TVA

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

AUG 0 5 1994

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION RELATING TO FINAL ENVIRONMENTAL STATEMENT (TAC NOS. M88691 AND M88692)

This letter provides the response to the NRC's June 21, 1994, request that TVA provide updated environmental information relevant to the Staff's review of the NRC's WBN Final Environmental Statement. In addition, NRC requested that TVA provide information on changes in the status of compliance with applicable environmental statutes and regulations, as well as more detailed information regarding any effect of WBN operation on endangered and threatened species.

The information set forth in the enclosure is responsive to NRC's request. To facilitate your review, the enclosure is generally organized by the section headings and numbers of the NRC's WBN Final Environmental Statement.

If you should have any questions, contact John Vorees at (615) 365-8819.

Sincerely,

Dwight E. Nunn
Vice President
New Plant Completion
Watts Bar Nuclear Plant

Enclosure

BSS:JV:BM:NEC
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50-390 TVA WATTS BAR 1

RESPONSE TO NRC'S REQUEST FOR ADDITIONAL INFORMATION RELATING TO THE FES.

REC'D W/LTR DTD 08/05/94....9408120253

TENNESSEE VALLEY AUTHORITY

ADDITIONAL ENVIRONMENTAL INFORMATION

WATTS BAR NUCLEAR PLANT

Units 1 & 2

August 1994

ADDITIONAL ENVIRONMENTAL INFORMATION

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1.0 INTRODUCTION

1.1 HISTORY

The Watts Bar Nuclear Plant (WBN) is a two unit, 3,411 MWt plant, located near Spring City, Tennessee, approximately 50 miles northeast of Chattanooga, Tennessee. The plant and all associated parking, administrative, and support facilities are located on Federal property under the control of the Tennessee Valley Authority (TVA). TVA is a Federal agency.

On January 23, 1973, the Atomic Energy Commission (AEC) issued TVA Construction Permit Nos. CPPR-91 and CPPR-92 for the two WBN units. These permits were issued following AEC staff's environmental review of the proposed plant. The conclusions from this review were included as AEC's comments on TVA's Draft Environmental Impact Statement (EIS) (issued in 1971). TVA released its Final EIS in November 1972.

In connection with its application for operating licenses for Units 1 and 2, TVA provided updated environmental information in an Environmental Information Statement (November 18, 1976) and supplemental information in response to staff questions (May 9, 1977). The Office of Nuclear Reactor Regulation released a Final Environmental Statement (FES) in December 1978 to support issuance of operating licenses to the two WBN units. This NRC FES relied on the earlier TVA Final EIS and documented changes in information, analyses, and conditions that had occurred since release of the EIS.

Construction delays extended the completion schedule for the plant and the construction permits for the units were extended accordingly. These extensions were supported by individual Environmental Assessments and Findings of No Significant Impact.

Unit 1 is now essentially completed and TVA expects to initiate commercial generation at the unit in the Summer of 1995. Unit 2 is approximately 65 percent complete and its completion is being reevaluated as part of an integrated resource planning process being conducted by TVA. This is a comprehensive evaluation of future demands for electric energy in the TVA region through year 2020 and is scheduled to be completed in December 1995.

By letter dated March 9, 1994, NRC staff requested that TVA provide updated environmental information in connection with the anticipated operation of WBN Unit 1. By letter dated May 18, 1994, TVA provided a copy of a report entitled "Watts Bar Nuclear Plant, Review of Final Environmental Statement" (August 1993). This report contains updated environmental information and summarizes TVA's review of its 1972 Final EIS. TVA determined in this report that while changes in the design and expected operation of WBN have occurred and new environmental information associated with the plant's operation has become available subsequent to the release of the EIS, "[n]one of the changes or new information materially affect impact projections in the EIS." TVA concluded that its Final EIS did not have to be supplemented.

By letter dated June 21, 1994, NRC staff asked TVA to provide additional environmental information to help determine whether NRC's 1978 FES should be supplemented. The information set forth in and referenced by this document is responsive to that request. It is generally organized by the section headings and numbers of the NRC FES.

1.2 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

All required Federal, State, and Local regulatory approvals were obtained for the construction of WBN. Permits and approvals which are necessary for plant operation have been obtained and are being renewed as required by applicable regulation. For example, WBN's National Pollution Discharge Elimination System (NPDES) permit was renewed in December 1993.

