its safety program. Employees are actively involved in the development and implementation of workplace standards and other program activities to minimize unsafe acts and conditions through participation on safety and health committees and through interaction with management and fellow employees.

Workplace Inspection Monitoring and Audits - Workplaces are regularly inspected and monitored to ensure that they meet regulatory and agency requirements. Regular audits assess the effectiveness of inspection and monitoring programs as well as activities to prevent accidents and illnesses. These audits provide the feedback necessary to ensure control of workplace hazards and keep efforts focused on continuous improvement.

Accident Reporting and Investigation - All accidents are reported and investigated by management. Investigations address the following elements:

- Root causes are identified,
- Corrective action to prevent future accidents is recommended,
- Accident data is analyzed for trends to help direct future safety program efforts, and
- Information is shared throughout TVA to support the accident prevention efforts to other organizations.

3.20.3 Fire Protection

BFN has a Fire Protection Plan which is applicable to all activities at or related to BFN which could affect the life or health of TVA employees or the public, the probability or severity of potential fires throughout the plant, or the ability to maintain safe plant shutdown, or limit radioactive release to the environment in case of fire. To assure that the program functions properly and to meet the requirements of 10 CFR 50.48, a Fire Protection Plan has been developed for BFN. The Fire Protection Plan is incorporated into the UFSAR by reference as recommended in NRC Generic Letter 86-10. This document is the sole source for fire protection program commitments at BFN. The Fire Protection Plan contains the current fire protection commitments that affect the Fire Protection Program. The Fire Protection Plan is revised, as required, to reflect all new commitments that affect the BFN Fire Protection Program.

The objectives of the Fire Protection Plan are achieved through the integration of fire protection into the design, construction, operation, and maintenance of the plant and equipment; by fire prevention techniques; and by providing appropriate fire detection and suppression features and fire rated compartmentation. This is known as a defense-in-depth concept, which employs multiple levels of safety measures to attain the required high degree of safety. In addition, the defense-in-depth approach includes the proper administrative controls necessary to maintain program integrity.

The BFN fire protection systems are designed to provide automatic fire protection for known hazardous areas where it is practical to do so, to provide adequate warning of fire in hazardous areas where automatic protection is not feasible, to provide adequate manually-actuated fire protection systems for the entire plant and yard areas (i.e., hose stations, hydrants, etc.) and to ensure the maintenance of divisional integrity of safety-related systems to the extent that the capability for safe shutdown of the reactors is assured during and after a fire. The common parts of the BFN fire protection systems are the high pressure water subsystem (supplies sprinkler/spray systems and fire hose stations), the low pressure carbon dioxide subsystems (used in plant areas with flammable oil and electrical hazards), the fire detection/annunciation and protective action initiation systems, and the compartmentation and fire retardant systems.

Fire prevention is an important part of the overall BFN Fire Protection Plan. The primary objective of the fire protection activities is to prevent fire from occurring. The plant fire prevention program consists of identification, evaluation, and control of fire hazards. Administrative controls have been established to control both combustibles and ignition sources to the greatest extent possible. Procedures have been established to minimize fire hazards and fire protection impairments in areas containing structures, systems, and components important to safety and to maintain the performance of the fire protection systems and personnel. NFPA guidelines have been used as a basis for these procedures.

Effective handling of fire emergencies is an important aspect of the BFN defense-in-depth Fire Protection Program. This is accomplished by the provision of a trained and qualified emergency response organization, the fire safety awareness of all plant employees, a comprehensive pre-fire plan, safe shutdown procedures, and the ability of the operations personnel to perform such procedures.

3.20.4 Electric and Magnetic Fields

TVA recognizes there is public concern about whether any adverse health effects are caused by electric and magnetic fields (EMF) that result from generation, transmission, distribution, and use of electricity. Many scientific research efforts and other studies examining the potential health and other effects of EMF have been and are being done. TVA is aware of, and ensures that is stays aware of, published research and study results and directly supports some of the research and study efforts.

Studies, interpretations, and research to date are not conclusive about potential associations between electric or magnetic fields and possible health impacts. A few studies have been interpreted by some as suggesting a weak statistical relationship between magnetic or electric fields and some form of rare cancer. However, equal numbers of similar studies show no association. The present weight of this type of evidence does not allow any conclusion and does not indicate a cause and effect relationship between fields and health effects. No laboratory research has found such a cause and effect adverse health impact from EMF, and no concept of how these fields could cause health effects has achieved scientific consensus.

TVA's standard for siting new transmission lines has the effect of minimizing public exposures to EMF during their operation.

3.20.5 Shock Hazards

Shock hazards are produced mainly through direct contact with conductors and have effects ranging from a mild tingling sensation to death (NRC, 1991). The transmission line towers associated with the BFN Plant are designed to preclude direct public access to the conductors. However, secondary shock currents are produced when persons contact capacitively charged objects (such as vehicles parked near a transmission line) or magnetically linked metallic structures (such as fences near a transmission line). Shock intensity depends on the strength of the electric field, the size and location of the object, and the ground insulation. Design criteria that limit hazards from steady state currents are based on the National Electrical Safety Code (NESC), which requires that transmission lines are designed to limit the short-circuit current to ground produced from the largest anticipated vehicle to less than 5 milliamperes (NRC, 1991). TVA's design ensures that the transmission lines meet the requirement given in NESC (TVA, 1994b). Therefore, the impact of shock hazards and EMF exposure are minimal, as a result of operation of the BFN Plant.

3.20.6 Airborne Pathogenic Microorganisms

Some thermophilic microorganisms associated with cooling towers and thermal discharges can have deleterious impacts on human health. These microorganisms include the enteric pathogens *Salmonella* sp. and *Shigella* sp., as well as *Pseudomonas aeruginosa* and thermophilic fungi. Methods of testing for these microorganisms are known and their presence in aquatic environments is often controllable. Other microorganisms normally present in surface water, but not as easily detected or controlled, include the bacteria *Legionella* sp. (which causes Legionnaires' disease) and the amoebae of the genera *Naegleria* and *Acanthamoeba*, which causes a rare but very serious human infection, primary aerobic meningoencephalitis (PAME) (NRC, 1991).

Legionella sp. has been found in the aerosols in the vicinity of condensers or cooling tower basins that were in the process of being cleaned. Two reported cases of infections related to *Naegleria* sp. that were associated with the cleaning of cooling towers have been reported (NRC, 1991). For this reason, utilities that identify microorganisms that are responsible for PAME in the cooling tower often require respiratory protection for workers in the vicinity of the cooling towers and condensers.

The potential health effects from *Naegleria* sp. at sites such as the BFN site, located on rivers with average flow rates less than 2,830 cubic meters per second (100,000 cubic feet per second), are a public health concern (NRC, 1991). These microorganisms occur in surface water where the risk of infection is always present. Increases in average water temperature due to weather or climatic conditions, or from the discharge of heat, may cause an increase in the levels of the microorganisms. Information obtained by TVA in discussions with the Centers for Disease Control and Prevention indicated that to contract primary amoebic meningoencephalitis from *Naegleria* sp., large doses of cyst-contaminated water must enter the nasal mucosa area. A few cases have been reported in swimmers from Texas and the Carolinas during the past few years; however, these were not associated with aerosol cysts from power plant cooling towers (TVA, 1994g). The Tennessee Department of Health was not aware of any cases for which either *Legionella* sp. or *Naegleria* sp. was associated with cooling towers in Tennessee (TVA, 1994b). TVA concludes that the operation of the BFN plant has not resulted, and is not likely to result, in adverse effects to human health as a result of the presence of these microorganisms.

3.20.7 Hazardous Chemicals

Table 3.20-1 lists the hazardous chemicals in storage for use at BFN along with their storage location. All of the hazardous chemicals at BFN are either stored inside plant buildings, or are equipped with secondary containment to contain the chemicals in the event of a spill. None of the chemicals stored onsite exceeds the quantity limitations that would require preparation of a Risk Management Plan under 40 CFR Part 68.

In accordance with State and Federal Regulations, BFN has developed a Spill Prevention, Control and Countermeasure (SPCC) Plan that includes spill response assignments and responsibilities, best management practices for controlling and managing oil and chemical storage, and contingency plans in the event of an incident.

BFN has an onsite Hazardous Materials Response Team that is trained and certified to respond to, contain, and clean up oil and hazardous chemicals that may be released. In addition, BFN has the necessary supplies and equipment onsite to control chemical releases, and has arrangements in place for outside assistance in the event of a serious incident.

BFN maintains Material Safety Data Sheets for all hazardous chemicals onsite, and operates a Chemical Traffic Control (CTC) Program to control the use and distribution of chemicals on the site.

Implementation of the alternatives discussed in this EIS would not result in significant differences in the amounts or types of hazardous chemicals stored or used at BFN on an annual basis. All chemicals proposed for use on-site are reviewed and approved for use through the CTC program.

Table 3.20-1 Chemical Storage by Area							
Drainage[a] Area	Location	Substance	Physical State	Maximum Storage[b]	Storage Vessels	Secondary Confinement	
						Type	Percent of Maximum Storage Capacity
4	Hazardous Waste Storage Building	waste solvents, waste acid, and waste caustic, spent fluorescent lighting	liquid	825	drums (15)	Floor drain sump	91
1	Intake	sodium hypochlorite	liquid	5,700	tank (1)	Concrete wall and floor	>100
		Calgon H-940 (sodium bromide)	liquid	5,700	tank (1)	Concrete wall and floor	>100
		Calgon CL-50 (sodium hexametaphosphate)	liquid	1,600	tank (1)	Double-walled tank	100
		Calgon PCL-401 (anionic copolymer)	liquid	1,600	tank (1)	Double-walled tank	100
		Calgon H-300 (glutaraldehyde)	liquid	300	bin (1)	Plastic pan	>100
		Calgon EVAC (molluscicide)	liquid	300	bin (1)	Plastic pan	>100
1	Offgas Building	ethylene glycol	liquid	15,000	tanks (3)	Building sump	>100
1	Modifications Area						
	• Oil Rack	methyl ethyl ketone	liquid	165	drums (3)	Metal pans	>100
		mineral spirits	liquid	385	drums (7)	Metal pans	>100
		ethylene glycol	liquid	110	drums (2)	Metal pans	>100
	• Paint Shop	paints, epoxies, and resins	liquid	1,500-2,000	1- and 5-gallon cans	None	-
1	• Materials Procurement Complex (MPC-B3B	hydrazine (35%)	liquid	165	drums (3)	None	-
	(BFN-1)	paint thinners	liquid	770	drums (14)	None	-
	(MPCJ)	boric acid	granular	3,425 lbs.	bags (35)	Not applicable	-
1	Reactor Building	aqueous film-forming foam	liquid	900	tank (3)	Floor drain sump	>100
		sodium nitrite (30%)	liquid	5	tank (1)	Floor drain sump	>100
		sodium pentaborate (9.2%)	liquid	4,850	tank (2)	Floor drain sump	>100

Table 3.20-1 Chemical Storage by Area

Drainage Area[a]	Location	Substance	Physical State	Maximum Storage[b]	Storage Vessels	Secondary Confinement	
						Type	Percent of Maximum Storage Capacity
4	Mixed Waste Storage Area	waste solvents, waste acids, and waste caustic, waste lead paint chips	liquid solid	3,465	drums (63)	Floor drain sump	65
1	• Service Building • • Paint Room • Power Stores						
		paint	liquid	100	cans (40)	None	
		ethylene glycol	liquid	165	drums (3)	None	
		mineral spirits	liquid	660	drums (12)	None	
		thinner	liquid	330	drums (6)	None	-
		sodium nitrite	solid	360 lbs.	plastic bags or jars	Not applicable	-
	Thinner Rack (near Service Building)	thinners	liquid	330	drums (6)	None	_
1	Turbine Building	sodium hypochlorite	liquid	8,530	tank (1)	Containment diking	>100
		Calgon PCL 401 (anionic copolymer)	liquid	1550	tank (1)	dike	>100
		Calgon CL 50	liquid	4400	tank (1)	dike	>100
		Calgon EVAC	liquid	300	bin (1)	plastic pan	>100
		Calgon H-300	liquid	300	bin (1)	plastic pan	>100
		Calgon H-940	liquid	1550	tank (1)	dike	>100
							>100
		hydrazine (0.1%)	liquid	125	reservoirs (1)	Floor drain collector tank	>100
		hydrazine (35%)	liquid	55	drum (1)	Metal pan	>100
		ammonium hydroxide (50 ppm)	liquid	125	tank (1)	Floor drain collector tank	>100

[a]There are no chemicals of concern stored in drainage areas 2 and 3.
[b]Units are gallons unless otherwise stated.

3.20.8 Site Emergency Response Plan

BFN has a Radiological Emergency Plan (REP) which addresses organizational responsibilities, capabilities, actions and guidelines for TVA during a radiological emergency. However, the REP is also designed to be implemented based on a variety of situations that could potentially adversely affect the operations of a TVA nuclear plant such as BFN. In addition to radiological emergencies, these include natural events, chemical spills, toxic gas releases, fires, plant operational problems, etc., which may pose a threat to the safe operation of the plant and have a potential impact offsite. The REP is described in Section 3.21.3.

3.21 Radiological Impacts Baseline

3.21.1 Normal Operations

3.21.1.1 Occupational

Occupational radiological impacts refer to radiation dose received by individuals in the course of their employment. Section 4.3.21.1.1 contrasts the current industry and facility occupational radiation dose trends against the current limits established by federal regulation to minimize the potential health risk to individual workers. At BFN, the average annual dose to workers and the average collective worker dose per reactor are consistent with current industry trends for this type of reactor (boiling water reactor) and worker radiation exposures are controlled to be significantly less than regulatory limits.

3.21.1.2 Public

Commercial nuclear power reactors, under controlled conditions, release small amounts of radioactive materials to the environment during normal operation. These releases result in radiation doses to humans that are small relative to doses from natural radioactivity. Nuclear power plant licensees must comply with NRC regulations (e.g., 10CFR Part 20, Appendix I to 10 CFR Part 50, 10 CFR Part 50.36a, and 40 CFR Part 190) and conditions specified in the operating license.

The BFN Offsite Dose Calculation Manual (ODCM) provides the methodology used to calculate offsite doses based on gaseous and liquid effluent releases from the plant. These releases are reported in BFN's annual radioactive effluent release report. The ODCM specifies the parameters used to calculate potential offsite doses due to radioactive liquid and gaseous effluents and to ensure compliance with the following limits:

- The concentration of radioactive liquid effluents released from the site to the unrestricted area will be limited to levels that meet regulatory requirements.
- The exposure to any individual member of the public from radioactive liquid effluents will not result in doses greater than the design objectives of 10 CFR Part 50, Appendix I.

- The exposure to any individual member of the public from radioactive gaseous effluents will not result in doses greater than the design objectives of 10 CFR Part 50, Appendix I.
- The dose to any individual member of the public from the nuclear fuel cycle will not exceed the limits in 40 CFR Part 190 and 10 CFR Part 20.
- The dose rate from radioactive gaseous effluents at any time at the site boundary will be limited to:
  (a) less than or equal to 5 mSv/yr (500 millirem per year (mrem/yr) to the whole body and less than or equal to 30 mSv/yr (3,000 mrem/yr) to the skin for noble gases, and
  (b) less than or equal to 15 mSv/yr (1,500 mrem/yr) to any organ for iodine-131 and -133, tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days.

BFN's recent operating experience has shown that doses from gas and liquid effluents are a small fraction of the applicable radiological dose limits.

TVA has conducted a Radiological Environmental Monitoring Program (REMP) since 1973 to assess the impact of BFN operations on the surrounding environs and the general public. The purpose of the REMP is to:

- Provide verification that radioactive material released to the environment as a result of plant operations and the ambient environmental radiation levels attributable to plant operations are within the NRC regulatory limits and the U.S. Environmental Protection Agency environmental radiation standards in 40 CFR Part 190.
- Provide for the assessment of any measurable buildup of long-lived radionuclides in the environment.
- Monitor and evaluate ambient environmental radiation levels.
- Determine if plant operations results in any statistically significant increase in the concentration of radionuclides in the environs of the plant site.

The REMP conducted for BFN is designed to monitor the primary pathways for exposure to humans. The BFN REMP includes measurement of direct radiation levels and collection and analysis of various sample types. Monitoring for the liquid pathway includes samples of fish, shoreline sediment and water from the Tennessee River. The airborne pathway is monitored by direct sampling for air particulates and gaseous radioiodine and sampling of milk, soil, and food crops that could be affected by the deposition of airborne radionuclides.

The results from the REMP are reported in the Annual Radiological Environmental Operating Report (AREOR). The data reported in the BFN AREOR demonstrate that the small amounts of radiological effluents released to the environment due to the operation of BFN have had no measurable impact on the environs around BFN.

Estimated doses to the maximum exposed member of the public due to radiological effluent releases from BFN are calculated on an annual basis. These dose values have consistently been very low, typically only a small fraction of applicable limits. For example, the maximum calculated whole body dose for liquid releases in 1999 was 0.037 mrem/year or 1.2% of the applicable limit. The maximum organ dose equivalent from gaseous effluents in 1999 was 0.04 mrem/year which represented 0.3% of the limit.

There are also no significant changes to the radiological effluent releases anticipated as a result of BFN operations over the current license period.

3.21.2 Facility (Design Basis) Accidents

The BFN Updated Final Safety Analysis Report (UFSAR) Chapter 14 addresses several design basis accidents such as Loss of Coolant Accident (LOCA), Main Steam Line Break (MSLB), Control Rod Drop Accident (CRDA), and Fuel Handling Accident (FHA). Since the design basis accidents are independent of the age of the plant, the extension of the lifetime operation of the plant from 40 years to 60 years will not impact the analysis of these accidents. This conclusion applies to all BFN units.

The originally licensed maximum thermal power level for the BFN units was 3293 megawatt thermal (MWt). The current analyses in Chapter 14 address BFN operation at the present 5% uprated power level of 3458 MWt. EPU at 120% of the originally licensed maximum thermal power level will affect accident analysis because the power level influences the radioactive isotope inventories and releases. All analyses will be re-performed at EPU power levels, and the plant will conform to all regulatory requirements prior to implementation of EPU.

Extension of the plant life from 40 years to 60 years will impact equipment qualification (EQ) of safety related equipment. The total integrated radiation doses will generally increase by 50%. However, the BFN 10 CFR 50.49 (EQ) program will ensure that all safety related equipment will be qualified to operate in its intended environment so as to perform its intended function. Any equipment that cannot withstand the full 60-year life of the plant will be replaced on a predetermined maintenance schedule as part of the 10 CFR 50.49 program. At any time during the life of the plant, all equipment will be qualified for its environment, and will be on a regular maintenance/replacement schedule as needed. Therefore, life extension will not negatively impact the safety of the public following an accident.

3.21.3 Site Radiological Emergency Response Plan

The following discussions detail how the BFN REP fulfills Federal (10 CFR 50) and State and Local (44 CFR 350) requirements.

10 CFR PART 50 DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

The REP has been developed to provide protective measures for TVA personnel, and to protect the health and safety of the public in the event of a radiological emergency resulting from an accident at a TVA nuclear plant. This plan, which has been approved by the NRC, fulfills the requirements set forth in Part 50, Title 10 of the Code of Federal Regulations, and was developed in accordance with the NRC and Federal Emergency Management Agency (FEMA) guidance. As specified in NUREG-0654, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans in Support of Nuclear Power Plants and REG Guide 1.101, the REP provides for the following:

- Adequate measures are taken to protect employees and the public.
- Individuals having responsibilities during an accident are properly trained.
- Procedures exist to provide the capability to cope with a spectrum of accidents ranging from those of little consequence to major core melt.
- Equipment is available to detect, assess, and mitigate the consequences of such occurrences.

- Emergency action levels and procedures are established to assist in making decisions.

The REP together with the appendices describes the methods TVA will use to:
- Detect an emergency condition.
- Evaluate the severity of the problems and conduct environmental monitoring.
- Notify Federal, State, and local agencies of the condition.
- Activate the TVA emergency organizations.
- Evaluate the possible offsite consequences by performing dose assessments.
- Recommend protective actions for the protection of the public.
- Mitigate the consequences of the accident.
- Maintain a drill and exercise program.

Since TVA authority is limited to TVA-owned and -controlled property, State and local agencies are responsible for ordering and implementing actions offsite to protect the health and safety of the public.

Specific procedures are developed to ensure that the plan is implemented as designed. These implementing procedures are designed to ensure that accidents are properly evaluated, rapid notifications made, and assessment and protective actions performed. These procedures are compiled in the EPIPs. Site specific procedures for abnormal and emergency operation and control exist but are not included in the EPIPs. These plant-operating procedures are designed to ensure the implementation of the EPIPs.

44 CFR PART 350 REVIEW AND APPROVAL OF STATE AND LOCAL RADIOLOGICAL EMERGENCY PLANS AND PREPAREDNESS

State Radiological Emergency Plans (SREPs) have been developed to provide a guide for the response of the State Government to any emergency caused by an incident at a TVA operated Nuclear Plant. The plan also provides integrated response actions of Federal, State, and local governments to an emergency that causes, or has the potential for causing, a release of a significant amount of radioactive material into the environment. In accordance with this plan, the State, in coordination with each concerned agency, will provide timely warning and protection for those citizens who may be threatened by an accident or incident at the plant. This plan fulfills the requirements set forth in Part 350, Title 44 of the Code of Federal Regulations, and was developed in accordance with the NRC and FEMA guidance.

As specified in NUREG-0654, Criteria for Preparation and Evaluation of Radiological Emergency Response Plans in Support of Nuclear Power Plants, the SREPs addresses State and local concepts of operation, organization, administration and logistics, communications, execution, authority and reference, and supporting plans. In addition, plans include annexes to provide guidelines for more specific planning and response information used to protect the public during a radiological emergency. The SREPs has been evaluated and approved by the FEMA which has the responsibility to ensure the adequacy for offsite planning.

The plan, to include annexes, describes the methods the involved agencies use relating to:
- Direction and Control,
- Alert , Warning, and Notification,
- Communications,
- Public Information and Education,

- Radiological Protection Measures for public and emergency workers, to include utilization of radiological and environmental monitoring for the assessment and minimization radiological health hazards,
- Medical and Public Health,
- Plume Exposure Emergency Planning Zone/Ingestion Pathway Zone, to include protective actions decision making for controlling the distribution and use of food and water and consumption of radio-protective drugs, and advising the agriculture community concerning livestock and farm products,
- Evacuation,
- Security,
- Reentry, Recovery, and Return,
- Radiological Emergency Response Training, and
- Exercises.

Since State and local agencies are responsible for ordering and implementing offsite actions for the protection of the health and safety of the public, county implementation procedures are also included.

3.21.4 Severe Accident Mitigation Alternatives

For purposes of this SEIS, the term "accident" refers to any unintentional event (i.e., outside normal or expected plant operations) that results in the release or potential release of radioactive material to the environment. Generally, the nuclear industry and the NRC categorize accidents as "design basis" or "severe." Design basis accidents are those for which the risk is great enough that a nuclear plant is required to be designed and constructed to prevent unacceptable accident consequences. Severe accidents are those considered too unlikely to warrant design controls.

The NRC has concluded in its generic license renewal rulemaking that unmitigated environmental impacts from severe accidents met the criteria for exclusion from requiring additional plant-specific analyses. Nonetheless, the NRC, noting that 1) ongoing regulatory programs related to severe accident mitigation have not been completed for all plants, and 2) these programs have identified plant programmatic and procedural improvements (and in a few cases, minor modifications) as cost-effective in reducing severe accident risks and consequences, elected to require that alternatives to mitigate severe accidents be considered for all plants that have not considered such alternatives. Site-specific information to be presented includes: 1) potential SAMAs; 2) benefits, costs, and net value of implementing potential SAMAs; and 3) sensitivity of analysis to changes to key underlying assumptions.

BFN has previously completed a Probabilistic Safety Assessment (PSA), which is a systematic and comprehensive analysis of the potential accidents that can occur at the plant. The PSA is a thorough description of the frequency and consequences of potential accidents; it incorporates both system reliability and human involvement in plant safety. The BFN PSA evaluates the potential for core damage during power operation (i.e., "Level I" analysis) and also includes containment failure and radionuclide source term estimations following core damage (i.e., "Level II" analysis). It does not, however, evaluate the effects of radionuclide release to the surrounding environment (i.e., "Level III" analysis); this is an integral part of a SAMA analysis.

In response to NRC requirements, BFN has also previously completed an Individual Plant Examination (IPE) which addresses internal events, and an IPE for External Events (IPEEE) such as flood, earthquake, fires, etc. The IPE and IPEEE are less comprehensive than the current PSA but they utilize standardized methodology which allows some degree of comparison of results between plants. Like the PSA, they involve Level I and II analyses which have been used to identify plant programmatic and procedural improvements (and in some cases, minor modifications) which are effective in reducing severe accident and risk consequences.

A SAMA analysis has been prepared for BFN that addresses operation during the 20-year license renewal period and relates the costs of potential programmatic, procedural, and physical changes to benefits associated with reducing the radiological damage to the surrounding environment (Level III). This analysis is described in Section 4.2.21.3 and in Appendix A.

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4.0 ENVIRONMENTAL CONSEQUENCES

Environmental consequences associated with the proposed alternatives are described in this chapter. Section 4.1 addresses the environmental impacts associated with the No Action Alternative which involves operation of Units 2 and 3 only until their existing license terms expire. Sections 4.2 addresses the environmental impacts associated with Alternative 1, which involves operating Browns Ferry Nuclear Plant (BFN) Units 2 and 3 for an additional 20-year period beyond the expiration dates of the current licenses. Section 4.3 discusses the environmental impacts associated with Alternative 2 (A, B, and C), which includes the refurbishment and restart of BFN Unit 1 with the additional 20-year operation for all three units. Section 4.4 identifies possible mitigation measures. Section 4.5 discusses the irreversible adverse impacts of the proposed actions. Section 4.6 compares short-term uses of the environment with the long-term productivity enhancements that are expected from the proposed actions. Section 4.7 describes irreversible and irretrievable commitment of resources, and Section 4.8 provides a listing of the references used throughout Chapter 4.

The environmental impacts described in this chapter are based on the affected environment as described in Chapter 3 and on the information describing the proposed actions in Chapter 2. The chapter is formatted to follow the section headings used in Chapter 3. The proposed actions would be carried out in a way which meets all environmental regulations and requirements and this would help ensure that associated impacts are environmentally acceptable.

4.1 Impacts to the Environment Associated with the No Action Alternative

The No Action Alternative would result in TVA not applying for relicensing for any of the three units at BFN at this time. The current operating licenses for Units 1, 2, and 3 would be allowed to expire in 2013, 2014, and 2016, respectively. Existing environmental conditions would remain unchanged or would change through actions other than operation of Units 2 and 3 only until the current licenses expire. The original BFN EIS describes the environmental impacts associated with operating Units 1 through 3. Operation of Units 2 and 3, until the existing licenses expire, is encompassed by the analyses in the original BFN EIS. To the extent that changes affecting environmental impacts have occurred, or that there is new information relevant to environmental impacts since the release of the original EIS, this is addressed either in Chapter 3 in the description of the Affected Environment or is embedded in the discussion of the changes from existing conditions that could occur as a result of the Action Alternatives.

4.1.1 Decommissioning

Under all of the alternatives (No Action and the action alternatives), TVA would eventually have to propose a decommissioning option and implement it. It is not proposing a decommissioning option now. The No Action Alternative would be the earliest entry into decommissioning. Therefore, although decommissioning is common to all of the alternatives, it is discussed in the context of the No Action Alternative with references to the action alternatives where appropriate.

Prior to choosing a decommissioning option, TVA would conduct appropriate environmental analyses and reviews. General information about decommissioning is included in this SEIS to update the original BFN EIS in the interim.

Environmental issues associated with decommissioning resulting from continued plant operation during the renewal term of a license have already been discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants* (GEIS), NUREG-1437 (NRC 1996; 1999). The GEIS included a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required by the Nuclear Regulatory Commission (NRC), unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria of Category 1, and therefore, additional plant-specific review for these issues is required. There are no Category 2 issues related to decommissioning at BFN.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to BFN Units 1, 2, and 3 decommissioning following the renewal term are listed in Table 4.1-1. For all of those issues, the NRC staff concluded in the GEIS that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4.1-1 Category 1 Issues Applicable to the Decommissioning of BFN Following the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
DECOMMISSIONING	
Radiation Doses	7.3.1; 7.4
Waste Management	7.3.2; 7.4
Air Quality	7.3.3; 7.4
Water Quality	7.3.4; 7.4
Ecological Resources	7.3.5; 7.4
Socioeconomic Impacts	7.3.7; 7.4

A brief description of the NRC staff's review and the GEIS conclusions, as codified in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, for each of the issues follows. As indicated, the analyses in the original EIS and those done here for the SEIS have not identified anything that leads TVA to conclude that decommissioning impacts are likely to be materially different under any of the alternatives. However, based on past experience, it is possible that decommissioning techniques would continue to be improved over time; and therefore, Alternatives 1 and 2 (the action alternatives) could result in fewer impacts or impacts of less severity.

- Radiation doses: Based on information in the GEIS, NRC found: "Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem [0.01 person-Sv] caused by buildup of long-lived radionuclides during the license renewal term." TVA has not identified any significant new information during its review and evaluation that would indicate any additional radiation dose would be experienced by either the public or workers (NRC, 1990). Therefore, TVA concludes that there would be no radiation doses associated with decommissioning following license renewal beyond those discussed in the GEIS.

- Waste management: Based on information in the GEIS, NRC found: "Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected." TVA has not identified any significant new information relevant to environmental concerns during its review and evaluation that leads to a different conclusion. Therefore, TVA concludes that there would be no solid waste impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air quality: Based on information in the GEIS, NRC found: "Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term." TVA has not identified any significant new information relevant to environmental concerns during its review and evaluation that leads to a different conclusion. Therefore, TVA concludes that there would be no air quality impacts from license renewal during decommissioning beyond those discussed in the GEIS.

- Water quality: Based on information in the GEIS, NRC found: "The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts." TVA has not identified any significant new information relevant to environmental concerns during its review and evaluation that leads to a different conclusion. Therefore, TVA concludes that there would be no water quality impacts from license renewal term during decommissioning beyond those discussed in the GEIS.

- Ecological resources: Based on information in the GEIS, NRC found: "Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts." TVA has not identified any significant new information relevant to environmental concerns during its review and evaluation that leads to a different conclusion. Therefore, TVA concludes that there would be no ecological resources impacts from license renewal during decommissioning beyond those discussed in the GEIS.

- Socioeconomic impacts: Based on information in the GEIS, NRC found: "Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth." TVA has not identified any significant new information relevant to environmental concerns during its review and evaluation that leads to a different conclusion. Therefore, TVA concludes that there would be no socioeconomic impacts from license renewal during decommissioning beyond those discussed in the GEIS.

A number of commercial nuclear power plants are currently conducting initial decommissioning efforts, and are developing both the technology and the licensing framework that will allow better understanding of and approaches to decommissioning by others in the future.

- Technology: The decommissioning commercial nuclear power plants, in cooperation with the Electric Power Research Institute (EPRI), the Department of Energy's (DOE) National Energy Technology Laboratory (NETL), and private industry, have developed technologies which are improving the effectiveness and safety of the decommissioning process. The most significant of these technologies are in the areas of site characterization (locating and characterizing radiological contamination), decontamination, dismantlement, disposal (e.g., volume reduction), and worker safety.(EPRI, 2001) Commercial robotics technology, although in its infancy, is already contributing in many of these areas.

- Licensing: The NRC, working with commercial licensees through the Nuclear Energy Institute (NEI), has and is continuing to develop a framework of rules and regulations to systematically "de-license" plants in the course of the decommissioning process (NRC, 2000a and 2000b).

In summary, choosing the No Action Alternative or any of the action alternatives would not result in foreclosing any decommissioning options, or result in any environmentally unacceptable conditions. Unlike license renewal under Alternatives 1 and 2, the No Action Alternative would not allow an additional 20-year period for decommissioning technology (including more advanced robotics) and the licensing framework to evolve and mature. Similarly, choosing the No Action Alternative would not allow an additional 20-year period to increase the likelihood that a permanent spent fuel repository would be available prior to the completion of decommissioning. The availability of a spent fuel repository would further reduce the potential for adverse environmental effects from decommissioning.

4.1.2 Power Replacement Alternatives

The range of options available to TVA as sources of replacement power, assuming a decision by the TVA Board of Directors to not seek license renewal of the BFN units, is addressed in *Energy Vision 2020*. The supply-side options include combined-cycle plants, purchasing and exercising call alternatives, purchasing power from independent power producers, developing renewable energy resources, and improving the existing hydroelectric generating systems.

Energy Vision 2020 analyzes the connection between various air pollutants and carbon dioxide emissions with fossil-fired power production, and used carbon dioxide emissions and pollutant levels as one of the measures to differentiate among TVA's energy strategies. For example, coal-based technologies emit over 200 pounds of carbon dioxide per million BTU of heat input; this is in stark contrast with nuclear power, which emits none. TVA has been an active participant in programs to minimize and/or mitigate the effects of utility emissions on global climate, such as the Climate Challenge Memorandum of Understanding signed by the Department of Energy, four utility organizations, and TVA on April 20, 1994. Consistent with these program objectives, *Energy Vision 2020* lists several potential means of lowering the carbon dioxide emitted per unit of electric energy produced by TVA, the first and foremost of which is increased production of nuclear power. The others are (1) hydroelectric power plant modernization, (2) addition of more efficient fossil-fired plants, (3) increased use of renewables, and (4) repowering of existing coal-fired plants with more efficient energy conversion systems. However, compared with a single 1,000 megawatt nuclear unit, these other alternatives either represent a smaller collective contribution to the overall energy production mix (1 and 3) or would still remain as large sources of carbon dioxide (2 and 4). The total power increase from hydro plant modernization is approximately 750 megawatts, and the current total power from other renewable energy sources (bioenergy, solar and wind) is less than 10 megawatts. Since currently about two-thirds of TVA's total power production originates from fossil fuels and further development of new hydroelectric generation is unlikely, any change in nuclear power generation within TVA will affect the overall production of greenhouse gases.

4.1.3 Socioeconomic Impacts of Discontinuing Plant Operations at Expiration of Current Licenses

4.1.3.1 Economic Conditions

According to the analysis by the NRC (NRC Generic EIS, Section 7.3.7), there are no significant socioeconomic impacts from decommissioning, and it is considered to be a Category 1 issue, not requiring additional plant-specific analysis. Nonetheless, should BFN not be relicensed, there would be some loss of jobs as the plant went into the decommissioning process, at license expiration followed by further loss at the end of the decommissioning period. In addition to these direct losses of income and employment, the impacts would be increased by additional indirect income and employment losses in the area as a result of decreased spending due to the direct income losses. The number of jobs lost would be roughly equal to perhaps one percent of the labor force of Limestone County, but would be only a tiny fraction of the labor force in the labor market area. The NRC study (NRC Generic EIS, Section 7.3.7) concludes that, "The impact of license renewal on the socioeconomic impacts of decommissioning are of small significance. Because license renewal does not affect the socioeconomic impacts that will occur at the time of decommissioning, there is no need for the consideration of mitigation as part of the license renewal environmental review."

The need for additional storage for spent fuel will require construction of a dry cask storage facility and replacement of the Modifications Fabrication Building in a different location (see Sections 2.3.2 and 2.3.3). This will be required under any of the alternatives. However, the employment and income impacts of these actions would be small and short-term, and therefore would not be important.

4.1.3.2 Demography

As shown in Section 3.13.1, the population of Limestone County is expected to be about 80,000 at the time of license expiration, with a labor market area population of close to 750,000. Thus, the population loss that could occur in association with this alternative would be only a small share of the total.

4.1.3.3 Community Services and Housing

Due to the small size of the population impact relative to the total population in the area, no important impacts to community services are expected. Sudden loss of this number of jobs could have a noticeable dampening effect on the housing market; however, this effect would be short-lived if the area continues to grow as expected and is likely to be small.

4.1.3.4 Local Government Revenues

Under this alternative, there would be little impact on the TVA in lieu of tax payments to the state of Alabama or to the share that the state passes on to Limestone County. As long as TVA owns the site, the book value of the property would be used in the formulas that calculate the payments. It is possible that sometime, most likely after decommissioning, ownership of the property would be conveyed to someone else. If so, TVA in lieu of tax payments would stop; however, if ownership were private there should be local tax collections based on the actual property value at that time. Most likely, by the time this might happen, the book value would be very low anyway, and therefore even this impact would be small.

The loss of jobs and income would cause a very small decrease in local sales and property tax collections. However, these would not be important as a share of the total revenues of local governments.

4.1.3.5 Environmental Justice

The primary impacts in the local area would be to employees at the plant and their families. Secondary impacts would be diffused throughout the area and would not be significant to any particular population group. Therefore, no disproportionate impacts to disadvantaged populations in the local area are expected.

4.2 Impacts to the Environment Associated with Alternative 1

4.2.1 Air Resources

4.2.1.1 Climate and Meteorology

Alternative 1 would not involve any potential impacts on the local climate and meteorology more severe than was assessed in the original BFN EIS. The potential for fogging and icing from operation of the cooling towers was based on conservative plume modeling and conservative assumptions for operation of the original six mechanical draft towers and should not increase with extended operation of Units 2 and 3 and operation of six mechanical draft cooling towers.

4.2.1.2 Ambient Air Quality

Alternative 1 involves the operation of Units 2 and 3 and operation of six mechanical draft cooling towers. These six towers will be configured as assessed in the original EIS. (As addressed in the environmental assessment that TVA completed for extended power uprate (EPU) for these units, TVA plans to also rebuild the other cooling tower that burned down, returning the total number of cooling towers at the site to six). The primary sources of non-radiological air pollutants are these cooling towers, three auxiliary steam boilers, and eight diesel-powered auxiliary generators. Four of the diesel generators are linked to Units 1 and 2 and four are linked to Unit 3.

In Volume 1, Section 2.5, of the original EIS, potential emissions and ambient air quality impacts are discussed. However, these earlier analyses only considered emissions from four of the eight diesel generators at the site. The emission estimates from the eight diesel generators should have been twice the emission estimates used in the original EIS. However, this does not change the expected impacts on air resources analyzed in the original EIS, because those impacts are still enveloped by the combination of the auxiliary steam boilers and the diesel generators that was assessed. The auxiliary steam boilers were evaluated for the maximum possible fuel consumption, and the expected actual maximum annual operation was stated to be less than half the level that was assessed.

Actual emissions are much smaller than those estimated in the original EIS, with one exception. There is an inconsistency in the estimated emissions and ambient concentration for carbon monoxide in Section 2.5 in comparison to the magnitudes for the other pollutants calculated there and the relative magnitudes for the actual annual emissions reported during 1996-1999. Apparently, the carbon monoxide emissions and ambient concentrations presented in Section 2.5 are about two orders of magnitude too small. However, the ambient air quality standard is still about five orders of magnitude larger than the revised estimate. Thus, the impact of carbon monoxide emissions is still considered negligible, consistent with the conclusion in Section 2.5, Volume 1, of the original EIS.

Potential impact on ambient air quality from operation of the cooling towers is associated with particulates emitted as part of the drift losses. Conservative estimated emissions of particulates are presented in Section 2.5, Volume 1, of the original EIS. Associated assumptions included closed mode operation for 7% of the time, helper mode operation for 22% of the time, and a conservative drift loss rate of 0.1%. Actual operating experience under the thermal regulations in effect, the reservoir conditions, and the plant's cooling requirements has shown that closed mode operation of the cooling towers has been unnecessary and is not expected to be done in the future. Cooling tower operation is conducted only in the warmer months of the year. During the last six years, Units 2 and 3 have both been back in service and the greatest amount of time that cooling tower operation has been required has been about 8% of a year. Therefore, for Alternative 1, the potential impacts on ambient air quality from operation of the cooling towers remain within the analyses presented in the original EIS.

4.2.1.3 Existing Air Emission Sources

There have been no material changes in plant emission sources compared to those assessed in the original EIS.

4.2.1.4 Air Quality Impacts

For Alternative 1, emissions of small amounts of fugitive dust may be associated with surface preparation and transport of concrete in mixing trucks for the construction of the proposed dry cask storage facility, and the proposed Modifications Fabrication Building. In addition, minor emissions of combustion exhaust products such as nitrogen oxides, carbon monoxide, sulfur oxides, and hydrocarbons can be expected from engines in concrete mixing trucks, other construction-related vehicles, and construction equipment. Some particulates would be emitted from a concrete batch plant in the unlikely event that one should be built instead of trucking in the concrete for the pads of the proposed dry cask storage facility. Trucks would still be used in that event to transport the concrete mixing materials to the batch plant location. Some vapors including hydrocarbons may be emitted from stored fuels and during refueling activities. All of these potential impacts on ambient air quality would be minor, intermittent and transitory during the various periods of construction. Chapter 2 provides details about these construction activities.

4.2.2 Geologic Setting

4.2.2.1 Impacts on Geology

The impacts on geology of continued operation of BFN under any of the options being considered are addressed in section 2.8-2 of the original EIS.

4.2.2.2 Impacts of Construction on Seismicity

Under some circumstances, human activities can change the ambient seismicity of an area. Four types of human activities are known to have the ability to change seismicity levels and patterns:

(1) the creation of large reservoirs; (2) large underground explosions, e.g., nuclear tests; (3) the injection (or withdrawal) of underground fluids; and (4) the excavation of mines (Gough, 1978). These activities can induce earthquakes ranging in size from micro earthquakes to earthquakes with m_b (body wave) magnitudes of 6 or slightly greater (Yeats, et. al. 1996).

None of these activities will be associated with Alternative 1. Therefore, no impacts are expected.

4.2.2.3 Impacts of Operation on Seismicity

Continued operation of BFN should have no impact on the natural level of seismic activity in the area.

4.2.3 Solid Wastes Management and Past Practices

4.2.3.1 General Plant Trash

Continued operation of BFN through the license extension period should not result in generation of additional volumes of general plant trash above and beyond the levels currently generated annually. Disposal of this material would continue as described in Chapter 3. As mentioned previously, landfill capacity and projections for availability of landfill space in Alabama indicate that sufficient space to accommodate this material from BFN should be available during the duration of operating under renewed licenses.

4.2.3.2 Construction/Demolition Debris

BFN would continue to maintain the license to operate the onsite C/D landfill through the duration of the extended BFN operating licenses. The volume of this type of material disposed should remain with the levels currently experienced (average of 0.04 tons per day) and would not require expansion of the existing landfill space on the site. In the unlikely event that additional materials are generated that exceed the capacity of the onsite landfill, arrangements for disposal in an alternative licensed facility would be made.

4.2.3.3 Low Level Radioactive Waste

Generation rates for this type of material would not be expected to exceed existing rates as a result of extension of the BFN licenses. BFN has provisions in place to either store or ship for processing and disposal the volumes of material generated. Existing storage and disposal facilities have adequate capacity to handle the volumes of material expected to be generated during the extended life of BFN.

4.2.4 Hazardous Wastes Management and Past Practices

As is the case for other types of waste material, annual generation of hazardous waste, universal wastes and used oil would not be expected to increase as a result of the license extensions for BFN. The existing process for managing these wastes within TVA would be expected to continue, and capacities of existing disposal and treatment facilities should be adequate to handle the relatively small volumes of material generated. In addition, ongoing waste reduction efforts would be expected to result in further reduction in the number of waste streams and the volumes of waste generated at BFN. Over the past 15 years, BFN has significantly reduced the generation of hazardous wastes through a combination of source reduction and product substitution. In CY 1987, BFN shipped over 220,000 pounds of hazardous waste for treatment/disposal. In CY 2000, BFN shipped 3,900 pounds for treatment/disposal, and over the last five years the average has been 4,700 pounds per calendar year.

4.2.5 Spent Fuel Management

Environmental consequences of additional spent fuel management resulting from license extension would be minimal. As described in sections 2.2, 2,3, and 3.5, additional spent fuel resulting from license extension would be stored in the spent fuel pool or a dry storage system approved by NRC in accordance with 10 CFR 72. Subsequently, all BFN spent fuel would be transferred to the DOE in accordance with the Nuclear Waste Policy Act of 1982 and subsequent amendments. The only component of a dry storage system not transferred to DOE would be the concrete storage overpack provided a modular system is chosen. If used, this component would be disposed as part of the Independent Spent Fuel Storage Installation (ISFSI) decommissioning.

4.2.6 Surface Water Resources

4.2.6.1 Construction Effects

Under continued operation of Units 2 and 3, two additional facilities would be constructed: the dry cast storage pad and the modification fabrication building. Concrete for the pad construction would most likely be trucked in rather than building a batch plant on site. The pad sections would need about 60 concrete truckloads each, or about 360 truck trips for Phases 1 and 2. Phase 3 would involve 180 truck trips. It is possible that the access road around the river side of the plant may first have to be "hardened" where it passes over underground pipes, which could add approximately 100 truck trips. The trucks have wide tires to minimize ground loading. The new modifications fabrication building would be designed as light commercial grade construction. It would be largely prefabricated, involving deliveries of prefabricated items, concrete, and other construction materials. Construction of this new building would involve no more than 8 or so truckloads of concrete, 6 to 8 gravel truckloads, and less than 4 truckloads of various other building materials.

Construction activities could potentially result in adverse water quality impacts. Improper water management or storage and handling of potential contaminants could result in the runoff of pollutants to receiving streams. Erosion, sediment, and accidental spills of fuel or oil could impact streams and threaten aquatic life. However, standard safeguards would be included in the project design, construction, and operation to minimize the risk of adverse impacts. Construction activities would comply with state permit requirements for the control of potential pollutants (e.g., general construction permit, best management practices (BMP) plan, erosion control plan, and spill prevention plan). BMPs sufficient to minimize the risk of and avoid adverse impacts will be followed for all construction activities. Site grading and soil removal would be minimized. For those areas which have grasses and other plants, clearing operations would be staged so that only land that will be developed promptly is stripped of protective vegetation; this is not applicable to the proposed dry cask storage site, which is predominantly gravel. Mulch or temporary cover would be applied whenever possible to reduce sheet erosion. Permanent vegetation, ground cover, and sodding would be installed as soon as possible after site preparation. Surface water runoff would be managed using sediment basins, silt fences, berms, or other control options. These and other similar precautions are expected to minimize potential construction impacts such that no special mitigation measures would be necessary.

4.2.6.2 Chemical Effluent Effects

Chemical treatment is provided for the Emergency Equipment Cooling Water, Raw Cooling Water, and Residual Heat Removal Service Water systems. The flow rates, chemicals, operation, and discharge concentrations are summarized in Table 4.2.6-1.

Under Alternative 1, existing chemical discharges and impacts would continue (as well as under the No Action Alternative). Discharges are regulated under the Clean Water Act (CWA) by the U.S. Environmental Protection Agency (EPA) and the Alabama Department of Environmental Management (ADEM). The National Pollutant Discharge Elimination System (NPDES) permit issued to the plant specifies the discharge standards and monitoring requirements for each discharge. The permit must be renewed every five years and this process helps ensure that no changes have been made to the facility that would alter aquatic impacts and that no unacceptable adverse impacts are occurring. Compliance with the NPDES process, other provisions of the CWA (e.g., Sections 316 (a) and (b), 401, 404), and other regulatory requirements (e.g., Federal Insecticide, Fungicide, and Rodenticide Act) should continue to ensure that potential chemical effluent effects are kept within acceptable levels.

Table 4.2.6-1 Summary of Projected Usage Rates for Chemical Effluents
EMERGENCY EQUIPMENT COOLING WATER
(EECW) SYSTEM (8,000 GPM AVERAGE FLOW)*

PRODUCTS	ACTIVE INGRED.	% ACTIVE INGRED.	PRODUCT FEED RATE (PPM)	ACTIVE FEED RATE (PPM)	FREQUENCY	DISCHARGE CONC. PRODUCT (PPM) (AT DSN001)	DISCHARGE CONC. ACTIVE (PPM) (AT DSN001)
PCL-401	Co-polymer	28.5	2.0	0.6	Continuous	0.01	0.003
CL-50	Poly phosphate	38.5	7.5	2.9	Continuous	0.04	0.016
H-940	NaBr	40	17	6.8	20 hrs/wk	NA	<0.1
NaOCl	NaOCl	10	51	5.1	20 hrs/wk	NA	<0.1
Nalco 1336	Toly-triazole (TTA)	50	2	1	Continuous	0.01	0.005
EVAC	Endothall	53	25	13.3	2/yr (72 hrs each)	<0.075	<0.04

* EECW empties to the intake forebay, mixes with the forebay water and the condenser circulating water (CCW) flow (2300 mgd) and discharges to the Tennessee River through DSN001.

RAW COOLING WATER/RAW SERVICE WATER
HIGH PRESSURE FIRE PROTECTION SYSTEMS*
(50,000 GPM TOTAL AVERAGE FLOW)

PRODUCTS	ACTIVE INGRED.	% ACTIVE INGRED.	PRODUCT FEED RATE (PPM)	ACTIVE FEED RATE (PPM)	FREQUENCY	DISCHARGE CONC. PRODUCT (PPM) (AT DSN001)	DISCHARGE CONC. ACTIVE (PPM) (AT DSN001)
PCL-401	Co-polymer	28.5	2.0	0.6	Continuous	0.07	0.02
CL-50	Poly phosphate	38.5	7.5	2.9	Continuous	0.25	0.10
H-940	NaBr	40	17	6.8	20 hrs/wk	NA	<0.1
NaOCl	NaOCl	10	51	5.1	20 hrs/wk	NA	<0.1
EVAC	Endothall	53	25	13.3	2/yr (72 hrs each)	<0.075	<0.04

*Portions of these systems empty to the intake forebay where they mix with forebay water and CCW before discharge to the Tennessee River through DSN001. The remainder discharges directly into the CCW and is discharged through DSN001.