WBN personnel stay abreast of new environmental requirements in a variety of ways. TVA's corporate environmental staffs provide regular information about proposed and final regulations. In addition, the Nuclear Environmental staff utilizes a contract service to provide an independent review of new regulatory/statute requirements at the Federal, State, and local levels. Subsequent to the review, Environmental Bulletins are issued to each site for incorporation into the Nuclear Power Environmental Control Manual. Finally, a Nuclear Power Environmental Compliance Manual is issued and maintained by the Nuclear Environmental staff that provides corporate guidance for site compliance with environmental regulations and requirements.

Federal and State environmental agencies conduct periodic inspections of TVA facilities to verify that they are being operated in accordance with applicable requirements. In addition, TVA has had in place an internal environmental audit program since 1981 that conducts periodic audits of TVA's major facilities, including WBN (most recently in December 1993). These audits are conducted by personnel who are independent of the TVA organization which operates the audited facility. The audits consist of a comprehensive review of a facility's status vis-a-vis applicable environmental regulations and TVA environmental policies. Weaknesses in facility environmental programs and nonconformity with requirements are identified and corrective action recommended. Audited facilities are responsible for correcting problems and reporting to the audit program, the actions taken. This audit process adds further assurance that TVA facilities, including WBN, are operated in compliance with applicable environmental requirements.

2.0 THE SITE

2.2 REGIONAL DEMOGRAPHY

2.2.1 Population Changes

Relying on projected population data prepared by the Bureau of Economic Analysis from the 1970 Census of Population, the FES provided population distributions for the years 1978, 1990, 2010, and 2020. These projections are now updated based on the 1990 Census of Population and new projections by the Bureau of Economic Analysis. Revised population distribution data based on the 1990 Census of Population show that an estimated 15,500 and 862,500 people lived within 10 miles and 50 miles, respectively, of the Watts Bar site in 1990. The 10-mile population is projected to grow to about 17,900 by the year 2040. The 50-mile population is projected to reach slightly more than 1 million by the year 2040. This is consistent with the FES projections for year 2020 of more than 14,000 for the 10-mile population and more than 900,000 for the 50-mile population.

The nearest population center is Cleveland, Tennessee, which had a 1990 population of 30,354. Cleveland is located approximately 30 miles south of the Watts Bar site.

Amendment 83 to the Watts Bar FSAR contains the complete set of updated demographic data. Within 10 miles of the site, resident population is distributed across the 16 compass points for circles of 1, 2, 3, 4, 5, and 10 miles radii. Within 50 miles of the site, the same 16 compass sectors are used for circles with radii at 10-mile intervals out to 50 miles. The years include historical data for 1970, 1978, 1980, 1986, and 1990. Projected data are for the years 2000, 2010, 2020, 2030, and 2040. In addition there is data on transient population including recreation visitation and school enrollments, low population zones, the nearest population center, and cumulative population density out to 30 miles.

2.2.2 Changes in Regional Socioeconomic Characteristics

The information and analyses in this section has not significantly changed from that discussed in the FES. Population changes and Socioeconomic impacts are discussed in Section 2.2.1 and 5.6 of this document, respectively.

2.3 WATER USE

2.3.1 Regional Water Use

The information and analyses in this section has not significantly changed from that discussed in the FES.

2.3.2 Surface Water Hydrology

The FES stated that two temporary chemical cleaning ponds had been constructed within the main yard holding pond and that TVA had not yet made a decision whether to retain these ponds. TVA subsequently decided to retain the two chemical holding ponds which are still being used to contain and treat chemicals from the turbine building. The small lined pond and the large unlined pond have volumes of approximately 1 million and 5 million gallons, respectively (compared to FES estimates of approximately 700,000 gallons and 7 million gallons, respectively). The discharges from these ponds are monitored in accordance with the plant's National Pollution Discharge Elimination System (NPDES) permit for metal cleaning wastes.

In addition, a 2.5 million gallon evaporation/percolation pond was constructed and approved by the State of Tennessee in WBN's NPDES permit. This pond was used for the treatment and disposal of spent trisodium phosphate cleaning wastes which resulted from the preoperational cleaning of Units 1 and 2. It is no longer being used and TVA plans to close this pond. This pond was constructed by excavating approximately 18 inches below the original surface and then building a three to four-foot berm around its perimeter. Groundwater is being monitored by a well (WN1) downgradient of the pond. Results of this monitoring were published in July 1990 (TVA Report No. WR28-1-85-133). Discharges from the pond have not and are not expected to impact public water supplies. When the water is eventually emptied from the pond, TVA plans to push in the berm walls and then cap and revegetate the area.