RHRSW SYSTEM -STAGNANT TREATMENT MODE
(2,000 GPM AVERAGE FLOW)*

PRODUCTS	ACTIVE INGRED.	% ACTIVE INGRED.	PRODUCT FEED RATE (PPM)	ACTIVE FEED RATE (PPM)	FREQUENCY	DISCHARGE CONC. PRODUCT (PPM)	DISCHARGE CONC. ACTIVE (PPM)
PCL-401	Co-polymer	28.5	70	20	2/Quarter	70	20
CL-50	Poly phosphate	38.5	80	30	2/Quarter	80	30
H-940	NaBr	40	17	6.8	2/Quarter	NA	<2.0
NaOCl	NaOCl	10	51	5.1	2/Quarter	NA	<2.0
H-300	Gluter-aldehyde	45	200	90	2/Quarter	200	90

* In the stagnant treatment mode, amounts are based on flushes twice per quarter for each of 10 heat exchangers (80 flushes per year). Each flush consists of 20 minutes at < 2000 gpm. Discharge is through DSN 005.

RHRSW SYSTEM -INTERMITTENT TREATMENT MODE
(4,500 GPM AVERAGE FLOW)*

PRODUCTS	ACTIVE INGRED.	% ACTIVE INGRED.	PRODUCT FEED RATE (PPM)	ACTIVE FEED RATE (PPM)	FREQUENCY	DISCHARGE CONC. PRODUCT (PPM)	DISCHARGE CONC. ACTIVE (PPM)
PCL-401	Co-polymer	28.5	2.0	0.6	Intermittent	2.0	0.6
CL-50	Poly phosphate	38.5	7.5	2.9	Intermittent	7.5	2.9
H-940	NaBr	40	17	6.8	20 hrs/wk	NA	<2.0
NaOCl	NaOCl	10	51	5.1	20 hrs/wk	NA	<2.0
EVAC	Endothall	53	25	13.3	2/Year 72 hrs each	13.0	7.0

* In the intermittent treatment mode, amounts are based on a total duration of treatment equivalent to 120 days per year at 4500 gpm. Discharge is through DSN 005.

4.2.6.3 Thermal Effects

The assessment of thermal effects assumes that sufficient cooling tower capacity will be provided to maintain the instream thermal limits as given in the current NPDES permit. As discussed in Chapter 2, if changes in the thermal limits are found to be potentially feasible and are proposed, analyses and discussions summarized herein will be updated, as appropriate.

Thermal impacts from continued operation of Units 2 and 3 remain within the levels evaluated during the original EIS. No additional thermal impacts to water temperature, reservoir stratification, sediment transport, scouring, dissolved oxygen concentrations, or eutrophication are expected because of continued operation of BFN.

4.2.6.4 Water Use/Water Availability

No additional water use/water availability impacts are expected from continued operation of Units 2 and 3.

4.2.6.5 Microbiological Organisms

No additional microbiological impacts are expected from continued operation of Units 2 and 3.

4.2.7 Groundwater Resources

4.2.7.1 Groundwater Occurrence

There are no environmental consequences to groundwater resources associated with Alternative 1.

4.2.7.2 Groundwater Use

Currently, groundwater is not used by BFN, and no groundwater use is anticipated for Alternative 1. Therefore, there would be no impacts to groundwater resources under this alternative.

4.2.8 Floodplains and Flood Risk

The floodplains and flood risk assessment involves ensuring that facilities would be sited to provide a reasonable level of protection from flooding. In doing this, the requirements of Executive Order (EO) 11988 (Floodplain Management) are considered. For non-repetitive actions, EO 11988 states that all proposed facilities should be located outside the limits of the 100-year floodplain unless alternatives are evaluated which would either identify a better option or support and document a determination of "no practicable alternative" to siting within the floodplain. If this determination can be made, adverse floodplain impacts would be minimized during design of the project. For a "critical action," facilities must be protected to the 500-year flood elevation. A "critical action" is considered to be any activity for which even a slight chance of flooding would be too great. One of the criteria used in determining if an activity is a critical action is whether essential and irreplaceable records, utilities and/or emergency services would be lost or become inoperable if flooded. Due to the nature of this facility, it is necessary to evaluate the flood risk associated with the Probable Maximum Flood (PMF) elevations for all alternatives. The PMF (see glossary) is more severe than the 500-year flood and is primarily used to conservatively evaluate dams and nuclear facilities.

Common to all of the alternatives, a dry cask storage facility, and Modifications Fabrication Building would be constructed. All existing and proposed facilities are, or would be, located outside the limits of the 100- and 500-year floodplains. Therefore, the project would be consistent with EO 11988.

All safety-related structures are protected against all flood conditions and would not be endangered by the Probable Maximum Flood (Reference: Individual Plant Examination of External Events (IPEEE). This includes potential flooding from all sources. For the small stream to the northwest of the plant site, the channel is designed with capacity sufficient to carry the PMF without flooding the plant. For the switchyard drainage channel, the switchyard is higher than the maximum water surface, preventing flow from entering the plant. In the vicinity of the radioactive waste, reactor, and diesel generator buildings, the flood elevations from the surface drainage would not exceed elevation 565.0, which is the plant grade. For the Cooling Tower System, the channels have sufficient capacity to pass the PMF runoff and condenser water without flooding the plant for any mode of plant operation. (Reference: FSAR)

The proposed dry cask storage facility would be located on ground above the PMF elevation based on site topography dated 1989. The proposed Modifications Fabrication Building would be located on ground below the PMF elevation, but the site would be raised or the building would be flood proofed consistent with other facilities of this nature on the plant site. Based on the same site topography, the proposed mechanical draft cooling tower would be located above elevation 570. All equipment within the cooling tower that could be damaged by flood waters would be located above or flood proofed to the PMF elevation, as required.

During the license renewal period (up to year 2036), the 100- and 500-year flood, and PMF elevations for the Tennessee River would not be expected to change as stated in Section 3.8. Although the 100- and 500-year flood flows for the small stream to the northwest of the plant site and the site drainage system could increase by as much as 2.5 times what they are now as a result of total development of the drainage basin, these flows would not adversely impact existing or proposed development because they would be significantly lower than the PMF flows, and these channels can handle PMF flows without flooding the plant.

4.2.9 Terrestrial Ecology

4.2.9.1 Vegetation

No uncommon plant communities or otherwise sensitive vegetation exists on the lands to be affected under Alternative 1. With respect to vegetation, any direct, indirect or cumulative impacts to the terrestrial ecology of the region are expected to be insignificant as a result of this Alternative.

4.2.9.2 Wildlife

Under Alternative 1, the operating licenses for Units 2 and 3 at BFN would be renewed at an EPU of 120% of the original operating power levels. Because no rare or uncommon communities of animals exist on the site, the construction and operation activities associated with Alternative 1 would not result in adverse impacts to any uncommon wildlife or their habitats.

4.2.9.3 Introduced Species

Because no intact native plant communities occur on lands to be disturbed by the proposed actions, and because introduced plant species are already present in these areas, any direct, indirect, or cumulative impacts due to the establishment or spread of introduced plant species are anticipated to be insignificant as a result of the actions associated with Alternative 1.

Two introduced species, the European house sparrow and the European starling, are known to exist on the project site. These species are quite common in the project area. Alternative 1 would not result in increased population levels of introduced animal species.

4.2.9.4 Managed Areas and Ecologically Significant Sites

Because the proposed actions would occur within the lands presently utilized for the operation and maintenance of the BFN no impacts to Managed Areas or Ecologically Sensitive Sites are anticipated.

4.2.9.5 Refurbishment Impacts

Alternative 1 involves only Units 2 and 3, which are currently operating successfully without the need for significant equipment replacements. License renewal of BFN Units 2 and 3 for a 20-year period beyond the current operating license expiration dates is not expected to require any replacement of equipment beyond possibly some electrical cables which undergo normal aging at ambient environment conditions. Nor is it expected that any major refurbishment of equipment will be necessary outside of what is already periodically scheduled for normal wear.

4.2.10 Aquatic Ecology

4.2.10.1 Fish

In 1985, BFN initiated a three-phase biological monitoring program to evaluate the effects of the thermal discharge on total standing stocks and selected fish species in Wheeler Reservoir, and a sampling program to monitor total standing stocks of fish in Wheeler Reservoir. The results of this monitoring program were reported to the State of Alabama in 1998 (Baxter and Buchanan, 1998), and additional analysis of the data was provided as part of the NPDES Permit Renewal application submitted in September 1999 (TVA, 1999). Both the final report, and the additional analyses concluded that the operation of BFN under the current permit limitations has not had a significant impact on the aquatic community of Wheeler Reservoir or on the specific aquatic species studied. In addition to the BFN specific studies, monitoring initiated in Wheeler Reservoir in 1990 as part of TVA's Vital Signs Monitoring Program provided an additional measure of the quality of the ecological health of the aquatic community in the vicinity of BFN (Dycus and Baker, 2000). Results since 1991 indicate no adverse impacts as a result of BFN operation.

Two species of special interest, sauger and yellow perch, were the focus of BFN thermal variance studies because both are considered coolwater species and, theoretically, more susceptible to elevated water temperature. Based on results of studies conducted from 1985 through 1992, operation of BFN had no significant adverse impact on the reproductive success of either species nor the movement of sauger past BFN. However, studies did indicate sauger spawning success was adversely impacted by overfishing in Wheeler Reservoir and drought conditions (e.g., low flows and decreased turbidity) in the Tennessee Valley during 1985 through 1988 (Maceina, et al. 1998, and Baxter and Buchanan, 1998).

No changes to the thermal discharge limitations are necessary to accommodate the EPU under Alternative 1 with extended operating periods. As noted earlier, use of the cooling towers would increase from approximately 1.8% of the time for current operations to approximately 2.3% of the time with EPU. This increase would not result in any impacts to the aquatic community of Wheeler Reservoir. TVA plans to continue an ongoing monitoring program for at least the term of the current permit cycle (five years) to confirm that operation at the uprated power levels does not have an adverse impact on the aquatic community in the vicinity of BFN.

4.2.10.2 Benthic Organisms

As identified in the EPU EA, an increase of approximately 2.3°F in the temperature of the circulating water would occur with the uprate of Units 2 and 3. This increase in discharge temperature would result in increased cooling tower usage during summer periods. However, in order to maintain compliance with the discharge limitations, discharge temperature at the diffusers would not change appreciably (Brellenthin, 2001). Water intake velocity would not change from that which was evaluated during previous studies when all three units were in operation at BFN. Therefore, no additional impacts to benthic macroinvertebrate communities due to discharge temperatures or entrainment are expected in the vicinity of BFN as a result of extending the operating licenses for Units 2 and 3.

4.2.10.3 Introduced Species

Future BFN operations will not have an impact on introduced species. The Vital Signs Monitoring Program will evaluate any impacts to the fish and macroinvertebrate communities in the vicinity of BFN. Monitoring BFN's raw water intake will document any increases in zebra mussel reproduction in the vicinity of BFN. This will allow formulation of treatment plans to prevent impacts to BFN operations resulting from zebra mussel infestation.

Grass carp abundance is not expected to be influenced by BFN operations. Introduced grass carp are normally sterile, so that their numbers can be maintained at desired levels by adjusting any future stocking rates.

4.2.10.4 Entrainment and Impingement of Fish and Shellfish, Heat Shock

For the continued operation of Units 2 and 3, the volume of water withdrawn from the reservoir remains within the levels evaluated during previous studies of intake effects on fish for three-unit operation at BFN, therefore, as found in the original EIS and in subsequent operational monitoring, entrainment and impingement levels are expected to remain at insignificant levels under Alternative 1. Any increased discharge temperatures would be within the NPDES permit limits; thus, there should be no significant thermal impacts.

4.2.10.5 Microbiological Organisms

Data collected during the 1990-1991 Browns Ferry Thermal Variance monitoring study and the TVA Vital Signs monitoring program did not indicate that the operation of BFN had influenced the phytoplankton community in Wheeler Reservoir (Lowery and Poppe, 1992). Under Alternative 1, no changes to thermal discharge limitations are necessary to accommodate extension of the units' operating licenses. In addition, intake velocity and volume would remain within previously evaluated levels. Therefore, no additional impacts to the plankton communities are anticipated.

4.2.11 Threatened and Endangered Species

4.2.11.1 Animal

Adoption of Alternative 1 is expected to have no effect on federal or state listed terrestrial animal species. Little or no habitat suitable for listed species exists on the project area, and no listed species are known to be on the site.

4.2.11.2 Aquatic

Effects from Alternative 1 are not expected to impact threatened or endangered aquatic species within the area affected by construction or operational changes at BFN as proposed herein. Therefore, these proposed changes and additions to BFN would have no effect on the species listed in Section 3.11.2. No threatened or endangered aquatic animals are presently known to exist within the area potentially affected by Alternative 1; therefore, no impacts to these species are expected to result from adoption of this alternative.

4.2.11.3 Plants

Because no occurrences of rare (federal- or state-listed) plant species are known on or immediately adjacent to BFN, no effects on rare plant species are expected as a result of Alternative 1.

4.2.12 Wetlands

There would be no impacts to wetlands as the result of continuing operation of Units 2 and 3 at BFN for an additional 20 years past the expiration dates of the current operating licenses. There would be no major construction activities scheduled that would impact or affect wetlands in the plant area and construction of the proposed dry cask storage and modification fabrication facilities would not impact any wetlands.

4.2.13 Socioeconomic Conditions

4.2.13.1 Demography

As shown in Section 3.13.1, the population of Limestone County is expected to be about 80,000 at the time of license expiration, with a labor market area population of close to 750,000. Under Alternative 1, the number of construction workers is small enough (less than 100 at peak) that there would be no noticeable impact to population, and any impact would be of very short duration.

4.2.13.2 Economic Conditions

Under Alternative 1, operation of Units 2 and 3 would continue without significant change from that in effect at the end of the current licensing period. Relicensing would result in no changes in operating employment levels at the plant, in payroll, or on other plant-related expenditures. However, a new Modifications Fabrication Building and a dry cask storage facility would be constructed. These construction activities, which are discussed in Sections 2.3.2 and 2.3.3, would add a small number of workers for a brief period of time, providing a positive but very small impact to the local economy. Since operations employment would continue at about the current level, there would be no impact to the local economy from operations under this alternative, as compared to current conditions.

4.2.13.3 Community Services and Housing

Under Alternative 1, there would be no noticeable impact to community services or to housing, due to the small size of the employment impacts and to the short duration of such impacts.

4.2.13.4 Local Government Revenues

Under Alternative 1, there would be no important impact to TVA's in lieu of tax payments paid to the state or received by Limestone County. The new facilities would add a relatively small amount to the book value of the property, and therefore would slightly increase the amounts, but the difference would not be significant.

4.2.13.5 Environmental Justice

As discussed in Section 3.13.4, the disadvantaged population in the immediate area near the site is relatively small. Any negative impacts to persons living near the site would be small and would tend to be dispersed through the area. Therefore, no disproportionate impacts to disadvantaged populations are expected.

4.2.14 Transportation

4.2.14.1 Highways and Roads

In years 2014 and 2016, Units 2 and 3 operating licenses would expire. Alternative 1 involves operating these relicensed units at EPU for an additional 20 years. There would be a minor increase in construction traffic during erection of a sixth mechanical draft cooling tower, the dry cask storage facility, and the modification fabrication facility. This minor traffic increase due to construction workforce and construction deliveries and disposals would be temporary and have no significant traffic impact. Operational traffic generated by the plant would not be affected under this alternative. Current traffic generated by BFN would remain at the existing level. However, traffic growth is expected to occur over this period of time. Assuming general traffic growth occurs along with projected population growth, Average Daily Traffic (ADT) on U.S. Highway 72 will increase to approximately 16,500 vehicles per day (vpd) and ADT on U.S. Highway 31 will increase to approximately 20,000 vpd. The ADT on secondary county roads which provide access to the plant would increase to approximately 2,000 vpd.

Traffic growth will continue during the license period for twenty years following to years 2034 and 2036. During this time, traffic volumes would increase, assuming 15% growth rate per decade, to approximately 21,900 vpd on U.S. Highway 72 and 26,500 vpd on U.S. Highway 31. The county roads would increase to approximately 2,600 vpd.

Under this alternative, there would be no additional impact to the local transportation network. The percentage of vehicles on the road would remain at the current level and decrease as background traffic grows.

4.2.14.2 Railroads

Alternative 1 would result in no impacts to the railway system.

4.2.14.3 River Transport

Alternative 1 would result in no impacts to river transportation.

4.2.14.4 Pipelines

Alternative 1 would result in no impacts to pipelines.

4.2.14.5 Transmission Lines

TVA completed a transmission system study in June 2000 for BFN that assessed the ability of the offsite power system to meet NRC requirements for electric power systems. (These requirements are delineated in 10 CFR 50 Appendix A, General Design Criterion 17.) This study included a 5-year look-ahead to the summer 2005 peak (net TVA peak system load of 33,775 megawatts), and assumed BFN Units 2 and 3 were generating at full power with a per-unit power uprate to 1,155 MW gross. The study examined both load flow and transient stability in response to a number of postulated system alignments, contingencies and design basis accident conditions. It was concluded that all the cases studied meet the BFN minimum voltage requirements and satisfy all General Design Criterion 17 requirements relative to safe shutdown of Units 2 and 3 in the event of a design basis accident. Therefore, no additional transmission facilities would be required.

TVA has also recently completed an interim study, excluding transient stability and fault analyses, of line loading in the vicinity of BFN (with EPU) for the year 2007. No transmission lines were identified as exceeding their load limits, although several of them had small margins. TVA is continuing to assess the capabilities of its transmission system, including in the vicinity of BFN.

4.2.15 Soils and Land Uses

Impacts to soils or land use on the site as a result of activities associated with license renewal for operation of Units 2 and 3 at EPU would be insignificant. The construction of the dry cask storage facility and modifications fabrication building would occur on sites previously disturbed or housing other facilities.

4.2.16 Visual Resources

The project area, located within the BFN site, is an industrial setting within the rural countryside. Scenic integrity is moderate, with many transmission lines and associated steel tower structures traversing the countryside and into the switchyard in the plant area. The terrain is gently rolling throughout the plant site and terminates on the west side overlooking the scenic Wheeler Reservoir. Together, the natural and cultural elements provide variety and some scenic attractiveness, which forms a mosaic of rural and industrial setting. This section examines the visual and aesthetic consequences of license renewal of BFN, including construction of facilities common to all alternatives. Visual consequences are examined in terms of visual changes between the existing landscape and proposed actions, sensitivity of viewing points available to the general public, their viewing distances, and visibility of proposed changes. In this assessment, scenic attractiveness is described using the following adjectives: variety, unity, coherence, vividness, harmony, tranquility, and uniqueness. Scenic integrity indicates the degree of intactness or wholeness of the landscape character. These measures help identify changes in visual character based on commonly held perceptions of landscape beauty, and the aesthetic sense of place. The foreground, middleground, and background viewing distances were previously described in Section 3.1.16.

There are common proposed activities for Alternatives 1, 2A, and 2B (and the No Action Alternative). These include the construction of a dry cask storage facility and a new Modifications Fabrication Building. The proposed facilities would have minor visual impacts on the industrial character of the plant site. However, adding the proposed facilities would increase the number of adversely-contrasting elements seen inside the development from the rural countryside. These incremental changes may not be individually significant, but together with other facilities, they would add to a continuous growth of structures seen in the landscape and a cumulative reduction of visual resources as seen from the countryside.

County Road 25 provides the main access route to both the plant entrances and to homes north of the site. Most views to the site will be from this area and from the homes across Wheelers Lake at Mallard Creek and Mallard Creek public use area. Increasing the number of vertical objects in the landscape would add to the visually discordant contrast between rural countryside and the industrial character of the plant site. The heights and related dimensions of the tallest existing structures in the plant site are shown in Table 4.2.16-1.

Table 4.2.16-1 Summary of Height/Size Information

Plant Feature (Existing)	Feature size same for each alternative
Transmission Towers at Switchyard, Northeast of Plant Site, and crossing Wheeler Reservoir	157 feet height at switchyard; 150 feet entering plant from northeast side; 247 feet mounted on river islands crossing Wheeler reservoir
Plant Reactor/Turbine Building	Roof heights vary from 111fee-4inches to 155feet
Existing Earthen Berm	70 feet. height; 3000 feet. length
Mechanical Draft Towers (4 existing)	65 feet. height
Off Gas Stack	Nominally 600 feet. height

IMPACTS OF CONSTRUCTION

Operating relicensed Units 2 and 3 at EPU under Alternative 1 will involve minor construction site preparation of a few areas at BFN. Visible construction would include minor grading to construct building pads, new laydown areas for construction equipment and materials, temporary facilities, and trenching for new utilities. As the construction reached completion, it would be seen in the foreground by passing motorists. Scenic integrity in the area would be somewhat low during the construction process. However, the visual discord as a result of construction would be temporary, and would last until site cleanup and reclamation of disturbed areas are complete.

IMPACTS OF OPERATION

The impacts of operation under Alternative 1, while operating Units 2 and 3 at EPU, could include a small increase in the number of plumes, and potentially the duration for which they will be seen, rising from the mechanical draft cooling towers. These plumes could be observed most frequently by area residents and, depending upon atmospheric conditions, by residents much farther away from the plant site.

4.2.17 Recreation

Since the proposed action would be contained within the existing plant site, impacts for Alternative 1 would be insignificant. This includes the construction of the proposed dry cask storage and the modification fabrication facilities. No recreation facilities, resources or activities would be significantly affected.

Cumulative impacts for Alternative 1 would be insignificant. This includes the construction of the proposed dry cask storage and the modification fabrication facilities.

4.2.18 Cultural Resources

4.2.18.1 Archaeological Resources

Alternative 1 proposes to relicense Units 2 and 3 at EPU. This action would have no affect on historic properties because activities will take place within existing facilities. The construction of the proposed dry cask storage facility and Modifications Fabrication Building would not have any direct effects on historic properties. However, historic properties (one prehistoric archaeological site and one historic cemetery) have been identified at BFN. Placement of construction spoil on either of these historic properties would be an adverse effect. These two historic properties encompass small portions of disposal areas 1 and 2. By excluding these two historic properties from potential disposal areas, placement of spoil would not result in an adverse effect to historic properties. The boundaries of these two sites, have been adequately demarcated on site-controlled drawings to prevent inadvertent disturbance of these sites. The Cox Cemetery, located in Area 2, would be avoided by all activities.

4.2.18.2 Historical Structures

No historic structures were identified within the visual area of potential effect. Therefore, there would be no effect on historic structures.

4.2.19 Environmental Noise

There would be no environmental noise effects from Alternative 1, the relicensing of Units 2 and 3, that are different from existing noise conditions described in Chapter 3.

Construction of the dry cask storage area and the modification fabrication building have the potential for short-term, insignificant environmental noise effects. Neither construction is a major project. The dry cast storage area consists of a light-commercial building, concrete pads, and fencing; and the modifications fabrication building is a large, light-commercial, prefabricated steel structure. Sections 2.3.2 and 2.3.3 give more details about these facilities.

Earth moving for site preparation and concrete deliveries are the two major noise sources from the construction of the dry cask storage area. The pads for Phase 1 and 2 would probably take a few months to complete, and this work would be done during normal business hours. This area is more than 4,200 feet from the closest residence and there is a small, wooded hill in between. Although concrete truck noise will be noticeable along the delivery route for a few weeks, the overall potential environmental noise effect is insignificant for this construction.

Construction of the modifications fabrication building will take a few weeks and will require about 25 to 30 truck deliveries. The proposed site of this building is tucked-in behind the main plant, and it needs minimal site preparation. Erection of this building has no potential for environmental noise effects.

There will be no operational noise effects from Alternative 1, the relicensing of Units 2 and 3, that are different from existing noise conditions described in Chapter 3.

4.2.20 Public and Occupational Safety & Health (Non-Radiological)

The site Safety and Health Program described in Section 3.20 would not be impacted or affected by license renewal and continuing to operate Units 2 and 3 for 20 years after the current operating licenses expire in 2014 and 2016, respectively.

4.2.21 Radiological Impacts

4.2.21.1 Normal Operation

4.2.21.1.1 Occupational

Occupational radiation dose refers to radiation dose received by individuals as a course of their employment. Parameters considered for the analysis included: baseline occupational dose, projected dose increments, and an estimated cancer risk increase for the projected dose increments. The scope for Alternative 1 (see section 2.2.1) addresses units 2 and 3 EPU with an extended operating license (20 years). EPU has been addressed by a specific environmental assessment (EA). A conservative basis assumption of that EA is that the annual collective dose would increase in direct proportion to the power level. Table 4.3.21.1.B summarizes the current facility dose parameter and forecasts the EPU basis dose assumption. Alternative 1 occupational radiation dose increases are less than those analyzed for Alternative 2 (see section 4.3.21.1). The occupational radiation dose increase in cancer risk associated with the EPU is addressed in Table 4.3.21.1.D. NUREG-1437 Vol. 1 Section 4.6.3.2 postulates that the radiation dose attributable to license extension might result in a 5 percent increase in the calculated cancer incidence to workers, but there may be no increase. The estimated cancer risks for the proposed Alternative 1 activities are bounded by the NUREG-1437 Vol. 1 Section 4.6.3.2 assumptions.

4.2.21.1.2 Public

Current radioactive effluent releases and associated exposures from BFN operations are not expected to change in adverse ways during a 20-year renewal period. There are no significant changes to the radiological effluent releases anticipated as a result of the proposed action(s) and, therefore, the impacts to the environment or the general public are not expected to change.

4.2.21.2 Facility (Design Basis) Accidents

The design basis accidents addressed in Chapter 14 of the BFN UFSAR are independent of the age of the plant. Therefore, extension of the operating lifetime of the plant from 40 to 60 years would not change the analysis of these accidents.

4.2.21.3 Severe Accident Mitigation Alternatives

As discussed in Chapter 3, a "severe" accident is a potential accident that is considered too unlikely to warrant design controls. A Severe Accident Mitigation Alternative (SAMA) analysis assesses alternative ways of mitigating the impact of such accidents. TVA has conducted and is refining a SAMA analysis for BFN. This analysis is specific to Unit 2 and Unit 3 at the current design basis power level. The complete SAMA analysis may be found in Appendix A of this SEIS. (The SAMA analysis will be extended to be consistent with EPU for the final SEIS.)

Methodology

The methodology selected for this analysis involves identifying those SAMA candidates that have the most potential for reducing core damage frequency and person-rem risk. The phased approach consists of:

- Extending the BFN Probabilistic Safety Analysis (PSA) results to a Level 3 analysis by determining offsite dose and economic baseline risk values,
- Determining the maximum averted risk that is possible based on the BFN baseline risk,
- Identifying potential SAMA candidates based on BFN PSA results, NRC and industry documents,
- Screening out potential SAMA candidates that are not applicable to the BFN design or are of low benefit in Boiling Water Reactors,
- Screening out SAMA candidates whose estimated cost exceeds the maximum possible averted risk, and
- Performing a more detailed cost estimate and Level 3 dose and economic risk evaluation of remaining candidates to see if any have a benefit in risk aversion that exceeds the expected cost.

Level 3 PSA Analysis

Plant-specific release data include the time-nuclide distribution of releases, release frequencies, and release locations. The behavior of the population during a release (evacuation parameters) was based on the generic MACCS2 model. These data were used in combination with site-specific meteorology and population data to simulate the probability distribution of impact risks (exposure and economic) to the surrounding (within 50 miles) population from the release accident sequences at BFN.

Determination of Present Value

This section of the SAMA analysis explains how TVA calculated the monetized value of the status quo (i.e., accident consequences without SAMA implementation). TVA also used this analysis to establish the maximum benefit that a SAMA could achieve if it eliminated all BFN risk. The following costs are included in the analysis:

1. Offsite exposure cost
2. Offsite economic cost
3. Onsite exposure cost
4. Onsite cleanup cost
5. Replacement power cost.

The cost was determined independently for both Unit 2 and Unit 3. Two real discount rates are used in the calculations. A 7% discount rate is used to reflect a "base case" discount rate and 3% is used to provide analysis sensitivity to the discount rate.

The sum of these costs are used to screen out SAMAs that are not economically feasible. If the estimated cost of implementing a SAMA exceeds the maximum benefit, it will then be discarded from further analysis. Exceeding this threshold would mean that a SAMA would not have a positive net value even if it could eliminate all severe accident costs.

SAMA Candidates and Screening Process

An initial list of SAMA candidates was developed from lists of SAMAs for Hatch Nuclear Plant, and, most importantly, from the plant specific risk profile as provided by the BFN PSA and the BFN Individual Plant Examination for External Events (IPEEE). This initial list was then screened to remove those that met the following criteria:

- does not apply to the BFN or to boiling water reactors in general,
- already in place at BFN, or
- rough order of magnitude costs exceed the screening cost savings.

This screening process leaves unique SAMA candidates that are applicable to BFN and are of potential value in averting the risk of severe accidents. A preliminary cost estimate was prepared for each of these candidates based on previous design/procedural modifications of similar scope to focus on those that had the possibility of having a positive benefit and to eliminate those whose costs are clearly beyond the possibility of any corresponding benefit. A more detailed estimate was prepared for those items that appeared to be potentially cost effective.

SAMA Analysis Results For BFN

Based on the existing BFN SAMA analysis it is not anticipated that Alternative 1 would result in justifying any significant modification.

SAMA Analysis Results from Previous Submittals

A review of previously approved and submitted SAMA analyses for other plants was performed to determine the potential scope of changes that would reasonably be expected to be applicable to this analysis. The following paragraphs are quoted from the conclusion of each referenced SAMA analysis.

Calvert Cliffs (approved) – "BGE identified and committed to pursue one enhancement in accordance with the CCNPP modification process. This involves the installation of a watertight door between the service water pump room and the adjacent fan room to reduce the likelihood of core damage from internal flooding events. BGE also committed to further evaluate the adequacy of CCNPP procedures regarding response to internal floods following resolution of the hardware flooding enhancement. BGE concluded that no additional mitigation alternatives are cost-beneficial and warrant implementation at CCNPP."

Oconee (approved) – "Because the environmental impacts of potential severe accidents are of small significance and because additional measures to reduce such impacts would not be justified from a public risk perspective, Duke concludes that no additional severe accident mitigation alternative measures beyond those already implemented during the current term license would be warranted for Oconee."

Hatch (in review by NRC) – "None of the SAMAs analyzed would be being [sic] justified on a cost-benefit basis."

Arkansas Nuclear One Unit 1 (in review by NRC) – "In summary, based on the results of this SAMA analysis, Entergy Operations discovered only one marginally cost-beneficial SAMA (emphasize timely recirc swapover in operator training) which is not age-related."

Peach Bottom (in review by NRC) - "The results of this study indicate that none of the SAMA candidates would yield a significant reduction in public risk relative to the cost required to implement the SAMA. No plant changes or modifications have been identified for implementation or further review at Peach Bottom Atomic Power Station."

Conclusions

Based on the SAMAs approved to date, or that are in review, it is not anticipated that a refined SAMA analysis for BFN will identify any significant modification that would be justified in reducing the risk of severe accidents.

4.2.22 Decommissioning Impacts

As explained in Chapter 2, under this Alternative (1), decommissioning would probably not be initiated for Unit 1 while operation is extended for Units 2 and 3. Instead, Unit 1 would likely remain in its current non-operable status until any renewed licenses expire or a subsequent decision is made to recover and restart the unit.

License renewal of BFN Units 2 and 3 would provide an additional 20-year period for decommissioning technology (including more advanced robotics) and the licensing framework to evolve and mature. In addition, it becomes much more likely that a permanent spent fuel repository would be available prior to the completion of decommissioning. Consequently, in comparison with the No Action Alternative, the potential for adverse environmental effects from decommissioning could be further reduced.

4.3 Impacts to the Environment Associated with Alternative 2

4.3.1 Air Resources

4.3.1.1 Climate and Meteorology

Alternative 2 would not involve any potential impacts on the local climate and meteorology greater than was assessed in the original EIS. The potential for fogging and icing from operation of the cooling towers was based on conservative plume modeling and conservative assumptions for operation of the original six mechanical draft towers. The results given in Volume 3, Section 3.4, of the original EIS are greater than would be expected from additional cooling capacities of all variations of Alternative 2. This is because the actual operation of the cooling towers has been and would be expected to occur only in the warmer months, mainly in the summer, and for much less time than the 29% assumed in the original EIS.

4.3.1.2 Ambient Air Quality

Alternatives 2A, 2B, and 2C involve restart of Unit 1 and consequent operation of Units 1, 2, and 3. The impacts discussion of the auxiliary steam boilers and diesel generators for Alternative 1 also applies to Alternatives 2A, 2B, and 2C. Alternative 2A includes the addition of two new rectangular mechanical draft towers, Alternative 2B includes the addition of two round mechanical draft towers instead of rectangular towers, and Alternative 2C includes enlargement of existing cooling tower number 3 by 25% and replacing the other 5 cooling towers with new and larger linear mechanical draft cooling towers.. However, the amount of condenser circulating (ie., cooling) water (CCW) flow would be the same for all three of these sub-alternatives. Therefore, the total drift loss from the cooling towers is expected to be the same for each alternative.

The CCW requirement for Alternative 1 is 3,579 cubic feet per second (cfs), which is less than the design rate of about 3,680 cfs for the original six cooling towers. The CCW requirement for each of Alternatives 2A, 2B, and 2C is 5,368 cfs. In order to estimate PM-10 emissions (particulates in the drift), TVA used this CCW value, the default drift factor of 1.7 pounds/10^3 gallons given in EPA publication AP-42, an estimated 101 parts per million (ppm) total dissolved solids (TDS) content of the intake water which was determined during a source assessment for Title V of the Clean Air Act, and a helper mode concentration factor of 1.03. The current National Ambient Air Quality standard for particulates applies to particles smaller than 10 microns. All of the particles resulting from the TDS in the drift are assumed to be at least this small, and the majority of them are expected to be smaller than the 2.5 micron criterion in a new standard that was promulgated in 1997, but was overturned by court action. Thus, the addition of cooling towers potentially changes the estimate of total particulate emissions identified in the original EIS.

In addition to the values stated above, an expected maximum operation in the helper mode was assumed to be 22% of the time. This amount of time should encompass the increase from two to three units and potentially more adverse conditions in future years than have been encountered in the last six years. It also provides direct comparison of the results with the helper mode results in the original EIS, Volume 1, Section 2.5. For Alternative 2, under any of the options, the estimated emissions would be about 22 pounds/hr compared to an emissions standard of 45 pounds/hr and total emissions would be 21.2 tons/yr compared to the 100 tons/yr stated in Section 2.5. Thus, despite the potential increase in the number of cooling towers, design change, and configuration, particulate emissions are expected to be less than the level identified in the original EIS. As discussed in Section 3.1.3, conservative assumptions about expected emissions and conservative modeling gave the large results in the original EIS. If the future maximum operation of the towers is no more than the 8% maximum experienced in recent years, the total emissions would be only about 7.7 tons/yr.

4.3.1.3 Existing Air Emission Sources

All existing BFN emission sources for air pollutants are described in the original EIS. The addition of two cooling towers or modification of sizes of cooling towers would result in emissions discussed in Section 4.3.1.2.

4.3.1.4 Air Quality During Refurbishment

For Alternatives 2A, 2B, and 2C, the same minor construction impacts as for Alternative 1 can be expected, and some additional impacts would be associated with the expected addition of more cooling tower capacity and Unit 1 restart work. These additional impacts may include fugitive dust from earth-moving activities required to reduce the height of the existing soil berm on the northeast side of the current set of cooling towers and to prepare the footprints for the additional cooling tower capacity and associated fuel combustion emissions from construction equipment and trucks. Emissions of small amounts of fugitive dust may be associated with surface preparation and transport of concrete in mixing trucks for the construction of the proposed dry cask storage facility, the proposed modifications fabrication building, and the proposed administration building. Minor emissions of combustion exhaust products such as nitrogen oxides, carbon monoxide, sulfur oxides, and hydrocarbons from engines in concrete mixing trucks, other construction-related vehicles, and construction equipment used in construction of the new facilities and in the Unit 1 refurbishment process can also be expected. Some vapors including hydrocarbons may be emitted from stored vehicle fuels and during refueling activities. As concluded for Alternative 1, construction-related impacts on ambient air quality for Alternative 2 will be minor, intermittent, and transitory.

4.3.2 Geologic Setting

4.3.2.1 Impacts on Geology

The impacts on geology of continued operation of BFN under any of the alternatives being considered are encompassed by the analysis in section 2.8-2 of the original EIS.

4.3.2.2 Impacts of Construction on Seismicity

Under some circumstances, human activities can change the ambient seismicity of an area. Four types of human activities are known to have the ability to change seismicity levels and patterns: (1) the creation of large reservoirs; (2) large underground explosions, e.g., nuclear tests; (3) the injection (or withdrawal) of underground fluids; and (4) the excavation of mines (Gough, 1978). These activities can induce earthquakes ranging in size from microearthquakes to earthquakes with m_b magnitudes of 6 or slightly greater (Yeats, et. al. 1996).

Activities (1), (2) and (4) can be associated with construction. Activities (1) and (2) would not occur at the site under Alternative 2A, 2B, or 2C. Activity (4), excavation, would occur on a relatively small scale at the site for Alternatives 2A, 2B, and 2C. These alternatives would require removal of some or all of the mound of earth located immediately north of the existing cooling towers. It is very unlikely that moving this material would change the crustal loading enough to trigger earthquakes. Therefore, there is essentially no possibility that any construction associated with re-licensing and refurbishment of Unit 1, including the construction of the three new facilities, would alter the natural level of seismic activity and no construction impacts are expected.

4.3.2.3 Local Geology

Continued operation of BFN and refurbishment activities, including the construction of the three new facilities, should have no impact on the natural level of seismic activity in the area.

4.3.3 Solid Wastes Management and Past Practices

4.3.3.1 General Plant Trash

In the event that Unit 1 is restarted, the amount of general plant trash would be expected to increase in proportion to the increase in site population required for the reconstruction effort. In addition, there would be additional trash generated as a part of construction activities, but this amount would be significantly less than that generated by construction of a new facility. Together this could be as much as a 30% increase over current levels during the construction period. Once operational, the amount of trash generated would be similar to the other operating units, and the overall amount generated would increase slightly (approximately 12.5 %) from the current 50 ton per month level due to the small increase in permanent plant staff necessary to operate three units. The increase in general plant trash could be offset to some extent by implementation of recycling efforts beyond those currently in place. This would include increasing the amount of white paper, aluminum cans, and special stock paper sent to recycling, and improving recycling of waste wood. The existing contractor is capable of handling the increased volumes anticipated.

4.3.3.2 Construction/Demolition Debris

A small amount of additional C/D wastes associated with construction activities (except as discussed below) would be expected in the event that Unit 1 is restarted. This amount may be as much as twice that currently experienced (0.04 tons per day, increased to 0.08 tons per day). The onsite landfill has the space and capacity to handle the anticipated increase without expansion, and there is sufficient alternative capacity in surrounding off site C/D landfills should the onsite facility prove inadequate. Once Unit 1 is completed, the amount of C/D waste generated as a result of three-unit operation would not be expected to increase significantly over the rates experienced for two-unit operation.

Alternative 2C (six large linear mechanical draft cooling towers) would result in generation of a large amount of construction/demolition debris and asbestos as a result of the need to remove four existing towers and modify the fifth tower to increase its size. Demolition of Towers 1, 2, 5, and 6 would result in approximately 39 to 45 dumpsters (40 cubic yards each) of fiberglass and vinyl, 60 to 70 dumpsters of asbestos, and 16 to 20 dumpsters of scrap lumber. The fiberglass and asbestos would be disposed in off-site permitted landfills, while the majority of the scrap lumber could be recycled. A minor amount of scrap metal (wires, fasteners, etc.) would also be generated and disposed through existing recycling programs. In addition, approximately 1,350 gallons of used oil would be generated as a result of removal of the fan motors and gearboxes; this material would be recycled through the existing BFN program. Discarded motors and gear boxes would also be recycled as scrap metal. Appropriate demolition notifications would be sent to the Alabama Department of Environmental Management.

4.3.3.3 Low Level Radioactive Waste

Should Unit 1 be restarted, generation rates would be expected to increase during construction activities primarily due to additional asbestos removal operations and the normal increases associated with nuclear construction activities. Once operational, the generation rates for this type of waste material would increase in proportion to the additional operational activity associated with three-unit operation. This would result in an increase to approximately 45 to 60 cubic meters per month. These increases would be expected to remain within the storage and disposal capacities of existing facilities. The existing contractor(s) is capable of handling the increased volumes anticipated.

4.3.4 Hazardous Wastes Management and Past Practices

Construction activities associated with Unit 1 restart would temporarily increase rates of hazardous waste, universal wastes and used oil generation due to the increased use of solvents and paint related materials necessary for refurbishment, and the recovery of various plant equipment. The increases anticipated could be as much as 25 to 30% over current levels of approximately 3,000 to 3,500 pounds per year. The existing TVA process for management of this type of waste is adequate to handle the expected increase. Once operational, hazardous waste generated as a result of operation of Unit 1 would be within the normal year to year variation currently experienced. The existing contractor(s) is capable of handling the increased volumes anticipated.

4.3.5 Spent Fuel Management

Environmental consequences of additional spent fuel management resulting from Unit 1 restart and license extension of the three BFN units would be minimal. As described in sections 2.2, 2.3, and 3.5, additional spent fuel resulting from license extension would be stored in the spent fuel pool or a dry storage system approved by NRC in accordance with 10CFR72. Subsequently, all BFN spent fuel would be transferred to the DOE in accordance with the Nuclear Waste Policy Act of 1982 and subsequent amendments. The only component of a dry storage system not transferred to DOE would be the concrete storage overpack provided a modular system is chosen. If used, this component would be disposed as part of the ISFSI decommissioning. Compared with license renewal of only Units 2 and 3, the addition of Unit 1 would just increase the number of storage casks needed and the required size of the ISFSI by approximately 33%.

4.3.6 Surface Water Resources

4.3.6.1 Construction Effects

The Unit 1 upgrade, restart, and increased cooling tower capacity involves substantial construction activities. As development occurs, soil disturbances associated with access roads and other construction activities could potentially result in adverse water quality impacts. Improper water management or storage and handling of potential contaminants could result in the runoff of pollutants to receiving streams. Erosion, sediment, and accidental spills of fuel or oil could impact streams and threaten aquatic life.

Standard safeguards would be included in the project design, construction and operation to minimize the risk of adverse impacts. Construction activities would comply with state permit requirements for the control of potential impacts (e.g., general construction permit, best management practices (BMP) plan, erosion control plan, and spill prevention plan). BMPs sufficient to minimize the risk of and avoid adverse impacts would be followed for all construction activities. Site grading and soil removal would be minimized. Clearing operations would be staged so that only land that would be developed promptly is stripped of protective vegetation. Mulch or temporary cover would be applied whenever possible to reduce sheet erosion. Permanent vegetation, ground cover, and sodding would be installed as soon as possible after site preparation. Surface water runoff would be managed to avoid adverse impacts using sediment basins, silt fences, berms, or other control options. These and other similar precautions are expected to minimize potential construction impacts such that no special mitigation measures would be necessary.

4.3.6.2 Chemical Effluent Effects

Under Alternative 2, the Emergency Equipment Cooling Water, Raw Cooling Water, and Residual Heat Removal Service Water (Intermittent Treatment Mode) systems would have increased flow rates. Conservative estimates indicate that flow would increase by up to one-third as Unit 1 is added to Units 2 and 3 (actual increases may be less due to some commonality among systems). Discharge concentrations would be similar to those shown in Table 4.2.6-1, due to proportional flow increases in the corresponding waste streams. No changes are expected in the flow, concentrations, or treatment frequencies for the Residual Heat Removal (Stagnant Treatment Mode), since the operation of this system would be the same under all sub-alternatives for Alternative 2.

Effluent discharges from other plant systems such as yard drainage, station sumps, and sewage treatment would not be expected to change significantly with the restart of Unit 1. The changes in discharges to the river would remain within the bounding conditions established in the NPDES permit and therefore should have minimal impact either individually or cumulatively on the environment. The discharges are regulated under the Clean Water Act (CWA) by the U.S. Environmental Protection Agency and the Alabama Department of Environmental Management. The NPDES permit specifies the discharge standards and monitoring requirements for each discharge. The permit is renewed every five years and this helps to ensure that no changes have been made to the facility that would alter aquatic impacts and that no significant adverse impacts have occurred. Compliance with the NPDES process, other provisions of the CWA (e.g., Sections 316 (a) and (b), 401, 404), and other regulatory requirements are expected to adequately control potential chemical effluent effects. In general, under these regulatory programs, TVA treats wastewater effluents, collects and properly disposes potential contaminants, and undertakes pollution prevention activities that comply with regulatory requirements and minimize the risk of adverse environmental impacts.

4.3.6.3 Thermal Effects

The restart of Unit 1 will require upgrading the cooling tower system from the existing Unit 2 and 3 capacity. The following analysis assumes that sufficient cooling tower capacity would be supplied to maintain the instream thermal limits in the current NPDES permit. As discussed in Chapter 2, if changes in the thermal limits are found to be potentially feasible and are proposed by TVA, analyses and discussions summarized herein will be updated, as appropriate either as part of this review if it is not yet completed, or as part of the NPDES process.

Under Unit 2 and 3 operation, the maximum flow rate for the once through Condenser Circulating Water system is approximately 2,312 MGD (actual annual average flow rates are slightly lower due to outages). Restarting Unit 1 will result in a maximum flow rate for all three units of approximately 3,468 MGD. No changes are expected in the plant intake system to accommodate the flow rate for all three units.

The discharge temperature of the cooling system water would be essentially the same for three-unit operation as for Units 2 and 3 operation, due to the proportional increase in cooling water flow. However, the total amount of heat added to the river and the water temperatures at the edge of mixing zone would increase with the restart of Unit 1. Table 4.3.6-1 summarizes the temperature changes based on a near-field modeling analysis of 29 years of historical data from 1969-1999 (Harper, 2001). (Years 1989 and 1990 were not included in the analysis due to missing data.) Results are also shown for 1988, one of the driest and hottest years in the period of analysis.

The mean 1969-1999 water temperature at the edge of the mixing zone increases from 67.9°F to 68.4°F as Unit 1 is added to Units 2 and 3. In 1988 the mean temperature at the edge of the mixing zone increased from 68.8°F to 69.5°F. Figure 4.3.6-1 compares the model results for 1988 under projected two-unit and three-unit operation with operation of any of the three potential cooling tower configurations described under Alternative 2. In both cases the maximum temperature at the edge of the mixing zone is maintained below 90°F with the use of cooling towers. In 1988, the temperature rise between intake and discharge ranged from 2.0°F to 7.6°F. The potential effects of the added heat load are discussed below, based on a far-field modeling analysis.

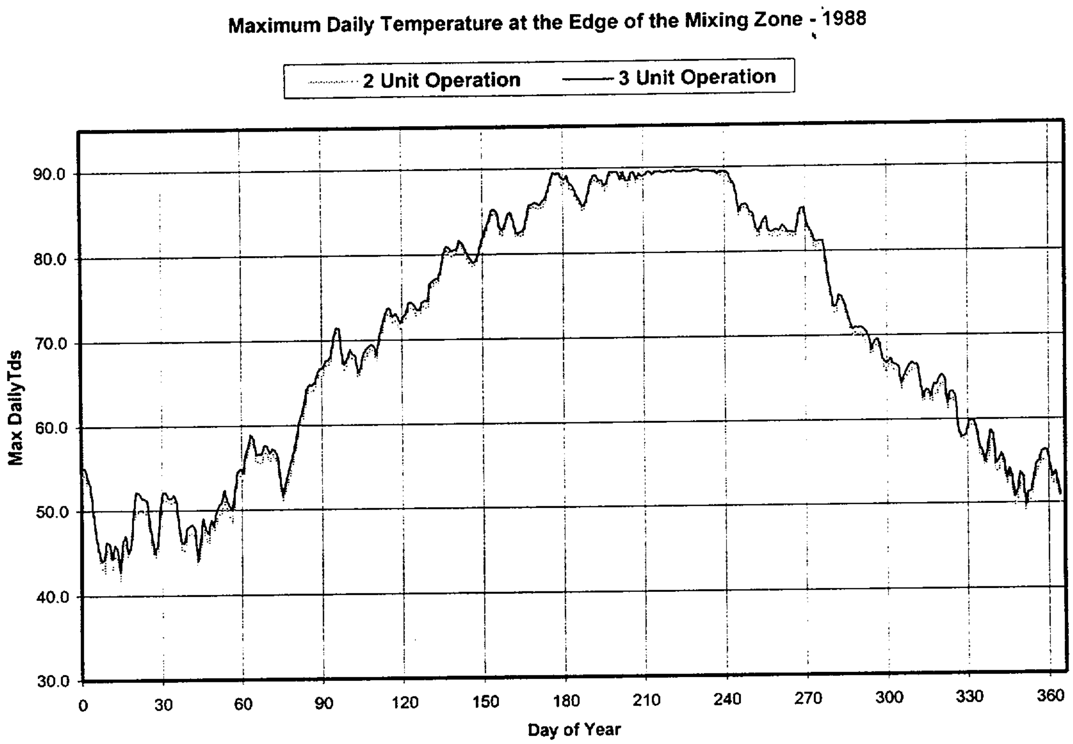
Table 4.3.6-1 Summary of Projected Thermal Effects on Water Temperatures (°F)

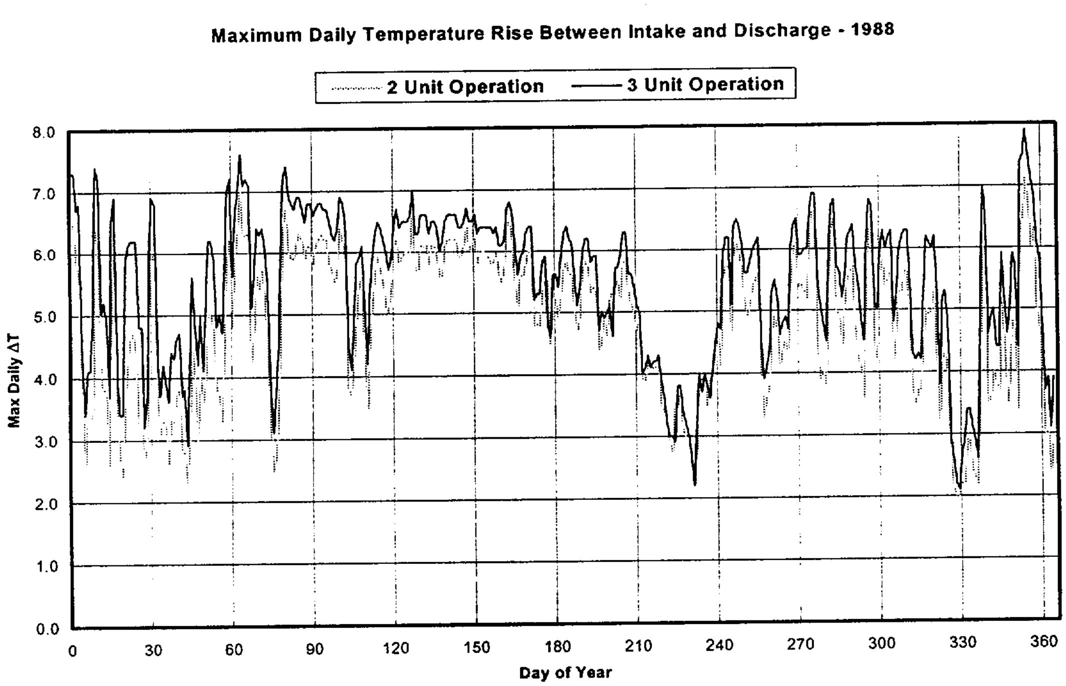
Operating Units	Years 1969-1999 (excluding 1989-90)						Year 1988					
	Discharge Point			Edge of Mixing Zone			Discharge Point			Edge of Mixing Zone		
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.
Units 2 and 3	45.6	89.2	117.4	35.8	67.9	90.0	52.8	88.7	115.4	41.2	68.8	89.8
All 3 Units	47.6	89.1	117.3	36.2	68.4	90.0	53.4	88.6	114.2	42.2	69.5	89.7
Difference	2.0	-0.1	-0.1	0.4	0.5	0.0	0.6	-0.1	-1.2	1.0	0.7	-0.1

* Based on modeling analysis of hydrological and meteorological conditions for the years indicated (Harper 2001).

With all three units operating, the maximum discharge temperature and temperature rise between intake and discharge would remain within regulatory limits. Use of the cooling towers would increase, and on rare occasions when the cooling towers are unable to meet the thermal limits, the plant would have to be derated to remain in compliance. During the 1969-1999 simulation period, model results showed that with Units 2 and 3 operating the new cooling towers configurations would be used 2.3% of the time and derating would be required 0.01% of the time (i.e., derated 27 hours over the 29 year period of analysis). With all three units operating, the cooling towers would be used 3.6% of the time and derating would be required 0.04% of the time (i.e., derated 101 hours over the 29 year period of analysis).

Figure 4.3.6-1 Water Temperatures for Two-Unit and Three –Unit Operation 1988





The implications of the thermal effects on reservoir water temperatures, dissolved oxygen concentrations, and eutrophication were evaluated using a far-field two dimensional reservoir model (TVA, 1993). Hydrological and meteorological conditions for 1988 (without cooling tower operation) were assessed as a potential worst-case condition for reservoir water quality (i.e., due to the low flows and warm weather). The potential reservoir effects from the restart of Unit 1 are expected to be less with the use of cooling towers and less in years of more typical hydrology and meteorology than in 1988. Results for 1988 are summarized in Table 4.3.6-2 for three reservoir locations: immediately upstream of BFN, immediately downstream of BFN, and in the reservoir forebay just upstream of Wheeler Dam.

Table 4.3.6-2 Summary of Wheeler Reservoir Modeling Analysis for 1988*

Parameter/Units	Upstream of BFN TRM 294		Downstream of BFN TRM 292		Reservoir Forebay TRM 275	
	Annual Mean	**Max. Day**	**Annual Mean**	**Max. Day**	**Annual Mean**	**Max. Day**
Temperature (°F)						
Units 2 and 3 (EPU)	64.5	87.0	65.0	87.1	64.5	85.1
All 3 Units (EPU)	65.8	88.3	66.5	89.0	64.8	86.7
All 3 Units (100%)	65.4	88.0	66.0	88.6	64.4	86.3
Difference (120%-100%)	0.4	0.3	0.5	0.4	0.4	0.4
Algal Biomass (mg/L)						
Units 2 and 3	1.7	4.6	1.8	4.5	1.6	3.5
All 3 Units	1.8	4.3	1.9	4.4	1.7	3.5
Difference	0.1	-0.3	0.1	-0.1	0.1	0.0
Dissolved Oxygen (mg/L)		**Min. Day**		**Min. Day**		**Min. Day**
Units 2 and 3	8.8	6.3	8.7	5.8	7.9	4.3
All 3 Units	8.7	6.7	8.7	6.6	7.9	4.5
Difference	-0.1	0.4	0.0	0.8	0.0	0.2

*Based on 1988 modeled reservoir conditions for the period and location indicated (Shiao, 2001).

The 1988 mean annual water temperature at the reservoir section downstream of BFN increased from 65.0°F to 66.5°F as Unit 1 is added to Units 2 and 3 (under the EPU operating capacity for all three units) in the modeled scenario. The mean annual water temperature at the downstream reservoir section was 66.0°F for all three units operating at their initial 100% capacities. Thus, the current three-unit operation represents an increase of 0.5°F over the original plant operation with all three units operating. The average daily reservoir temperature at this downstream section on the warmest day in 1988 increased from 87.1°F to 89.0°F as Unit 1 is added to Units 2 and 3 (under the EPU operating capacity for all three units). With all three units operating at their initial 100% capacity the water temperature on the warmest day was 88.6°F. Thus, the proposed three-unit operation is predicted to result in an increase of 0.4°F on the warmest day, over the original plant operation. Similar model results are shown in Table 4.3.6-2 for the upstream and reservoir forebay stations. The model results indicate potentially higher upstream as downstream temperatures due to periodic back flow conditions. The cumulative thermal impact would be insignificant, due to the small increase in reservoir temperatures, the limited effect on temperatures downstream of Wheeler Reservoir, and the lack of other major thermal discharges in the vicinity.

The 1988 mean annual dissolved oxygen and algal concentrations in the reservoir were essentially unchanged with the addition of Unit 1. On the day of lowest dissolved oxygen concentration in 1988, the model indicted a potential DO decrease of 0.2 mg/L to 0.8 mg/L at the three reservoir sections. Algal concentrations on the day of highest productivity were essentially unchanged. Cumulative impacts of thermal changes on DO and algal concentrations would be insignificant.

Based on these results and the future operation of the plant in compliance with regulatory requirements for thermal effluents, Alternative 2 is expected to have insignificant effects on reservoir stratification, dissolved oxygen concentrations, eutrophication, sediment transport, scouring, and cumulative impacts.

4.3.6.4 Water Use/Water Availability

Restart of Unit 1 is not expected to adversely affect the availability of water or water use by others, as the maximum cooling water withdrawal is approximately 5,368 cfs, compared to an annual average flow at Wheeler Dam of 49,800 cfs. With once-through cooling essentially all of the water is returned to the river. Even during times of minimum river flow sufficient water will be available from reservoir storage for use by others.

4.3.6.5 Microbiological Organisms

There are no developed public recreation facilities located at the BFN site. Located directly across the Tennessee River from the site is Mallard Creek Recreation Area. This is a TVA-developed and operated area. It includes camping, picnicking, swimming beach, and a boat launch area. Approximately two miles upstream of BFN is Round Island Recreation Area also developed and operated by TVA. It features facilities for camping, swimming, picnicking and boat launching. The reservoir in the vicinity of the plant site is moderately utilized by recreational boaters and fishermen.

During the 1999 TVA Vital Signs Monitoring, samples were collected at five swimming beaches and four boat ramps throughout the reservoir and analyzed for fecal coliform bacteria. All of the samples were within the State of Alabama guidelines for water contact. Since essentially no microbiological organisms will be discharged by BFN, no microbiological impacts to the reservoir or water uses are expected.

4.3.7 Groundwater Resources

4.3.7.1 Groundwater Occurrence

Activities potentially affecting groundwater resources would include foundation treatment, excavation, and grading associated with Alternative 2 facilities. These facilities might include parabolic or mechanical draft cooling towers, a Dry Cask Storage Facility, a Modifications Fabrication Building, and a permanent Administration Building. Although no groundwater use is anticipated during construction, excavations that penetrate the water table may require temporary construction dewatering. Therefore, transient impacts to groundwater resources from dewatering activities might be expected to produce localized and temporary reductions in the groundwater table. Although several water supplies are known to exist in the area, the only water supply identified close to BFN was Limestone County Water System Well G-1, more than two miles north of the proposed project site. Any groundwater drawdown impacts associated with plant construction dewatering would be temporary and of negligible magnitude due to the limited excavation depths, the relatively short duration of facility construction, and the distance of neighboring wells.

Excavation and grading associated with construction of the proposed facilities would result in permanent displacement of shallow soils above the water table. This includes the proposed berm relocation sites for sub-alternatives under Alternative 2. However, the long-term impact of these activities on groundwater resources would be negligible for all facility configurations given the limited depth and area of disturbance. The areas proposed for the mechanical draft or hyperbolic cooling towers are underlain by weathered Tuscumbia limestone and Fort Payne chert bedrock that might require foundation treatment for stabilization. Although permanent local impacts to groundwater levels and movement might be experienced from foundation treatment, the long-term impacts of these activities on groundwater resources would be negligible for the proposed cooling tower configurations given the limited area of disturbance.

A secondary construction concern is associated with potential contaminant releases during construction activities. The potential contaminants are primarily fuels, oils, and solvents used for operation and maintenance of vehicles and equipment. However, this potential risk would be lessened by careful handling and proper disposal of potential contaminants according to BMP guidelines. Possible BMP measures include careful handling and proper disposal of contaminants according to guidelines of the BFN Spill Prevention, Control and Countermeasure Plan.

No adverse impacts to groundwater resources are anticipated from operation and maintenance of new facilities associated with Alternative 2 for the project.

4.3.7.2 Groundwater Use

Currently, groundwater is not used by BFN, no groundwater use is anticipated during construction, and site dewatering wells have been inactive since the 1980s. Although excavations that penetrate the water table may require temporary construction dewatering under Alternative 2, drawdowns would be temporary and of negligible magnitude to impact off-site private water supplies. No adverse groundwater use impacts are anticipated from all alternatives considered for the project.

4.3.8 Floodplains and Flood Risk

The floodplains and flood risk assessment for Alternatives 2A and 2B is the same as for Alternative 1.

Under Alternative 2A, Units 2 and 3 would be relicensed at EPU levels, Unit 1 would be refurbished, restarted, and relicensed at EPU levels, and a dry cask storage facility, Modifications Fabrication Building, permanent Administration Building, and two additional mechanical draft cooling towers would be constructed. All anticipated flood impacts would be the same as those listed for Alternative 1 except for potential PMF flooding impacts to the two new towers. The towers would be located above the PMF elevation in a new footprint. The construction of these towers would involve the relocation of material to one of three potential spoil areas. These areas are all located outside the limits of the 100-year floodplain, consistent with EO 11988.

Under Alternative 2B, Units 2 and 3 would be relicensed at EPU levels, Unit 1 would be refurbished, restarted, and relicensed at EPU levels, and a dry cask storage facility, Modifications Fabrication Building, permanent Administration Building, and two new hybrid cooling towers would be constructed. All anticipated flood impacts would be the same as those associated with Alternative 2A.

Under Alternative 2C, Units 2 and 3 would be relicensed at EPU levels, Unit 1 would be refurbished, restarted, and relicensed at EPU levels, and a dry cask storage facility, Modifications Fabrication Building, Permanent Administration Building, and 5 new linear mechanical draft cooling towers would be constructed. Based on the site topography dated 1989, the proposed mechanical draft cooling towers would be located at the existing cooling tower footprints above elevation 570. All equipment within the cooling towers that could be damaged by floodwaters would be located above or flood proofed to the PMF elevation, as required. The construction of these towers would also involve the relocation of material to one of three potential spoil areas. These areas are all located outside the limits of the 100-year floodplain, consistent with EO 11988.

4.3.9 Terrestrial Ecology

4.3.9.1 Vegetation

Alternative 2 would cause some disturbance of existing plant communities in conjunction with the addition of any of the three configurations of new cooling towers and the relocation of soil that would accompany the construction of these towers. However, no uncommon terrestrial communities or otherwise unusual vegetation occur on the lands to be disturbed under this Action Alternative. With respect to vegetation, any direct, indirect, or cumulative impacts to the terrestrial ecology resources of the region are expected to be insignificant as a result of the proposed activities.

4.3.9.2 Wildlife

Under Alternative 2, the operating licenses for the three units at BFN would be renewed for up to 20 years, and Unit 1 would be restored to service. Associated with this would be the restoration of several existing cooling towers and/or the construction of new cooling towers, and the construction of three new facilities. These construction activities would result in the removal of some early successional habitats in the vicinity of the existing facilities. Because no rare or uncommon communities of animals exist on the site, this action alternative would not result in adverse impacts to any uncommon wildlife or their habitats.

4.3.9.3 Introduced Species

Because no intact native plant communities occur on lands to be disturbed by the proposed project, and because introduced plant species are already present in these areas, any direct, indirect, or cumulative impacts due to the establishment or spread of introduced plant species are anticipated to be insignificant as a result of the actions associated with Alternative 2.

Two introduced species, the European house sparrow and the European starling, are known to exist on the project site. These species are quite common in the project area. Alternative 2 would not result in increased population levels of introduced animal species.

4.3.9.4 Managed Areas and Ecologically Significant Sites

Because the proposed actions would occur within the lands presently utilized for the operation and maintenance of the BFN no impacts to Managed Areas or Ecologically Sensitive Sites are anticipated.

4.3.9.5 Refurbishment Impacts

Similar to the experience with recovery of Units 2 and 3, no substantial ecological impacts are expected for the recovery of Unit 1. Site worker population could be temporarily increased to a peak of approximately 3,000 (possibly fewer if some of the workers remain at their parent companies and are not relocated to the BFN site). This influx of workers would require either permanent or temporary new office and shop buildings, and would increase the load on the waste treatment plant. The waste treatment system at BFN is sized to operate with a maximum plant population of approximately 4,500.

As was the case for recovery of Units 2 and 3, equipment being replaced would necessitate the disposal of the original items, which in some cases might involve decontamination and/or eventual shipment to a low-level waste repository. Refurbishment may also result in producing other materials requiring disposal, such as decontamination chemicals and worker C-zone items (booties, gloves, tape, rags, etc.).

Any of the sub-alternatives under Alternative 2 would involve major additions to existing cooling tower capacity. Some of this additional capacity may be accomplished by refurbishment of the existing cooling towers, and this could necessitate the disposal of fill materials (some of which contain non-friable asbestos) and possibly steel and concrete (see Section 4.3.3.2). Disposal of all such materials that cannot be recycled would be in permitted landfills, either on-site or off site, thus impacts to terrestrial resources would be minimal and insignificant.

4.3.10 Aquatic Ecology

4.3.10.1 Fish

Refer to 4.2.10.1. With implementation of BMPs and other measures as needed, to prevent the entry of pollutants into surface waters potential impacts to aquatic life resulting from construction of new facilities would be insignificant.

Potential impacts from changes in thermal characteristics of CCW discharge from BFN and entrainment and impingement of fish are discussed in section 4.3.10.4.

4.3.10.2 Benthic Organisms

The refurbishment and restart of Unit 1 at EPU is proposed in addition to operating Units 2 and 3 at EPU for Alternative 2. To provide additional heat dissipation capacity for the restart of Unit 1, different cooling tower configurations have been identified. The new cooling towers would either be mechanical draft or new hybrid ("modified parabolic") towers in new footprints. With the addition of two cooling towers, discharge temperatures at the diffusers would not change appreciably from that which was experienced in the 1970s and 1980s when Unit 1 was on line. As mentioned, monitoring, begun in the Fall of 2000, will continue through at least the term of the current permit cycle (5 years) to confirm that operation at the uprated power levels has no adverse impact on the aquatic community in the vicinity of BFN. The proposed actions would not impact the benthic macroinvertebrate communities in the vicinity of BFN diffuser discharges.

4.3.10.3 Introduced Species

The Vital Signs Monitoring program is designed to track introduced species throughout the Tennessee Valley. Actual monitoring will document any increases in zebra mussel reproduction in the vicinity of BFN. Monitoring raw water for zebra mussel larvae inside BFN would allow formulation of treatment plans to prevent biofouling impacts to BFN operations resulting from zebra mussel infestation.

Grass carp abundance is not expected to be influenced by BFN operations. Introduced grass carp are normally sterile, so that their numbers can be maintained at desired levels by adjusting any future stocking rates.

4.3.10.4 Entrainment and Impingement of Fish and Shellfish, Heat Shock

With the return of Unit 1 to operation, the total condenser circulating (ie., cooling) Water (CCW) flow would increase by about 21.5%. This increased CCW intake volume would increase impingement of adult fish and entrainment of fish eggs and larvae. In 1978, TVA concluded that hydraulic entrainment (percent of river flow entrained annually) ranged from 3 to 12 percent during the period from 1974 to 1977. Entrainment of fish eggs and larvae ranged from 1 to 13.3 percent during the same period. Shad dominated the entrainment samples representing 80 to 98 percent of all larval fish collected. Those taxa having an essentially pelagic, planktonic distribution (suspended within the water column and transported by river currents) were entrained in increasing percentages as intake demand increased especially during three-unit operation in 1977. Annual percent entrainment of numerically important taxa (taxa greater than 1 percent of annual entrainment) during 3-unit operation (1977) ranged from 4.5 to 15.6, sucker and mooneye families, respectively. Sport and commercial fish annual entrainment that were greater than 1 percent during the same period (sunfish and crappie 4.8%, sauger and walleye 14.6% and catfishes 29%) are species known to spawn near shore and in BFN's intake channel. Impingement during the same period of 1974 through 1977 concluded that four species (threadfin and gizzard shad, freshwater drum and skipjack herring) accounted for approximately 95 percent of the total numbers of fish impinged on BFN's traveling screens. No other fish species impinged was greater than 1 percent (TVA 1978). It is not anticipated that the increased CCW flow would adversely impact the fish community in Wheeler Reservoir. Operational monitoring of impingement and entrainment during the first year of operation of Unit 1 can be used to confirm this analysis of effects to the fish community. In addition, annual Vital Signs monitoring currently being conducted, would also show effects to the fish community in Wheeler Reservoir. Increased discharge temperatures are not planned; thus, heat shock impacts are not anticipated.

4.3.10.5 Microbiological Organisms

With the return of Unit 1 to operation, total CCW flow would increase by about 21.5%. In 1978, TVA determined that almost all the phytoplankton in the CCW intake is coming from the north bank of the Tennessee River upstream of BFN. The plankton community is dynamic and can reproduce and recolonize rapidly. Therefore, to the extent Wheeler Reservoir plankton serves as a food source for other aquatic life, restart of Unit 1 is not anticipated to have an adverse effect on aquatic life dependent upon plankton as a food source. Operational monitoring during the first year of operation of Unit 1 would help to confirm the level of intake impacts to Wheeler Reservoir fish populations, and possibly to plankton densities. Thus, there would be no impacts to microbiological organisms resulting from any of the proposed action alternatives.

4.3.11 Threatened and Endangered Species

4.3.11.1 Animals

As described in Chapter 3, four listed species of animals are reported from Limestone County. Implementation of Alternative 2 would not result in adverse impacts to federally listed gray or

Indiana bats. Gray bats likely forage along the shoreline of the Wheeler Reservoir, adjacent to the nuclear plant. However, renewal of the operating license resulting in the continued operation of the nuclear plant and modifications and construction of the cooling towers would not affect this species because they only forage over aquatic habitats and their foraging areas would not be altered by the proposed project. No suitable habitat for Indiana bats or the Tennessee cave salamander exists on the project site. Some habitat suitable for Appalachian Bewick's wren exists on the site; however, proposed modifications at the site would not eliminate this habitat. Therefore, Alternative 2 is expected to have no direct or cumulative effects on listed terrestrial species or their critical habitat.

4.3.11.2 Aquatic

As described in Chapter 3, there are five federally protected aquatic species in Wheeler Reservoir in the vicinity of BFN, but these are found in habitats upstream of the plant. During the three phases of BFN's thermal variance monitoring (1985-1998) and current Vital Signs Monitoring programs, no threatened or endangered aquatic species were found within the area affected by construction or operational changes at BFN as proposed herein. The seven survey reports cited in section 3.11.1 support the conclusion that, the proposed changes and additions to BFN would have no effect on the species listed in Section 3.11.2.

4.3.11.3 Plants

No occurrences of rare (i.e., federal- or state-listed) plant species are known on or immediately adjacent to the lands to be disturbed under Alternative 2. Therefore, no direct, indirect, or cumulative impacts to rare plant species are anticipated under this Alternative.

4.3.12 Wetlands

Construction activities associated with Alternative 2 would require the excavation and removal of soil for the construction of new cooling towers. None of the excavation or spoil areas will occur in wetlands, thus there would be no impacts to wetlands.

4.3.13 Socioeconomic Conditions

4.3.13.1 Demography

Under Alternative 2, Unit 1 recovery staffing requirements would have an impact on the population of Limestone and surrounding counties. Staffing would reach a peak of approximately 3,000 workers. This peak would only last about 6 months, while the construction project would last about six years in total. A staffing level of at least 1,500 would be maintained over approximately four years, with a staffing level of at least 2,000 being sustained over almost three years. Not all of these workers would be located at the plant site, e.g., design staff, which would exceed 500 workers for about three years . Furthermore, only a minority of on-site workers would relocate as a result of employment on this project, further mitigating the impact on the local area. Many workers would commute from their homes outside Limestone County. In 1971, at the peak of the original BFN construction, about 25 percent of the employees at the site changed their residence in order to work at the site. This suggests that no more than 750 workers (25 percent of 3,000 peak employment) would move into the area to work on this project, and very likely less than this. With families this would mean a maximum population increase of 2,000 to 2,500 persons. The duration of any such population increase would likely be 3 to 4 years, coinciding with the sustained staffing levels of 1,500 to 2,000.

This maximum population increase is equivalent to about twice Limestone's annual population growth through the 1990s (or 4.0 percent of the current county population). However, because many workers would commute from outside the county, a more meaningful comparison is made with the growth rate of the labor market area. The maximum population increase resulting from the project is equivalent to less than one-third the area's annual population growth (or 0.4 percent of the current area population). The most likely locations for those moving into the area outside Limestone County to work would include Huntsville, Florence, and Decatur in Alabama, along with possibly Pulaski and Fayetteville in Tennessee. The impact of population growth resulting from this project would be eased as a result of the gradual build-up in staffing. Peak staffing would be the result of almost 4 years of steady staffing increases.

4.3.13.2 Economic Conditions

Under Alternative 2, recovery of Unit 1 would generate additional income in the area from a large workforce over a time span of approximately 6 years (see Section 2.4.2.1).

A sustained employment level of 1,500 to 2,000, less at least 500 off-site workers, results in perhaps 1,000-1,500 new jobs over 3 to 4 years. This represents 3.5 to 5.2 percent of Limestone County's current employment level, or 0.3 to 0.4 percent of labor market area employment. The income earned by 1,500 on-site workers would represent approximately 4 percent of annual earnings in Limestone County, but only 0.3 percent of the labor market area's annual earnings (and many of these workers would reside outside Limestone County). A permanent staff of 150 would be required to operate Unit 1, and their earnings would represent about 0.7 percent of Limestone County annual earnings and 0.1 percent of area earnings. Alternative 2 would have a beneficial, albeit relatively minor, effect on income in Limestone County and the broader labor market area.

4.3.13.3 Community Services and Housing

Under Alternative 2 during construction, there most likely would be some short-term strain on community services, including police and emergency services. Schools likely would experience noticeable impact. Housing for movers could become a short-term concern. However many of the movers would seek short-term rental facilities, including motels, or sites for trailers, easing somewhat the strains on the traditional housing market. Housing and the impacts on community services would be spread around geographically within the labor market area, including Huntsville, lessening the extent of the impacts on any one location or governmental jurisdiction. Also, many of the workers would commute on a weekly or other less than daily basis, and would not reside in the area all the time. Residential locations would depend on the availability of suitable facilities or sites, and could be anywhere in the labor market area. These strains on the local and area housing markets most likely would lead to increased prices for at least some types of housing. The impacts on housing prices would begin to diminish after the peak construction employment level is reached and then essentially disappear by the end of the construction period.

The increase in permanent employment associated with operation of Unit 1 in addition to Units 2 and 3 could have a temporary impact on the local housing market and housing prices in Limestone County and, to a lesser extent, the surrounding area. However, given the recent relatively fast growth in population in Limestone County, the impact likely would be minor and not very important. As of 2000, there were 2,209 vacant housing units in Limestone County, which are enough to absorb the peak number of new households that could be expected during the project, even if they all located in Limestone County.

4.3.13.4 Local Government Revenues

Under Alternative 2, in addition to the expenditures that would occur with Alternative 1, there would be significant capital expenditures on Unit 1, estimated to be about $1.24 billion. As a result, TVA in lieu of tax payments to the state would increase. In turn, there would be increases in the amounts redistributed by the state to north Alabama counties located in the TVA service area. The total annual payment to the state of Alabama is estimated to increase by about $4.3 million. Based on the current redistribution formula, about $660,000 would be redistributed to Limestone County. Madison and Morgan Counties would also receive similar increases, estimated to be about $710,000 and close to $560,000, respectively. Other counties in the area would receive smaller increases. In addition, there would be additional tax revenue associated with expenditures made in the area for materials associated with the proposed refurbishment as well as sales tax revenue associated with purchases by individuals employed during construction and subsequently during operation. The magnitude of these increases could vary greatly, depending on the amount of local purchases for construction and on the relocation and buying decisions of workers employed at the site.

4.3.13.5 Environmental Justice

As discussed in Section 3.13.4, the disadvantaged population percentage in the immediate area near the site is relatively small. Any negative impacts to persons living near the site would be small and would tend to be dispersed through the area. Potential impacts of concern would include air quality, transportation, visual, and noise. The use of BMPs and planned mitigation, as discussed in this chapter, would help maintain such impacts at a level of no significance. No disproportionate impacts to disadvantaged populations are expected.

4.3.14 Transportation

4.3.14.1 Highways and Roads

IMPACTS OF CONSTRUCTION

Additional traffic would be generated due to refurbishment of the Unit 1 at EPU and the associated construction of additional cooling tower capacity. No impacts to the state and county roads in the vicinity of the site are expected. The construction period spans almost six years with a construction workforce rising to peak levels of 3,055 employees on-site during the refurbishment period. Assuming an average ridership of 1.6 persons per vehicle, and a trip in and out each day, about 3,820 vehicles will be added to the road network due to daily commuters during this peak construction period. Assuming traffic is split equally in three directions on Shaw Road, Nuclear Plant Road, and Browns Ferry Road, the Average Daily Traffic (ADT) on these county roads would increase to approximately 2,900 vehicles per day, or a 180% increase in ADT. U.S. Highways 72 and 31 would not be significantly impacted.

For a more detailed analysis (Highway Capacity Analysis), the assessment of traffic effects for the project is based on the transportation planning and engineering concept of level of service (LOS). This concept addresses the quality of service, or operating conditions, provided by the roadway network, as perceived by motorists during the peak hour of traffic, typically the afternoon rush hour. Six LOS are designated as A through F, with A being the best. With this type of analysis, level of service D is viewed as the minimally acceptable LOS of the roadway because associated conditions can be tolerable for short periods of time, or peak hour conditions. In contrast, an LOS of E or F would be viewed as an unacceptable level. Peak work force levels were calculated using certain assumptions. First, it was assumed that 80% of the peak on-site personnel would work day shift and travel during peak hours. Also, at worst case, peak work force was determined using both peak construction forces and existing work forces common during an outage. As for the broad ADT analysis, an average ridership of 1.6 workers per vehicle was assumed. Current peak traffic was assumed at 12% ADT and the current truck composition is 10% of average daily traffic. Also, for this analysis, an even split was assumed on the three county roads toward U.S. Highway 72 or U.S. Highway 31.

The results of the level of service analysis show a decrease on the county roads from level of service C to D during the construction phase. The county roads would provide traffic flow conditions where tolerable average operating speeds are maintained but would be subject to considerable and sudden variation. These conditions can be tolerable for short periods of time. In this instance, such conditions could occur twice during the day and last for up to one hour.

There will also be additional traffic added to the road network throughout the day in the form of construction material deliveries to the site and disposals from the site. This truck traffic will vary over the length of the refurbishment project. For example, the dry cask storage pad construction may generate up to 25 truck trips per day, but would only last approximately a month. The level of service analysis is based upon peak commuter traffic. This condition would only last approximately six months when the maximum work force would be on site; therefore, the analysis provides a conservative estimate. This conservatism offsets and compensates for unknown construction material truck deliveries and disposals, traffic growth, possibility of fewer sharing rides, and variation of traffic flows during peak hours on the local roads, without altering the final results regarding the significance of future road transportation impacts. The level of service analysis concentrates on peak hours; therefore, there would be no loss of level of service during off-peak hours when trucks will mostly travel.

There will be some additional delay at the various plant exits and the intersections with County Road 25 at shift changes. Those experiencing the delay would primarily be the construction commuters. Such a problem can be easily tolerated for the short duration of the peak construction period. If unacceptable delays routinely occur, which is not expected, delayed shift changes could be instituted to help alleviate the problem. In summary, TVA concludes that the roads in the area are capable of absorbing this additional traffic and stay within an acceptable level of service.

IMPACTS OF OPERATION

Additional commuter traffic generated during operation of the refurbished Unit 1 at EPU would result in an ADT increase on the county roads of less than 5 percent due to an additional workforce of approximately 150 employees. There would also be approximately 50% additional hydrogen and Calgon water chemistry truck deliveries; or less than 10 trucks per week. This minor increase in operational traffic results in an insignificant impact to the transportation system.

Traffic growth would continue during the licensing period for twenty years following to year 2033. During this time, traffic volumes would increase, assuming 15% growth rate per decade, to approximately 22,000 vpd on U.S. Highway 72 and 26,600 vpd on U.S. Highway 31. The county roads would increase to approximately 2,700 vpd.

ANTICIPATED IMPACTS

The county roads are in good condition for access and would be adequate to support the traffic requirements during both construction and operation. Traffic increases during construction are much higher than that during operation; however, construction periods are temporary and peak forces only last for approximately six months. Nevertheless, even the traffic increases associated with the peak construction force levels do not result in any unacceptable service levels. There would be some delay turning onto County Road 25 from the plant due to traffic congestion at shift changes and leaving multiple exits simultaneously. Generally, as distance from the site increases, impacts to the transportation network decrease, as traffic becomes more disbursed. The major multi-lane highways U.S. Highway 72 and U.S. Highway 31 would provide higher capacity levels and an increase in traffic would tend to be less noticeable in these areas.

Traffic and ADT predictions are projected over many years. These projections may vary greatly over such a length of time. However, 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 are expected to also improve.

4.3.14.2 Railroads

Alternatives 2A, 2B, and 2C would result in no impacts to the railway system.

4.3.14.3 River Transport

Alternatives 2A, 2B, and 2C would result in no impacts to river transportation.

4.3.14.4 Pipelines

Alternatives 2A, 2B, and 2C would result in no impacts to pipelines.

4.3.14.5 Transmission Lines

If restarted, Unit 1 is projected to return to operation in 2007. An interim study of the impact on the transmission system of BFN Unit 1 restart as an upgraded unit being added in the year 2007 to the previously upgraded Units 2 and 3 has been completed. No transient stability or fault analysis studies were included in the study. No new line right-of-ways or construction of new transmission lines would be required or are proposed for the restart of Unit 1. The results of this 2007 load flow study identify the cumulative effects of the three-unit generation changes as well as increased loads in the area and other generation changes in the area. The results of the analysis are:

1) At least one additional 500-kV circuit breaker would have to be installed in the existing BFN 500-kV switchyard; this is assumed to be needed for stability reasons without the benefit of detailed transient stability studies.
2) The following 161-kV lines become overloaded due to single contingency events. Line uprates (i.e., retensioning or increasing tower height or adding towers as necessary to maintain height clearances of conductors which warm and sag under higher power loading), reconductoring (i.e., increasing conductor size) or other solutions would be required to correct these overloads.
    - Madison-Redstone 161-kV transmission line - 13.2 miles
    - Redstone-Farley 161-kV transmission line - 5.5 miles
    - Limestone-Jetport 161-kV transmission line - 8.1 miles
    - Limestone-North Huntsville 161-kV transmission line - 15.9 miles
    - Limestone-Peach Orchard 161-kV transmission line - 10.7 miles

   The right-of-ways which are occupied by the affected transmission lines have been kept clear of tall vegetation. Mowing and other maintenance equipment has been on these right-of-ways periodically over the operation life of the lines. As a result, it is less likely that the activities associated with line upgrading would impact significant resources than if new transmission lines were constructed on new right-of-ways.
3) Other transient stability improvements or circuit breaker replacements may be required.

TVA continues to study the capability of its transmission system and analyses will be appropriately updated in the future.

4.3.15 Soils and Land Uses

4.3.15.1 BFN Environs

Potential impacts to site soils and land use associated with refurbishing Unit 1 and relicensing all three units are related to construction of cooling towers, buildings, and a dry cask storage facility. Two building are proposed, a Modifications Fabrication Building, and a new Administration Building. Alternative 2A proposes two new mechanical draft towers and Alternative 2B proposes two new hybrid towers. Alternative 2C proposes construction of 5 linear mechanical draft cooling towers and expansion of existing cooling tower 3. All of the Alternative 2C towers are to be built in the same location as existing towers. The existing Modifications Fabrication Building would be removed to enable construction of the dry cask storage facility. An Administration Building and a new Modifications Fabrication Building would be erected. Temporary land use would be required for activities when removing old components and constructing new components. In addition, the large number of temporary workers needed to accomplish the major refurbishment activities would require temporary facilities be installed for on-site parking, training, site security access, office space, change areas, fabrication shops, mockups, and related needs. This would require from 2.5 to 10 acres. Because any of these structures, either temporary or permanent, would be located on soil which has previously been disturbed, the impacts would be insignificant. The entire plant site is classified as built-up land, thus any construction at the plant would have insignificant impact to on-site land use.

4.3.15.2 Future Land Uses/Modifications (Including Offsite)

Land use in the region surrounding a nuclear power plant may change as a result of plant-related population growth. The changes proposed by this action only support about 150 additional permanent employees. Any impacts would be temporary and insignificant.

4.3.15.3 Land Use Planning and Controls

Limestone County receives in lieu of taxes revenue from TVA and this revenue significantly aids the development of the county. This revenue would not be adversely affected by implementation of either of the Action Alternatives. No impacts to land development are expected from any of the proposed actions.

Impacts associated with continued use of transmission line right-of-ways (ROWs) after restart of Unit 1 are largely related to agricultural land use. Buildings cannot be built within the ROWs and the vegetation must be maintained to prevent interference with the lines. These effects would continue during the extended license period. No new ROWs for construction of transmission line are proposed as part of the alternatives addressed in this SEIS.

4.3.16 Visual Resources

In addition to the common proposed activities of constructing a dry cask storage facility and a new Modifications Fabrication Building, Alternative 2 proposes the construction of a permanent Administrative Building. These proposed facilities would have minor visual impacts on the industrial character of the plant site. However, adding the proposed facilities would increase the number of adversely-contrasting elements seen inside the development from the rural countryside. These incremental changes may not be individually significant, but together with other facilities, they would add to a continuous growth of structures seen in the landscape and a cumulative reduction of visual resources as seen from the countryside.

Approximately 514 personnel would occupy the new Administrative Building upon completion of construction. Most of these employees would likely be relocated from other existing plant office buildings, making those buildings available for incoming Unit 1 recovery personnel. Parking would be displaced during the construction of the Administrative Building; therefore, the existing gravel parking lots around and among the mechanical draft cooling towers would be used. Parking in these areas would be visually similar to the nearby parking that is being displaced. An additional parking facility, for approximately 200 automobiles, would be constructed immediately northeast of this area in the foreground of County Road 25. The parking facility would be viewable by motorists and workers on the northeast side of the plant site.

County Road 25 provides the main access route to both the plant entrances and to homes north of the site. Most views to the site will be from this area and from the homes across Wheelers Lake at Mallard Creek and Mallard Creek public use area. Increasing the number of vertical objects in the landscape would add to the visually discordant contrast between rural countryside and the industrial character of the plant site. The heights and related dimensions of the proposed structures are shown in Table 4.3.16-1.

Table 4.3.16-1 Summary of Height/Size Information

Plant Feature (Proposed)	Feature size same for each alternative
Mechanical Draft Towers (2 proposed)	60 feet height
Parabolic Cooling Towers	60 feet height; 300 feet base diameter
Proposed Berms (Soil from existing berm)	10 feet to 40 feet height

Alternate 2A includes the same activities as Alternate 1 with the addition of two new mechanical draft cooling towers located on the west side of the existing cooling towers at the base of the existing berm. In order for the towers to be located in this area, the berm would be modified by removing a portion of the existing earth and placing it in one of three alternate sites. These sites are discussed in greater detail in section 3.1.16.

The new cooling towers proposed under this alternative would be architecturally similar to the existing towers. The proposed towers and the existing would be approximately the same height, as shown in Table 4.3.16-1. The new towers would be seen by motorists along Browns Ferry Road in the middleground as the plant site comes into view, and briefly in the foreground traveling north on County Road 25. Motorists traveling south on County Road 25 would see the upper portions of the towers briefly above the remaining berm on the east side. Residents across Wheelers Lake southwest and from Mallard Creek public use area would see additional vertical structures in the landscape that would obscure views to natural areas beyond. These additional towers would add to the continuous growth of visually discordant structures in middleground views for these residents.

Lowering and re-shaping the existing berm would have both positive and negative impacts. Motorists traveling south on County Road 25 would have much broader views of the cooling towers and of other main buildings within the plant site (i.e., the turbine/reactor building and the new Administrative Building). Residents north of the plant could have views of the skyline affected by the appearance of rooflines of industrial facilities. For these residents, the harmonious mosaic of cultural and natural features in the countryside becomes less intimate.

However, for motorists traveling north on County Road 25 and for workers and visitors within the plant site, re-shaping, lowering, and relocating the berms to one of three alternate locations could have a positive or beneficial affect. The topography surrounding BFN is gently rolling with little visual interest achieved through dramatic elevation changes. By creating elevation changes with berms, scenic classification could range from moderately desirable to desirable. Elevation changes, particularly with heights over 10 feet, break up forms in the foreground and add visual interest to a viewshed.

Alternate 2B would be the same as Alternate 2A with the exception of two new hybrid "modified parabolic" cooling towers that would be used instead of the mechanical draft towers. These towers would provide a striking contrast when viewed adjacent to the existing mechanical draft towers. Materials, colors, and forms would be quite different. For residents across Wheeler Lake and visitors at Mallard Creek day use area, the towers would increase the number of adversely-contrasting elements as seen in the middleground across the river.

Alternate 2C, demolishing the four existing Ecodyne cooling towers, constructing five new linear mechanical draft cooling towers and increasing the size of the existing Balke-Durr cooling tower by 25%, would add to the number of linear elements seen across the plant site. The new mechanical draft towers would be larger than the existing Ecodyne cooling towers, providing a greater contrast to the broadly horizontal forms seen over the plant site now. Motorists along County Road 25 would have the greatest views of the new towers.

In comparison, Alternate 1 would have the least visual impact (of the Action Alternatives) for both plant workers, visitors, and motorists along County Road 25. This alternate would require the least amount of grading and earth moving activities, particularly since the berm adjacent to the cooling towers would not be disturbed. The new administrative building, modification and fabrication shop, and proposed dry cask storage facility would have little visibility from nearby homes and passing motorists. Development of this alternative would result in fewer cumulative visual impacts within BFN industrial setting.

IMPACTS OF CONSTRUCTION

As the new Administrative Building reached completion, it would be seen in the foreground by passing motorists. Very little, if any, outdoor work for Alternatives 1 or 2 would take place at night. This is also true for work during the No-Action Alternative such as the dry cask spent fuel storage facility and the new modifications/fabrication building. Any such outdoor night-time work would be minimal and would be the exception, not the general practice. There may be some indoor work scheduled at night, particularly for support tasks such as scaffolding and other job preparations. Scenic integrity in the area would be somewhat low during the construction process. The visual discord of construction would be temporary, and would last until site cleanup and reclamation of disturbed areas are complete.

Alternate 2A would have the same impacts of construction as Alternate 1 with additional grading and the introduction of two new vertical structures in the landscape. There would be a temporary increase in the amount of machinery seen on site from area residents and motorists. Construction activities would include tree removal from the berm area, material stockpiles, and related work seen in the foreground and middleground from the highway and nearby homes. There could potentially be an increase in truck traffic along County Road 25 as dirt is being hauled from the existing berm to one of the three alternate sites. Scaffolding, lift trucks, and other machinery would be seen by area residents during the construction of the two new mechanical draft cooling towers.

Alternate 2B would have similar visual impacts during construction as Alternate 2A. During the construction process, different types of machinery may be utilized to construct the modified parabolic cooling towers than the mechanical draft units, and frequencies for material deliveries may vary. However, visual discord would be temporary and would last until site cleanup is complete.

Alternate 2C would require various pieces of machinery, staging areas, and storage yards for the removal of the existing cooling towers and the construction of the new, larger towers. Some of this equipment, such as cranes, could be readily seen in the foreground by local residents and motorists along County Road 25. Scenic integrity could be low during this period. As with each of the proposed alternates, visual discord as a result of construction will last only until the site has been restored to pre-construction conditions

IMPACTS OF OPERATION

Under Alternatives 2A, 2B, and 2C, the impacts for operation would be identical and similar to those in Alternative 1. In each of these alternatives, additional plumes may be seen as a result of adding two additional cooling towers. The shape, size, and duration of these plumes would vary with operations and atmospheric conditions.

4.3.17 Recreation

Impacts for Alternative 2 (A, B, and C) would be insignificant because no recreational facilities, resources, or uses would be affected. This includes activities associated with the construction of the proposed dry cask storage, the modification fabrication facilities, and the permanent administration building as well as the restoration and restart of Unit 1. Accordingly, cumulative impacts for Alternative 2 (A, B, and C) also would be insignificant.

4.3.18 Cultural Resources

4.3.18.1 Archaeological Resources

Under Alternative 2, TVA is considering refurbishing and restarting Unit 1 in addition to extending the licenses for all three units. The three variations of this alternative, 2A, 2B, and 2C, proposed the addition or replacement of cooling towers in the vicinity of the present mechanical draft towers. The proposed construction activities included in 2A, 2B, and 2C are in previously disturbed locations and would not directly affect historic properties, but would result in excess waste disposal in the three designated spoil disposal areas. The construction of the proposed dry cask storage facility, Modifications Fabrication Building, and administration building will not have any direct affects on historic properties, but would also result in disposal of material in the three designated spoil disposal areas.

The disposal of materials in these areas may affect historic properties that are listed or have the potential to be listed in the NRHP. One potentially eligible archaeological site was identified during the Phase I survey of Area 1 (see Figure 2.2-7). This site has a potential to have intact deposits that would provide valuable information about the prehistoric period in this region. The site is marked on BFN drawings and it is expected that it would be avoided by any future activities. If avoidance is not possible, a Phase II archaeological survey will be required. A Phase II survey would require additional excavation through close interval shovel testing, hand-dug test unit excavation and potentially backhoe trenching in order to delineate site boundaries and establish site significance. Any such investigations would require consultation with the SHPO. The Cox Cemetery, located in Area 2, would be avoided by all disposal activities.

4.3.18.2 Historical Structures

No historic structures were identified within the visual area of potential effect. Therefore, there will be No Affect on historic structures.

4.3.19 Environmental Noise

Additional or larger replacement cooling tower(s) are the only sources of potential noise effects from the action alternatives. The cooling towers for action Alternative 2A include the original cooling towers and two more similar ones located to the northeast of current towers 4, 5, and 6, see Figure 2.2-6. Cooling towers for Alternative 2B also include the original towers and two, circular towers. These round towers are about 300 feet in diameter, 60 feet high, and have 18, 300 horsepower fan-motors. See Figure 2.2-8 for the locations of the additional circular cooling towers. Alternative 2C expands tower 3 by 25%, replaces towers 1, 2, 5, and 6 with larger capacity ones, and erects a similar one on the site of tower 4.

4.3.19.1 Construction Noise

Potential construction noise effects for Alternatives 2A, 2B, and 2C come from sources typically found at medium size industrial construction projects. Construction projects have phases that usually include: clearing and/or demolition; site preparation and excavation; placing supports and foundations; erecting structures or buildings; and finishing and cleanup. Each of these phases has its own combination and number of noise emitting pieces of equipment and processes. For example, clearing and demolition routinely use grubbing hoes and bulldozers; while placing supports and foundations might need pile drivers and cement mixers. In general, equipment with larger engines makes more noise than equipment with smaller engines, and processes that rely on impact action produce higher peak noise than continuous operations. In addition, the condition of the equipment can greatly influence the noise emissions. Noise emissions at 50 feet from construction equipment ranges from about 75 dBA for a forklift or modern tractor to over 100 dBA for pile driving. Also, the duration of the construction phases impacts the potential noise effects.

Each of the Alternatives would have a slightly different set of equipment and phase durations for their respective construction. Where 2A and 2B would require more earthmoving than 2C, 2C requires demolition of existing cooling towers. Alternatives 2A and 2B might require more foundation work than 2C, but 2C probably requires more actual building of structures. The total time and equipment for these Alternatives should be about the same.

Predicting the level of intruding noise in the Paradise Shores area from any of the Alternatives would be highly speculative because of the variables discussed above. Based on other construction projects, it is likely that construction noise would be heard in the Paradise Shores area, and impact noise such as pile driving might be heard across the river at the Lakeview community. Although heard, the potential effect of this intruding noise should be insignificant for several reasons, including:

- People understand that construction projects use heavy equipment and that the equipment produces noise, and they understand that the construction has an ending point. Frequently, people like to watch the equipment work and the noise is part of the experience.
- Very little, if any, outdoor work for Alternatives 1 and 2 would take place at night. This is also true for work during the No-Action Alternative such as the dry cask spent fuel storage facility and the new modifications/fabrication building. Any such outdoor night-time work would be minimal and would be the exception, not the general practice. There may be some indoor work scheduled at night, particularly for support tasks such as scaffolding and other job preparations, but this would be limited.
- Construction is usually a 5-day-a-week operation. It follows the normal business week and leaves the weekends free from the intruding noise.
- The construction durations of these Alternatives are relatively short, and the noisiest phases of the construction, usually site preparation and placing supports, are even shorter (several weeks, or less).
- None of the intruding noise from even the peak noise sources would be a hazard to hearing loss or interfere with communications.

Although the construction would probably be heard, potential noise effects can be addressed or ameliorated in several ways if necessary. This includes using only modern, well-maintained equipment with factory-equivalent mufflers, notifying adjacent residents about the construction schedule and noisiest activities, and quickly responding to noise complaints and concerns. In addition, portable barriers are effective in reducing noise in a particular direction from small, noisy operations, such as rock drilling.

Overall, residents in the Paradise Shores area should hear construction noise, but this should be of a relatively short duration, and the long-term effect is expected to be insignificant for the reasons given above.

4.3.19.2 Intruding Noise

The intruding noise from the cooling towers for Alternative 2 was calculated using information from two potential vendors and the protocol in the EEI, Electric Power Plant Environmental Noise Guide (EEI, 1984). This guide gives a comprehensive method of estimating the sound power of the noise emitting equipment and calculating the propagated noise at a receiver location. It is assumed that the meteorological conditions are for summer, and no additional noise reducing factors such as ground or foliage attenuation were used.

Table 4.3.19-1 presents the total noise from each action alternative at both Paradise Shores and the Lakeview community.

Table 4.3.19-1 Total Noise at Paradise Shores and Lakeview Community for Alternative 2 (All data in dBA)

Location/Alternative	Total L_{eq} 24 hour	DNL 24 hour	Average annual DNL 17 days op.	Average annual DNL 27 days op.
Paradise Shores/ Current[1]	47	52	50	50
Alternative 2A	47	53	51	51
Alternative 2B	48	53	51	51
Alternative 2C, vendor 1[2]	54	61	53	53
Alternative 2C, vendor 2[3]	50	57	52	52
Lakeview Community/ Current[1]	44	48	46	46
Alternative 2A	44	48	46	46
Alternative 2B	44	48	46	46
Alternative 2C, vendor 1[2]	45	49	46	46
Alternative 2C, vendor 2[3]	43	47	46	46

[1]All original cooling towers operating at full capacity.

[2]Cooling tower vendor 1 is Balcke-Durr, which estimated noise values based on empirical handbook data.

[3]Cooling tower vendor 2 is Marley, which supplied noise data based on actual field measurements from similar towers.

4.3.19.3 Effects

4.3.19.3.1 Guidelines

The average annual day-night average sound level (DNL) for Alternatives 2A, 2B, and 2C are under the EPA guideline of 55 dBA based on 17 days of full capacity operation. At the high end of the operating range of 27 days, the average annual DNL for each alternative is still under EPA guideline. The primary noise source will be large cooling tower fan motors.

Table 4.3.19-1 shows the total noise levels at Paradise Shores and the Lakeview community for all original cooling towers operating at full capacity. Using these values as a baseline for comparison, the total noise level (24 hour DNL) for Alternative 2C (with either of two potential cooling tower vendors) would be above the 3 dBA incremental increase guideline (FICON, 1992) at Paradise Shores, but not at the Lakeview Community. This level, which calls for additional analysis, occurs only on the days that all of the Alternative 2C cooling towers (either potential vendor) operate. The additional analysis was completed and included all variations of Alternative 2 described in this document and potential mitigation presented at the end of this section.

As a comparison to the guideline used in the original EIS, none of the Alternatives 2A, 2B, or 2C causes total 24 hour DNLs above 65 dBA that HUD uses as normally acceptable for residential development (HUD, 1971, 1985).

4.3.19.3.2 Hearing Loss

No residents in any of the adjacent communities would be exposed to noise levels that are hazardous to their hearing from Alternatives 2A, 2B, or 2C.

4.3.19.3.3 Annoyance

There could be a small percentage of residents of Paradise Shores highly annoyed from the intruding noise associated with the action alternatives. The largest 24 hour DNL from Alternative 2C, vendor 1, could highly annoy as many as 6 to 7 percent of the residents based on equation 3.19-1 or Table 3.19-1. Alternative 2C, vendor 2, has the next highest 24-hour DNL, which could highly annoy 4 to 5 percent. The percentage of highly annoyed from Alternatives 2A and 2B are about 2 to 3 percent. The same techniques show that the current environment could also cause about 2 to 3 percent of the residents to be highly annoyed.

Less than 2 percent of the residents in the Lakeview community should be highly annoyed from the intruding noise associated with Alternatives 2A, 2B, and 2C.

4.3.19.3.4 Communication Interference

Sentence intelligibility would not be affected by the intruding noise associated with the action alternatives at Paradise Shores or the Lakeview community. The highest 24-hour L_{eq} is 54 dBA at

Paradise Shores from Alternative 2C, vendor 1. At this level, EPA estimates sentence intelligibility to be 99% (EPA, 1974). None of the 24 hour DNLs would cause indoor communication interference based on the assumption that normal residential construction provides 20 dBA noise reduction (FICUN, 1980). This reduction would limit the intruding noise to 41 dBA or less inside the residences.

4.3.19.4 Summary

The potential 3 dBA or more increase in the total noise 24 hour DNL would not meet the guideline given by the Federal Interagency Committee on Noise (FICON) for Alternative 2C, vendors 1 and 2. These potential noise effects could be reduced by using a well planned operating procedure for the cooling towers and by using low-noise fan-motors in the design of the new towers. Operating the cooling towers farthest away from Paradise Shores when feasible would also significantly reduce the intruding noise to just a few days per year. This would reduce the percentage of residents who could be highly annoyed.

The EPA guideline of 55 dBA average annual DNL is met with all alternatives at both locations.

There are no noise consequences from Alternatives 2A, 2B, or 2C in the Lakeview community.

4.3.20 Safety and Health (Non-Radiological)

If Unit 1 recovery and license renewal/extended operation is added to the license renewal and continuing operation of Units 2 and 3, there is still no change to the Safety and Health Program described in Section 3.20. However, during the construction/modification work in recovering Unit 1 injury rates would be expected to be higher than during periods of operation. Based on a review of past performance, these injury rates would be expected to be approximately 20% higher than during periods of operation.

4.3.21 Radiological Impacts

4.3.21.1 Normal Operation

4.3.21.1.1 Occupational

Alternative 2 activities (as described in section 2.2.1) address Unit 1 recovery and operation at an EPU, and a twenty-year operating license extension for all three units. This alternative has the most significant occupational radiation dose impact of the identified alternatives. Occupational radiation dose refers to radiation dose received by individuals as a course of their employment. Parameters considered for the analysis included: baseline occupational dose, projected dose increments, and an estimated cancer risk increase for the projected dose increments.

Baseline Occupational Dose

This section contrasts the current industry and facility occupational radiation dose trends against the current limits established by federal regulation. Selected attributes for the comparison are the average annual dose received by a worker, average annual dose per reactor, the collective worker dose, and the percentage of workers that receive radiation dose above a given threshold. Radiation dose attributes are categorized by reactor type. Light water power reactors in use within the United States are either a pressurized water reactor (PWR), or boiling water reactor (BWR) design. BFN reactors are the BWR type. Title Ten of the Code of Federal Regulations Part 20 (10 CFR part 20) establishes occupational radiation dose limits. These limits are designed to minimize the potential health risk to the worker. The annual occupational radiation dose limit for a worker is 5.0 rem. Facility radiation exposure control policies ensure compliance with established federal regulations and incorporate ALARA (as low as reasonably achievable) philosophies. Table 4.3.21-1 summarizes the current occupational radiation dose trend for the BWR industry and BFN.

Table 4.3.21-1 Baseline Occupational Radiation Dose (rem)

	Average Annual Worker Dose	Annual Dose Per Reactor	Collective Worker Dose	Percent of Workers > 2 rem
BWR Industry -1999[1]	0.110	184	6473	0.029
BFN - 1999[2]	0.122	223	447	0
BFN - 2000[2]	0.122	167	333	0
BWR Ind. 1994-1999[1]	0.243	236	51902	0.467
BFN 1994-1999[2]	0.419	250	2999	0.061

[1] NUREG 0713 Vol. 21 (1999)
[2] BFN Radiological Data: 10CFR20.407 Submittals, or Facility Radiological Control Database.

Projected Dose Increments

Projected dose increments are a forecast of dose increase for the proposed activities. Activities that may contribute to a dose increase are EPU, additional facility maintenance or modification needed to support an extended license agenda, and Unit 1 recovery. Each of these topics is addressed in the following paragraphs.

EPU at Units 2 and 3 has been addressed by a specific environmental assessment (EA). A conservative basis assumption of that EA is that the annual collective dose would increase in direct proportion to the power level. Table 4.3.21-2 summarizes the current facility dose parameter and forecasts the EPU basis dose assumption.

Table 4.3.21-2 Extended Power Up-Rate Dose Impact		
	Average Annual Collective Dose (rem)	Average Annual Collective Dose Per Reactor (rem)
BFN 2-Unit (1994-2000)	438	219
Alternative 1	526	263
Alternative 2	789	263

Facility maintenance or modification needed to support a license extension (Alternative 2) for Units 2 and 3 should not be necessary. Unit 2 and 3 systems received repair and modification during the extended outages that concluded May 24, 1991 and November 19, 1995, respectively. Further, Units 2 and 3 will have received extended power up-rate modification prior to license extension. These units should be prepared to operate through the extended license period without additional significant maintenance, modification, or refurbishment.

Unit 1 has been in an extended outage since March 1985. The estimated resources (work within the power house, potential radiation exposure environment) to recover the unit is 7.385 million man-hours protracted over a five year period. An estimated dose rate (rem per hour) was derived from Unit 2 and 3 data. Data was corrected to account for radioactive material decay that has occurred during the Unit 1 extended outage (i.e., 15 years). The decay correction factor is 0.145. The average collective dose (1998 to May 2001) is 395 rem; the average annual man-hours in the power house for the same period is 541,712. The quotient of these values yields the desired dose rate: 0.00073 rem per hour. An estimated dose for the Unit 1 recovery is defined by the product of the man-hours, decay correction factor, and the dose rate; 782 rem (7.385×10^6 hours X 0.145 X 7.3×10^{-4} rem/hour). An estimated collective dose for the Alternative 2 scenario (Unit 1 recovery, 3-unit EPU, and 20-year extended license) is 16,562 rem [782 rem + (263 rem/Reactor-year X 3 Reactors X 20 years)].

Cancer Risk

Health risk associated with radiation dose may be segregated into two general categories, non-stochastic and stochastic. A direct association of cause and effect is representative of the non-stochastic category. An example would be the death of an individual that received a radiation dose of 2,000 rem over a short period of time (a few hours). Stochastic effects are those that occur at random with no direct association to a causative agent. Cancer is an example of a stochastic effect. Cancer occurs spontaneously with no specific association with a causative agent. Hiroshima and Nagasaki bomb survivors who received radiation doses greater than 50 rem have experienced an increased cancer rate when compared with similar populations that only received background radiation dose. Background radiation dose is dose received by members of the public from naturally occurring radioactive materials in the earth's crust and cosmic radiation.

Stochastic Radiation Effects

Stochastic radiation effects are random events whose probability of occurring (rather than the severity of the effect) is a direct function of dose. These effects are normally regarded as having no threshold. Radiation carcinogenesis is generally regarded as stochastic. Cause-effect functions called *Dose Response Models* have been developed to estimate the stochastic effects for radiation exposure. A dose response model hypothetically relates a biological effect to the dose received by either a cell or an individual. It correlates the radiation dose received with the biological effect expected to be observed. There are currently four different hypothetical dose response models that are commonly used to predict radiation induced biological effects. These models are illustrated in Figure 4.3.21-1 and explained as follows:

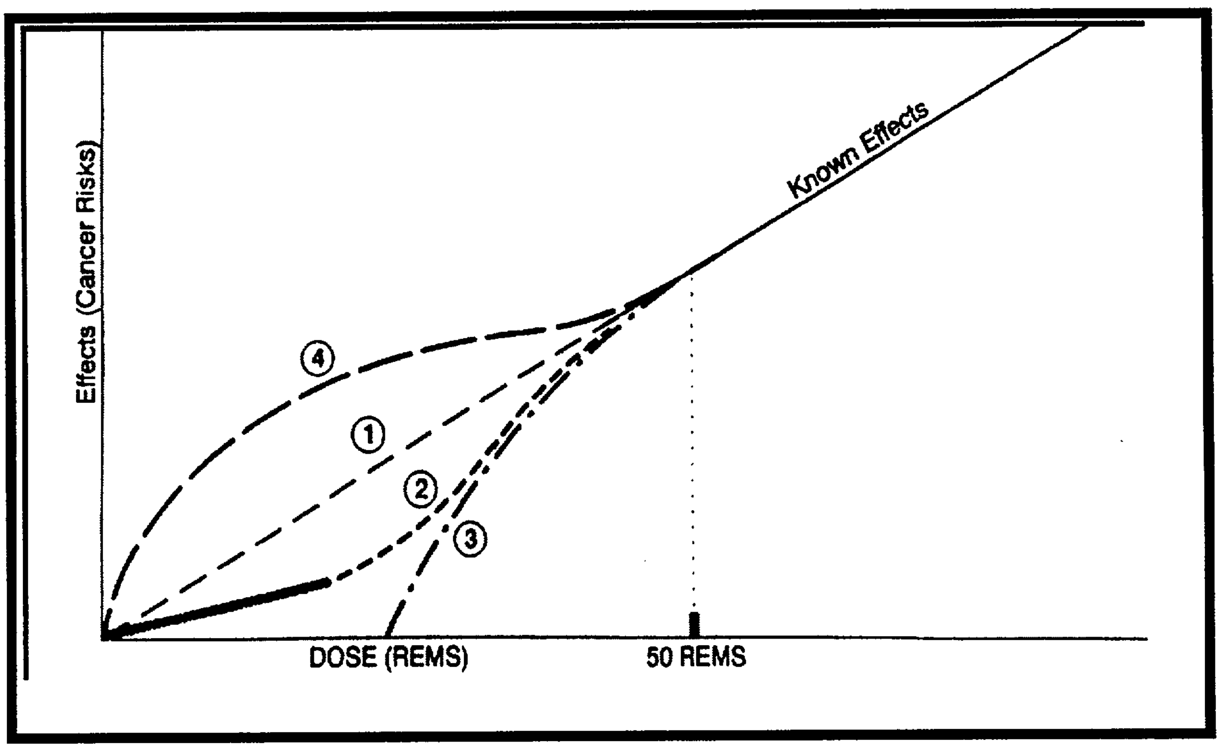
Curve 1: In the linear dose response model, the relationship between the dose received and the biological effect is considered directly proportional. The effect of any one unit of dose would be the same for either a high or a low dose. Thus if 10,000 rem resulted in one additional cancer, 1,000 rem would be predicted to result in 0.1 additional cancers, and 100 rem would be predicted result in 0.01 additional cancers. This is a simple linear proportionality.

Curve 2: The linear quadratic dose response model contains both a linear and a quadratic term. It hypothesizes that the effect is linear for a low dose (as in curve 1) and increases more aggressively as the dose is increased. Therefore, the dose response curve is linear in the low-dose range, becoming quadratic as the dose is increased. The majority of scientists today and the NRC endorse the use of the linear quadratic dose response model. (U.S. Nuclear Regulatory Commission. *Instructions Concerning Risks From Occupational Radiation Exposure.* Regulatory Guide 8.29. Washington, DC)

Curve 3: The third dose response model is known as the threshold model. It postulates that there is a level of dose below which there is no measurable or observable effect. Once that threshold dose is reached, the effect may increase with increasing dose by a linear, linear-quadratic, or quadratic model.

Curve 4: A few scientists believe that radiation effects level off with increasing exposure so that even a small dose implies a significant risk.

Figure 4.3.21-3 Dose Response Models That Predict How The Effects Of Radiation Vary With Dose At Low Levels



Estimated Cancer Risk

NUREG-0713 Vol. 1 Section 4.6.3.2 references the collective background radiation dose to the U.S. population to be on the order of 75 million rem/year. This background radiation dose is presumed to present no discernible health risks. Cancer risk is often assessed in terms of the relative increase with respect to the hypothetical causative agent. A fatal cancer risk coefficient of 4×10^{-4} rem^{-1} has been recommended by BEIR-V 1990. As an example; the possible annual cancer events from the U.S. background dose is 30,000 (75×10^{6} rem X 4×10^{-4} rem^{-1}). The increased total BWR industry collective dose for 1999 with respect to the 1999 U.S. background dose is 30,002.59 (75, 006,473 rem X 4×10^{-4} rem^{-1}). This represents a 0.0086% increase {100 X (30,002.59 - 30,000)/30,000}. Table 4.3.21-4 summarizes the relative annual cancer risk with respect to the U.S. background dose. Table 4.3.21-5 summarizes the relative cancer risk for the proposed actions relative to the BWR industry collective dose.

Table 4.3.21-4 Annual Occupational Radiation Dose Increased Cancer Risk Relative to U.S. Population Background Dose

	Average Annual Dose - 1999		
	U.S. Background	BWR Industry	BFN
Collective Dose (rem)	75×10^{6}	6473	447
Possible Cancer Increase	30,000	2.59	0.179
Percent Increase	0	0.009	0.0006

Table 4.3.21-5 Occupational Radiation Dose Increased Cancer Risk Relative to BWR Industry Collective Dose

	Collective Worker Dose		
	BWR Industry	Alternative 1	Alternative 2
Collective Dose (rem)	418,557	10,520	16,562
Possible Cancer Increase	167.4	4.2	6.6
Percent Increase	0	2.51	3.96

NUREG-1437 Vol. 1 Section 4.6.3.2 postulates the radiation dose attributable to license extension might result in a 5% increase in the calculated cancer incidence to workers, but there may be no increase. The estimated cancer risks for the proposed activities are bounded by the NUREG-1437 Vol. 1 Section 4.6.3.2 assumptions.

Conclusions

Occupational radiation dose attributed to the recovery of Unit 1, normal three-unit operation to the conclusion of the current license and into an extended license period has been examined from multiple perspectives. Average annual dose to the worker and the average annual dose per operated reactors are consistent with current BWR industry trends. Worker radiation exposures are controlled to be significantly less than the limits established by federal regulation, 10 CFR part 20. The estimated cancer risk increase associated with the occupational dose forecast for Alternative 2 activities is demonstrated to be bounded by the assumptions stated by NUREG-1437 Section 4.6.3.2. In that the No Action Alternative (discontinue operation of Units 2 and 3 when their current licenses expire) and Alternative 1 have less occupational radiation dose significance than those analyzed for Alternative 2, these scenarios are similarly bounded.

4.3.21.1.2 Public

The radioactive effluent releases or exposures from BFN operations are expected to increase no more than 1.8 times (see following note) recently reported values after a restart of Unit 1. The recently calculated doses are a small fraction of the applicable radiological dose limits and are expected to remain a small fraction of dose limits. The impacts to the environment are expected to have negligible impact due to restart of Unit 1.

NOTE: Recent dose and release data reflect 2 reactors operating at 100% of initial rated power. The two operating reactors have been re-licensed to operate at EPU and it is assumed that Unit 1 would be re-licensed to operate at EPU before restart (i.e., 3 reactors at 120% vs. data for 2 reactors operated at 100%; 360% / 200%; hence 1.8).

4.3.21.2 Facility (Design Basis) Accidents

The design basis accidents addressed in Chapter 14 of the BFN UFSAR are independent of the age of the plant. Therefore, extension of the operating lifetime of the plant from 40 to 60 years will not impact these accidents. This applies to all three units.

4.3.21.3 Severe Accident Mitigation Alternatives

The BFN Severe Accident Mitigation Alternatives (SAMA) analysis summarized in Section 4.2.21.3 and included as Appendix A of this SEIS, is specific to license extension of Unit 2 and Unit 3 at the current design basis power level (i.e., pre-EPU). The SAMA analysis will be extended to be consistent with Alternative 1 (including EPU). There is currently no PSA for Unit 1. However, presuming that, prior to restart, Unit 1 is refurbished such that its severe accident frequency is comparable to that of Units 2 and 3, then based on the existing BFN SAMA analysis and SAMA analyses completed to date at other nuclear plants similar to BFN, it is not anticipated that Alternative 2 would result in justifying any significant modification.

4.3.22 Decommissioning Impacts

Under Alternative 2, Unit 1 would join Units 2 and 3 in extending operation for an additional 20 years past expiration of the current licenses. Similarly to Alternative 1, decommissioning would be delayed by this 20 year period under Alternative 2, providing an opportunity for decommissioning technology (including more advanced robotics) and the licensing framework to evolve and mature. In addition, it becomes more likely that a permanent spent fuel repository would be available prior to the completion of decommissioning. Consequently, in comparison with the No Action Alternative, the potential for adverse environmental effects from decommissioning could be reduced under either of the action alternatives.

4.4 Identification of Mitigation Measures

Mitigation includes avoiding, minimizing, rectifying, reducing, or compensating for the impacts. Some potential mitigation measures were identified in the discussions of environmental consequences earlier in Chapter 4. These measures are generally of two types:

- physical changes incorporated during project design and construction, and
- programs and environmental controls initiated to meet regulatory standards.

These potential mitigation measures are assumed to be implemented as part of the actions proposed in Chapter 2 and provide part of the basis for the identification of environmental impacts in Chapter 4. In other words, these measures are integrated into the action and would be conducted as part of the project.

4.4.1 Air Resources

Mitigation measures to minimize potential air pollutant emissions during construction activities for the new Administration Building, the new Modifications Fabrication Building, the dry cask storage facility, and any new cooling towers would be the best management practices that TVA uses for construction of any new facilities. This would include such measures as wetting ground surfaces as appropriate to reduce fugitive dust, requiring equipment and trucks to be well-maintained and tuned for efficient fuel combustion, covering fuels and fueling connections to minimize evaporative losses, and requiring contractors to adhere to such policies.

No specific mitigation measures are expected to be required during operational use of the new facilities.

4.4.2 Geology

No mitigation is identified for Alternatives 1 or 2.

4.4.3 Solid Wastes Management and Past Practices

No mitigation is identified for Alternatives 1 or 2.

4.4.4 Hazardous Wastes Management and Past Practices

No mitigation is identified for Alternatives 1 or 2.

4.4.5 Spent Fuel Management

No adverse environmental impacts that require mitigation have been experienced or are expected from spent fuel management at BFN. This is because similar facilities (spent fuel pools at TVA nuclear plants and dry cask storage facilities at other utilities) have been in successful operation for years. Should an unexpected problem develop regarding the handling or storage of spent fuel, a number of options are available to the BFN staff. These range from minimizing worker dose (by decreased exposure time, increased distance to the source, and/or intervention of shielding) to modifying or selecting a different storage cask design. No mitigation measures are identified at this time for either alternative.

4.4.6 Surface Water Resources

No mitigation is identified for Alternatives 1 or 2.

4.4.7 Groundwater Resources

No mitigation is identified for Alternatives 1 or 2.

4.4.8 Floodplains and Flood Risk

No mitigation is identified for Alternatives 1 or 2.

4.4.9 Terrestrial Ecology

No mitigation is identified for Alternatives 1 or 2.

4.4.10 Aquatic Ecology

No mitigation is currently identified as necessary for Alternatives 1 or 2. For Alternative 2, operational monitoring of impingement and entrainment during the first year of operation of Unit 1 could identify unexpected effects to the fish community. Annual Vital Signs monitoring currently being conducted could also show effects to the fish community. Based on the results of the monitoring program, appropriate mitigative measures would be determined, if needed.

4.4.11 Threatened and Endangered Species

No mitigation is identified for Alternatives 1 or 2.

4.4.12 Wetlands

No mitigation is identified for Alternatives 1 or 2, as there are no wetlands present in any of the areas proposed for spoil disposal or excavation.

4.4.13 Socioeconomic Conditions

No mitigation is identified for Alternatives 1 or 2.

4.4.14 Transportation

Specific site mitigation measures to improve the local roadways could include employee programs that provide flexible working hours. This would reduce road travel during peak hours. Delayed shift changes would also help alleviate the congestion at the plant entrances/exits. Restrictions for trucks traveling during the peak hour could also be made. None of these measures are being committed to at this time, but would be implemented if transportation delays become intolerable.

If very heavy loads are to be transported on the plant site, TVA would assess the impact of these loads over or adjacent to underground structures (e.g., a pipe or a concrete cable tunnel that could be damaged). Ground loadings in these critical areas would be minimized by constructing temporary "bridges" over the underground structures and/or using transport vehicles with increased axles and wheels to minimize load pressures. When heavy loads are hauled on public roadways, it is normal engineering practice for the transport company to define the route and obtain necessary permits for hauling heavy loads. In addition, trucks would meet all safety standards and hauling would comply with all federal, state, and local ordinances.

4.4.15 Soils and Land Uses

No mitigation is identified for Alternatives 1 or 2.

4.4.16 Visual Resources

No mitigation is identified for Alternatives 1 or 2.

4.4.17 Recreation

No mitigation is identified for Alternatives 1 or 2.

4.4.18 Cultural Resources

The archaeological site identified in Spoils Disposal Area 1, along with an adequate buffer zone, would be removed from the disposal area or Phase II testing would be conducted to confirm the significance of the site. If the site is determined by Phase II testing not to be significant, no further consideration of the site would be required.

Cox Cemetery, along with an adequate buffer zone, would be excluded from Spoils Disposal Area 2.

4.4.19 Environmental Noise

The potential 3 dBA or greater increase in the 24 hour DNL for action Alternative 2C, vendors 1 and 2, at Paradise Shores would be reduced much of the time. Frequently, the intruding noise would have less than a 3-dBA increase when fewer than all of the cooling towers are running or when they run at reduced capacity. This would be especially noticeable if towers 3 and 4, which are closest to Paradise Shores, are the last to be operated and the first to be shut-down. The 24-hour L_{eq} drops by 6 dBA for both alternatives when towers 3 and 4 are not operating.

Using low-noise fans that operate at reduced speeds are effective when included as part of the cooling tower design. Low-noise fan-motors are 7 to 8 dBA less than standard ones. This reduction would lower the total noise at Paradise Shores to about background noise levels. TVA is not committing to use such fans at this time.

4.4.20 Public and Occupational Safety & Health (Non-Radiological)

No work activities associated with license renewal and possible Unit 1 recovery are projected to require mitigation regarding health and safety. Any plant process or activity that results in harm to individuals, on site or off site, would be suspended (i.e., "stop work") until it could be re-evaluated and the problem corrected.

4.4.21 Radiological Impacts

BFN has been carefully designed, built, and is operated to minimize all releases of radiation emissions to the environment. To ensure public and worker safety, the plant is monitored to strict safety standards set by the regulator on a 24-hour a day, seven days a week basis. Nuclear plant emissions for TVA have always been at or below the safe levels permitted by federal standards. TVA has demonstrated and continues to demonstrate an excellent safety record in this area for its two operating units at BFN and at its other nuclear stations. TVA aggressively conducts a sustained effort to ensure that collective worker radiation doses, as well as annual and cumulative lifetime individual worker radiation doses, are maintained as low as reasonably achievable (ALARA).

Unexpected radiation dose problems are rare, but are mitigated in exactly the same manner as expected or anticipated problems, in keeping with the ALARA concept. This can involve a wide range of dose minimization strategies in the detailed work planning, including use of least exposure pathways, minimizing the time to complete the task, practicing the activity with mock-ups, etc. Additional shielding or the use of respirators may be adopted if it is determined that the total integrated dose is reduced, i.e., the dose increase from placement and removal of the shielding or due to the increased dwell time from being slowed down by the respirator is more than offset by the decrease in worker task dose. Although no activities associated with the Alternatives in this SEIS are projected to have associated radiological impacts requiring mitigation, any unexpected problems would be remedied accordingly.

4.5 Irreversible Adverse Impacts

Continued operation of the BFN units would result in unavoidable but very minor impacts to air and water quality, sound and visual resources. Air quality would continue to be affected by routine radioactive gaseous emissions typical of boiling water reactor operations. Water resources would continue to be affected in terms of surface use and quality because of routine radioactive effluent releases and the need for cooling water Unit 1 operation (at EPU) would result in increased waste heat discharge to Wheeler Reservoir, but all regulatory temperature limits would be met. Unit 1 operation (at EPU) would also result in increased entrainment and impingement of aquatic biota, which is not anticipated to be environmentally significant, but could result in the need of mitigative measures. The routine discharge of chemicals would continue to have a minor affect on the aquatic biota near the plant discharge pipes. Also unavoidable would be the generation of additional low-level radioactive waste, which would be transported and managed off site at a low-level radioactive waste disposal facility such as the one in Barnwell, South Carolina.

Alternative 1 essentially involves no change from the present day operation of BFN except that additional on-site storage capacity for spent fuel would be needed unless a national repository (such as the one being developed at Yucca Mountain, Nevada) is competed and becomes available before the current operating licenses for Units 2 and 3 expire (2014 and 2016, respectively). The irreversible adverse impacts are therefore limited to the continued generation of various types of wastes, including spent nuclear fuel, and a larger temporary facility to store that spent nuclear fuel.

Irreversible adverse impacts for Alternative 2 would be the same as those for Alternative 1 except for the addition of significant cooling tower capacity and some minor building changes and additions and operating equipment refurbishments.

4.6 Relationship of Short-Term uses and Long-Term Productivity

The economic and societal returns to the TVA service region would be considerable for either Alternative 1 or 2, including stable and dependable electricity, and continued employment covering a wide spectrum of jobs and pay ranges. Demands for peaking and baseload energy are projected to increase, and license renewal of the BFN units is one way to help meet the continuing demand for baseload resources. Alternative 1 would maintain BFN as a preferred significant local employer with very minimal consumption of resources.

The construction of additional cooling tower capacity associated with Alternative 2 would result in small short-term impacts to the environment relative to the long-term maintenance and enhancement of productivity. The short-term impacts are primarily those that occur during the period of construction activities, including relocation of excavated spoils associated with increasing cooling tower capacity and equipment replacements during Unit 1 refurbishment. The major short-term uses of materials associated with Alternative 2 include the concrete, steel (reinforcement bars, sheet metal, structural beams, etc.) and fill composition used in constructing the additional cooling tower capacity. The use of short-term resources to restore Unit 1 for power production would affect the long-term productivity of the site by providing an additional reliable source for the production of bulk electric power. Alternative 2 would also provide an additional 150 permanent jobs and around 3,000 temporary jobs during Unit 1 recovery.

4.7 Irreversible and Irretrievable Commitment of Resources

The proposed action alternatives would result in irreversible and irretrievable commitments of resources including land, water, fuels, and other mineral resources over the 20-year extended lifetime of the facilities. Human resources (measured in man-years) are also included as a part of the comparison of the resource commitment by alternatives. This comparison is presented in Table 4.7-1. Listed values include EPU unless otherwise noted.

Depending on the alternative selected, cooling tower capacity addition could result in the removal of up to 106 acres of site land from most future uses. Continued operation of the plant would result in consumption of nuclear fuel and small amounts of fossil fuels, water, metals, and a number of other materials, some of which cannot readily be replaced or recycled. At this time, all constituents of the spent nuclear fuel are considered non-recoverable since no reprocessing of the spent fuel is allowed. Additional temporary spent fuel dry storage at the site would consume construction materials and result in minor increases in worker radiation exposure but would be built on already-disturbed site land.

The potential additional land resource commitment is irretrievable, but land is not considered to be in short supply in the region, given the large amount of non-industrialized property. Some river water would be evaporated during brief periods of cooling tower operation, typically less than one month per year. Since this water is returned to the earth as vapor, however, it is not considered to be an irreversible and irretrievable commitment of resources.

Table 4.7-1 Irreversible and Irretrievable Commitments of Resources				
Resource	Alternative 1	Alternative 2A	Alternative 2B	Alternative 2C
Land	no additional	up to 106 acres	up to 106 acres	no additional
Nuclear Fuel(1)				
Uranium oxide	149,130 lb.	149,130 lb.	149,130 lb.	149,130 lb.
Zircaloy	60,324 lb.	60,324 lb.	60,324 lb.	60,324 lb.
Stainless Steel	6,641 lb.	6,641 lb.	6,641 lb.	6,641 lb.
Inconel	777.5 lb.	777.5 lb.	777.5 lb.	777.5 lb.
Fuel Oil(2)	385,000 gallons/yr	385,000 gallons/yr	385,000 gallons/yr	385,000 gallons/yr
Industrial Gases				
Hydrogen(3)	16,850,000 scf/yr	25,880,000 scf/yr	25,880,000 scf/yr	25,880,000 scf/yr
Oxygen(4)	7,995,000 scf/yr	12,300,000 scf/yr	12,300,000 scf/yr	12,300,000 scf/yr
Nitrogen(5)	1,025,000 scf/yr	1,538,000 scf/yr	1,538,000 scf/yr	1,538,000 scf/yr
Ion Exchange Resins(6)	3,914 ft^3/yr	5,871 ft^3/yr	5,871 ft^3/yr	5,871 ft^3/yr
Construction				
Steel(7)	1058 tons	1764 tons	1854 tons	1845 tons
Concrete(8)	6,480 cu. yards	11,422 cu. yards	14,764 cu. yards	16,906 cu. yards
Labor (Man-years)	24,000(9)	35,750(10)	35,800(11)	35,700(12)

(1) Per unit per reload (i.e., each reactor refueling batch; two years between refuelings).

(2) The same type of fuel oil is used for auxiliary heating boilers, emergency diesel generators, and various other diesel engines at BFN; annual consumption is essentially independent of Unit 1 restart.

(3) Used for reactor water chemistry control and generator internal atmosphere; in units of standard cubic feet per year.

(4) Predominantly used for reactor water chemistry control; in units of standard cubic feet per year.

(5) Predominantly used in containment atmosphere inerting; in units of standard cubic feet per year.

(6) Used for condensate demineralizers and radwaste processing; in units of cubic feet per year.

(7) Includes concrete reinforcing bars and anchors, framing members (girders, beams, columns), conduit, gratings, etc.

(8) Total concrete for buildings, cooling towers (includes equipment support pads, ducts, etc.), and dry cask storage facility.

(9) Total site staff of 1200 for 20 years.

(10) Total site staff of 1350 for 20 years + Unit 1 restart (avg. 1500 for 5 ½ years) + cooling tower work (~200 workers for 2 years) + spoils hill relocation (~100 workers for 1 year).

(11) Same as (10) except additional 50 man-years for construction of round cooling towers.

(12) Same as (10) except no spoils hill relocation.

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5.0 PERMITS AND APPROVALS

5.1 Introduction and Scope

The major approval action required to permit operation of the Browns Ferry Nuclear Plant (BFN) units to continue after their current operating licenses expire is for the Nuclear Regulatory Commission (NRC) to issue renewed operating licenses for each unit. The current operating licenses for Units 1, 2, and 3 expire at midnight on December 20, 2013, June 28, 2014, and July 2, 2016, respectively. If the NRC approves Tennessee Valley Authority (TVA)'s license renewal application, each unit's renewed license would permit operation for an additional 20-year period beyond these expiration dates.

Most of the equipment involved in the alternatives addressed in this Supplemental Environmental Impact Statement (SEIS) is already in place, having been completed under the various construction and operation permits applicable during initial plant construction approximately thirty years ago. Other than the operating licenses issued by the NRC, no new permits or approvals are required for the potential cooling tower capacity additions, the dry cask storage facility, or the new site worker facilities (Administration Building, Modifications Fabrication Building) considered in this SEIS. However, continued operation will require BFN to maintain the following permits:

- Air Permits (for the Emergency Diesel Generators, Auxiliary Boilers, and Fueling Facility (i.e., the site gasoline pumping station),
- Construction/Demolition Waste Landfill Permit, and
- NPDES Permit

5.2 Overview of Required Permits/Approval

This section provides a brief background discussion and synopsis of the considerations involved for each type of permit or approval required for the alternatives discussed in this SEIS.

5.2.1 Operating License Renewal

5.2.1.1 License Renewal Background

The NRC published 10 CFR Part 54 in December 1991, establishing the regulatory requirements governing nuclear plant license renewal. Since publishing the original license renewal rule (hereinafter referred to as the Rule), the NRC and the industry worked together on the interpretation and implementation of the requirements of the Rule. These efforts led to an amending of the Rule, with the publication of the amended Rule in May 1995.

Subsequently, the Nuclear Energy Institute (NEI), (an industry-sponsored advocacy organization) embarked on a program to provide more definition and clarity to the process. This program led to the development of the Electric Power Research Institute (EPRI) License Renewal Technical Guidelines. Subsequently NEI published NEI 95-10, "Industry Guidelines for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule," to provide the industry with a consistent implementation process for the Rule. The industry used a demonstration program to further verify that the use of this generic guidance document in the development of a license renewal application would satisfy the requirements of the Rule. NRC and industry interaction during and following the demonstration program identified issues requiring additional guidance. In August 1996, the NRC issued a draft regulatory guide DG 1047, endorsing NEI 95-10, revision 0, with specific caveats, as an acceptable basis for preparing a license renewal application. In addition, both the NRC and NEI hosted workshops in October 1996, which provided additional guidance to interested utilities.

To implement the requirements of 10 CFR Part 54, several documents must be prepared for submittal to the NRC. The systems, structures and components within the scope of license renewal and their intended functions that are the basis for their inclusion must be identified. An Integrated Plant Assessment (IPA) to identify applicable passive, long-lived structures and components or commodity groupings must be developed and an aging management review must be performed. Time-Limited Aging Analyses (TLAAs) and exemptions must be evaluated and their applicability must be justified.

5.2.1.2 License Renewal Documentation

There are certain regulatory requirements that must be satisfied in order to obtain a renewed operating license that allows continued operation of a nuclear power plant beyond its original license term. The license renewal application contains general information, technical information, information regarding technical specifications, and environmental information, each of which is addressed below. The application must be filed no earlier than 20 years prior to the expiration of the operating license currently in effect.

General information concerns the plant site and the plant owner, TVA. This includes administrative information similar to the information filed with the original application for an operating license. The required information is specified in 10 CFR 50.33 (a) through (e), (h) and (I). The application must also include conforming changes to the standard indemnity agreement, 10 CFR 140.92, Appendix B, to account for the expiration term of the proposed renewed license.

Technical information includes: (1) the IPA, which is the demonstration that the effects of aging on long-lived, passive structures and components are being adequately managed such that the intended functions are maintained, consistent with the Current Licensing Basis, in the renewal period; (2) the listing of Structures and Components subject to Aging Management Review; (3) results of the Aging Management Review; (4) the listing and evaluation of TLAAs and any exemptions in effect which are based on TLAAs; (5) a supplement to the plant's Final Safety Analysis Report (FSAR), which contains a summary description of the programs and activities that are cited as managing the effects of aging and the evaluation of TLAAs; and (6) changes to the Current Licensing Basis of the plant.

Information regarding Technical Specifications must include any changes or additions to the plant's technical specifications that are necessary to manage the effects of aging during the period of extended operation.

The license renewal application will contain a supplement or a revision to the original Environmental Report that complies with the requirements of 10 CFR Part 51. This document contains environmental information required by NRC from TVA and which is used by NRC to compose the site-specific supplement to their Generic Environmental Impact Statement for License Renewal of Nuclear Plants. The information comprising this document will largely be excerpted from TVA's National Environmental Policy Act (NEPA) review (i.e., this SEIS).

5.2.2 NPDES Permit

In accordance with the Federal Water Pollution Control Act, the Alabama Water Pollution Control Act, and the Alabama Environmental Management Act, BFN has a permit to discharge various plant effluents into the Tennessee River. This permit, which must be renewed every five years, covers the effluents and discharge points listed in Table 5.2.2-1. The permit specifies discharge limitations and monitoring requirements at each discharge point (Discharge Serial Number). The current permit was issued December 29, 2000, by the Alabama Department of Environmental Management (ADEM); it became effective on February 1, 2001, and will expire January 31, 2006.

5.2.3 Air Pollution Control Permits

BFN has Permits To Operate its three Babcock and Wilcox Auxiliary Boilers (Permit No. 708-0003-Z001) and its eight Emergency Diesel Generators (Permit No. 708-0003-Z002). These permits were jointly issued by the Tri-County District Health Service, Air Pollution Control Program, and the Alabama Air Pollution Control Commission, on October 5, 1978; there is no expiration date.

BFN also has an Air Permit for its Gasoline Dispensing Facility (Permit No. 708-0003-Z003). This permit was issued by the ADEM on August 28, 1995; there is no expiration date.

Table 5.2.2-1 Discharge Points and Effluents of NPDES Permit	
Discharge Point	**Effluent**
Diffuser Outfall (DSN001)	Condenser Circulating Water, Raw Cooling Water, Turbine Building station sump, Liquid Radwaste System effluent, Intake Building sump
DSN005	Residual heat removal service effluent
DSN012	Intake screen backwash
DSN013a	Storm water runoff from switchyard drainage ditch
DSN013a(1)	Treated domestic wastewater, medical lab photo developing waste, blowdown from Training Center chiller system, flush water from the Standby Liquid Control System, flush water from cooler/air compressor cleaning, filtered waste from insulator showers (for personnel involved in periodic asbestos stripping and handling operations) and rainwater
DSN013b	Sedimentation pond discharge
DSN014	Storm water runoff from west perimeter drainage ditch
DSN017	Air conditioner condensate and storm water runoff from Training Center and Live Well Center areas
DSN024	Storm water from the northeast and east permiters (includes adjacent farmland, vehicle service shop and mechanic shop)
DSN019	Storm water from the east side of plant (includes Fire Training Area, Low Level Radwaste storage facility, inert landfill and Hazardous Waste storage area

5.2.4 Solid Waste Disposal Permit

BFN has a Construction/Demolition Landfill Permit for its solid waste disposal landfill located on the site (Permit No. 42-02, Facility Location: Northwest quarter of the Northwest quarter of Section 18, Township 4 South, Range 5 West, Limestone County). ADEM issued the current permit on March 17, 2000, with an effective date of May 17, 2000, and an expiration date of May 16, 2005. This permit, which must be renewed every 5 years, allows BFN to dispose of the following materials in its landfill: "Non-hazardous, non-radioactive solid wastes including scrap lumber, bricks, sandblast grit, crushed metal drums, glass, wiring, non-asbestos insulation, roofing materials, building siding, scrap metal, concrete with reinforcing steel, and similar construction and demolition wastes."

The possibility exists that one or more cooling towers might be refurbished or replaced with larger, more efficient cooling towers, in their approximate present locations. To demolish the existing cooling towers, a Notice of Demolition to ADEM would be required and would be initiated by the Environmental staff at BFN. The advance notice requirement is that this written notification must be post marked in the mail at least 10 days before the work is actually started. Also, for the cooling towers that contain asbestos, the workers that remove the asbestos panels will also have to be trained and certified by the State of Alabama in asbestos regulation compliance.

5.3 New Permits and Approvals Not Required, Not Applicable, or Indirectly Applicable

5.3.1 Land Use

The Farmland Protection Policy Act directs federal agencies to identify and take into account the adverse effects of federal programs on the preservation of farmland. The Act requires that Form AD 1006, "Farmland Conversion Impact Rating," be completed with assistance from the USDA-NRCS if prime farmland is to be permanently converted to nonagricultural use as a result of a proposed federal action.

As a federal agency, TVA is not subject to state or local zoning requirements. Land use impacts are assessed in this SEIS. Because the new structures and relocated spoils associated with the SEIS Alternatives would be located on previously disturbed soils and the plant site is classified as built-up land, their associated impacts would be insignificant.

5.3.2 Wetlands

If wetland determinations indicate that "jurisdictional" wetlands would be modified or significantly altered to accommodate development of the proposed project, requisite permits must be obtained from both the U.S. Army Corps of Engineers (USACE) and the Alabama Department of Environmental Monitoring. Wetlands are also subject to Executive Order 11990 (Protection of Wetlands).

It is unlikely that any activity associated with the SEIS Alternatives, including the footprint of either the project facilities or related appurtenances, will affect jurisdictional wetlands.

5.3.3 Floodplains

Executive Order 11988 (Floodplain Management) requires flood hazard assessments of proposed activities and requires consideration of alternatives for actions that would occur within a floodplain or floodway. TVA has conducted a class review of certain repetitive actions that occur in floodplains. See 46 Fed. Reg. 22845 (1981). The use of measures to minimize floodplains impacts as identified in TVA's 1981 class review would ensure that the floodplains are not adversely impacted by these repetitive actions.

All changes to site facilities associated with the SEIS alternatives would be located above the Probable Maximum Flood. Therefore, no identification of preferable options or determination of "no practicable alternative" per Executive Order (EO) 11988 is required.

5.3.4 Biological

Alabama has a list of protected species that overlap and extend beyond those protected by the federal Endangered Species Act (ESA). Potential impacts on state listed species are considered in this SEIS. In addition, per Section 7 of the ESA a more structured consultation process with the U.S. Fish and Wildlife Service (USFWS) may be required if a "may affect" situation exists. The Fish and Wildlife Coordination Act also requires that aquatic species be considered in project planning and would be a requirement of the USACE and state permitting processes. The USFWS usually combines both consultative processes.

There are no impacts to endangered or threatened species that would result from any actions associated with the alternatives being considered in this SEIS. Therefore, no further reviews by state or federal agencies are required.

5.3.5 Cultural Resources

All federal agencies are mandated under the National Historic Preservation Act of 1966 (NHPA) and the Archaeological Resources Protection Act (ARPA) of 1979 to protect significant archaeological resources and historic properties located on TVA lands or affected by undertakings. In response to this federal legislation, TVA conducts surveys to record historic properties. A historic property is "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places."

As discussed in Section 4.3.18.1, a Phase II archaeological survey will be required if the site identified in Area 1 (see Figure 2.2-7) cannot be avoided by either Alternative 1 or Alternative 2 activities.

5.3.6 Air Navigation

Coordination with the Federal Aviation Administration (FAA) is required when it becomes necessary to ensure that the highest structures associated with the project do not impair the safety of aviation. Submission of a letter of notification (with accompanying maps and project description) to the FAA would result in a written response from the FAA certifying that no hazard exists or recommending project changes and/or the installation of warning devices such as lighting.

The BFN site facilities elevation is dominated by the 600-foot high Off-Gas Stack, which has quadrant strobe lights near the top and constant red warning lights mid-way up the stack. No new structures associated with the Alternatives in this SEIS would be as high as or higher than existing structures; therefore, no new notifications to the FAA are required.

5.3.7 Noise

Noise impacts and mitigation plans are addressed in this SEIS. Although federal regulations apply to only certain pieces of construction equipment, any local regulatory requirements on noise would have to be considered and met. However, no applicable local noise ordinances were identified for Limestone County.

5.3.8 Emergency Planning and Community Right-to-Know

The proposed plant notification and reporting under the Emergency Planning and Community Right-to-Know Act (EPCRA) goes into effect when the plant becomes operational rather than as a preconstruction process. Provisions of EPCRA flow down to designated Alabama and local officials and to the managers of the plant itself. Being a federal agency, TVA is not subject to EPCRA; however, as a matter of policy and consistent with EO 12856, TVA complies with EPCRA to the same extent as other utilities.

5.3.9 Health and Safety

The federal Occupational Safety and Health Administration (OSHA) governs the occupational safety and health of the construction workers and the operational staffs. As a federal agency, TVA is not directly subject to regulation from OSHA; however, it must comply with OSHA's substantive requirements, as these are incorporated in its occupational health and safety practices. Contractors would continue to be subject to these substantive requirements.

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6.0 PUBLIC PARTICIPATION AND COORDINATION EFFORTS

Public participation and interagency coordination/review are part of the National Environmental Policy Act (NEPA) process during the preparation of an Environmental Impact Statement (EIS). Public and appropriate federal, state, and local agencies were invited to provide input during the scoping process and were provided a copy of the Draft EIS for review and comment. Section 6.1 describes the scoping process to determine the content of the EIS and Section 6.2 describes the public participation and agency review of the Draft EIS. Section 6.3 defines the role of lead and cooperating agencies in the preparation of this EIS.

6.1 TVA Scoping and Public Participation Process

One activity in EIS preparation is the description of what the evaluation will cover, or rather, the scope of the EIS. An important part of this "scoping" process is the solicitation of public participation in the determination of the issues to be evaluated and the inclusion of that information in the evaluation process. This section summarizes TVA's efforts to solicit public comments which helped to define the content of the EIS.

6.1.1 Public Involvement

On Thursday, February 15, 2001, a Notice of Intent (NOI) was published in the *Federal Register* (TVA, 2000a). The NOI provided a project summary, as well as details on the project description; TVA's Integrated Resource Plan; the proposed issues to be addressed in the EIS; the alternatives to be evaluated; and a description of the scoping process. A copy of the NOI is provided in Appendix E.

TVA formally began the NEPA process for this project by conducting a public meeting on March 6, 2001, in Decatur, Alabama, on the campus of Calhoun Community College. The meeting was announced via paid newspaper announcements in the March 4, 2001, Sunday editions of *The Decatur Daily*, *The Athens News-Courier*, *The Huntsville Times*, and *The Florence Times Daily*. The paid newspaper announcement also appeared on March 6, 2001, in *The Athens News-Courier*. In addition to the paid announcements, TVA provided a news release about the project and upcoming meeting to the local media on March 4 and 6, 2001. *The Athens News-Courier* carried an article about the project and the public scoping meeting in the February 25, 2001, Sunday edition. *The Decatur Daily* carried an article about the project and the public meeting in its Sunday edition on March 4, 2001. *The Florence Times Daily* also carried an article about the project and the public scoping meeting on March 5, 2001.

The paid announcements included a map which illustrated the location of Browns Ferry Nuclear Plant (BFN), as well as the location of the public meeting. The announcements and the news release stated that the meeting was being held to obtain public input on the proposed plans to apply for renewal of the operating licenses for Units 1, 2, and 3 at BFN. They further stated that written comments on the project would be received through March 23, 2001. Copies of the paid announcements and news releases are in Appendix E.

Approximately 80 persons attended the meeting, including representatives from the following newspapers: *The Huntsville Times*, *The Birmingham News*, *The Knoxville News-Sentinel*, *The Athens News-Courier*, *The Decatur Daily*, and *The Florence Times Daily*. Representatives from WVNN/WZYP radio and WVNN-TV, both from Athens, Alabama, were also present. A representative for TVA addressed those in attendance to provide information about the proposed project and to explain that the purpose for the scoping was to obtain input from the public regarding what issues should be included as part of the DSEIS. Following the public address, the attendees were divided into four different break-out groups to allow those in attendance to verbally express their ideas, concerns, and/or questions. Each of the break-out sessions was facilitated by a representative of TVA or a member of the faculty from Calhoun Community College.

Comments received during the public meeting were noted and later reviewed to help identify environmental issues that should be addressed in the DSEIS as well as those minor issues which do not warrant detailed evaluation. On March 7, 2001, several newspapers published follow-up articles. *The Knoxville News Sentinel* published a follow up article entitled, "TVA gets citizens' input on extending life of BFN." *The Birmingham News* published an article entitled, "High consumption TVA's woe, not power shortage, critic says." *The Florence Daily Times* published a follow up article entitled, "TVA plan gets mixed reaction from residents." *The Athens News-Courier* published an article entitled, "TVA looks at 20 more years." On March 8, 2001, *The Maryville Times* of Maryville, Tennessee, published a follow up article entitled "TVA's BFN restart proposal finds criticism, support." Also on March 8, 2001, Reuters released an article entitled, "TVA mulls reviving mothballed Alabama Nuclear power plant."

6.1.2 Major Issues of Public Concern

From comments received during the public meeting, received in responses to letters sent, and from internal TVA scoping of the project, environmental issues pertinent to the proposed actions and the comparison of alternatives and alternatives were identified. These are listed below and addressed in this EIS:

- Air Quality,
- Surface Water Quality,
- Groundwater Quality,
- Floodplain Impacts and Flood Risk,
- Terrestrial Ecology,
- Aquatic Ecology,
- Threatened and Endangered Species,
- Wetlands,
- Socioeconomics,
- Land Use/Soils,
- Transportation Resources,
- Visual Resources,

- Aesthetics and Recreation,
- Cultural Resources,
- Environmental Noise, and
- Health and Safety

6.2 Public and Agency Review of the DSEIS

To be completed after Public Meeting to review the DSEIS.

6.3 Lead and Cooperating Agencies

TVA is the lead agency in preparing this SEIS. No cooperating agencies were identified. However, other federal, state, and local agencies were coordinated with during the DSEIS review period, as appropriate, including the following:

To be determined

7.0 LIST OF PREPARERS

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Education: B A., Biology; A S., Aquaculture
Experience: 15 years experience in large river biomonitoring and cold water fisheries.

Marc C. Berg
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Experience: 14 ½ years experience in the nuclear engineering field.

John B. Brellenthin
Position: Environmental Supervisor, Browns Ferry Nuclear Plant
Education: B A., Biology
M S., Wildlife Biology
Experience: 23 years experience with TVA in Environmental Research and Compliance Programs; 2 years experience with the Dept. of Energy - Clean Coal Technology Program; 4 years experience with the Carolina Power and Light Company - Env. Program; 1 years Env. Consulting.

Roy V. Carter
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B.S.C.E., Civil Engineering
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Education: B.S., Civil Engineering
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Nancy Fraley
Position: Natural Areas Coordinator
Education: M.S., Botany
Experience: 12 years experience in botanical surveys and habitat protection; 11 years experience in environmental education.

Stephen J. Fraley
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Walter Harper
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Education: B.S., Mechanical Engineering, Christian Brothers College, 1969
M.S., Mechanical Engineering, University of Tennessee Space Institute, 1971
Experience: 25 years experience in analysis of problems in environmental fluid mechanics, hydrothermo-dynamics and computational fluid dynamics, numerical modeling, contaminant transport, heat and mass transfer.

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MSCE, Sanitary Engineering
PhD, Water Resources and Environmental Engineering
MBA, Business Management
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B.S., Civil Engineering (Environmental Engineering)
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Experience: 25 years experience with TVA in soil fertility, land reclamation, and waste utilization research.

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Ph.D. Anthropology (Archaeology)
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Education: M.B.A., B.S.
Experience: Former president for over 13 years of industrial and environmental safety consulting firm and over 30 years experience in noise control.

Jeffrey W. Munsey
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B.S., Geophysics
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Norris Nielsen
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M.S., Meteorology
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Dale W. Nix
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