The runoff holding pond that was originally built for construction, will remain in service. Presently, it collects discharge water from WBN's on-site sewage treatment plant, the heating, ventilating, and air conditioning (HVAC) cooling water system at the WBN Training Center, fire protection wastewater, and site storm water runoff. The discharge from the pond is monitored in accordance with the NPDES permit.

All point source discharges and storm water runoff points are currently being monitored in accordance with the NPDES permit. As required by the amendments to the Clean Water Act and EPA regulations, the State of Tennessee recently adopted storm water control regulations. Under the general storm water permit for industrial sources, all requirements for erosion and sedimentation controls (i.e., inspections, corrective actions, and annual sampling) have been implemented at WBN. In addition, biotoxicity sampling is conducted semiannually at the main diffuser discharge and the runoff holding pond in accordance with the NPDES permit.

2.3.3 Water Quality

The information and analyses in this section has not significantly changed from that discussed in the FES.

2.4 METEOROLOGY

2.4.1 Regional Climatology

Based on information contained in the Local Climatological Data Annual Summary with Comparative Data for Chattanooga, Tennessee for 1992, the regional climate description in the FES remains valid. The climate of the region and temperature and precipitation trends have not changed appreciably.

2.4.2 Local Meteorology

Long-term weather records

Long-term weather records from Chattanooga, Tennessee through 1992 (based on the reference in Section 2.4.1) were compared with those discussed in the FES. Differences are as follows:

> the minimum temperature of minus 23 degrees Celsius (minus 10 degrees Fahrenheit) which occurred in January 1966 occurred again in January 1985,
>
> the maximum 24 hour precipitation of 166 millimeters (6.53 inches) which occurred in March 1973 increased to 168 millimeters (6.62 inches) in September 1977,
>
> the maximum 24 hour snowfall of 226 millimeters (8.9 inches) which occurred in December 1963 increased to 259 millimeters (10.2 inches) in January 1988,
>
> the maximum monthly rainfall of 351 millimeters (13.8 inches) which occurred in March 1973 increased to 415 millimeters (16.32 inches) in March 1980.

None of these changes in maximum weather events affect environmental impact conclusions in the FES.

Onsite Wind Data

The onsite wind data presented in Chapter 2.3 of the WBN FSAR, Amendment 63 increase the period of record from the two years (July 1973 through June 1975) presented in the FES to 15 years (January 1974 through December 1988). The summary of the 10-meter (33-foot) level data provided in Table 2.3.13 of the FSAR indicates that the predominant wind flow is still from the south-southwest (with a 16 percent frequency). The mean wind speed at the 10-meter (33-foot) level increased from the 1.5 meters per second (3.0 miles per hour) in the FES to 1.9 meters per second (4.2 miles per hour). The higher mean wind speed from the longer, more representative data period, will tend to increase dispersion and lower any dose impacts. Therefore, the FES mean wind speed is conservative.

2.4.3 Severe Weather

Severe weather statistics in Section 2.3.1.3 of the WBN FSAR, Amendment 83 for hail, high winds, thunderstorms, ice storms, and air stagnation are consistent with the FES. Therefore, the FES values remain valid.

For tornado frequency and recurrence interval calculations, the FSAR used the period of 1950 through 1986 for a 30 nautical mile radius of WBN. The resulting tornado probability is 1.48E-4 and the recurrence interval is 6755 years. The FES used the period of 1953 through 1974 for a 160 kilometer (100 mile) square containing WBN. The resulting tornado probability is 7.6×10^{-4} and the recurrence interval is 1300 years. Therefore, the FES calculations are conservative.

2.4.4 Dispersion

As mentioned in the discussion of Section 2.4.2, a 15 year period of onsite data is used in the FSAR as compared to the 2 year data period in the FES. Calculation of atmospheric dispersion values (χ/Q) for both the FSAR and FES utilize Regulatory Guide 1.111 methodology, although in the FSAR the releases are treated as ground level and in the FES the releases are treated as partially elevated. In addition, a terrain adjustment factor has been included in the FSAR analysis as discussed in Section 7.9.4 of the WBN Offsite Dose Calculation Manual (ODCM), Revision 3 to account for temporal and spatial variations in airflow expected from the river valley at WBN. The resulting χ/Q values (see Table 11.3-10 in the WBN FSAR, Amendment 77 and Table 5.3 of the FES) show that the FES values are more conservative than the FSAR values. Therefore, the FES analysis remains valid. The resulting values for the locations where the highest radiation doses are expected are compared in the following table.

Comparison of χ/Q Values for the WBN FSAR and FES

Location	FSAR			FES		
	χ/Q (s/m^3)	Distance (m)	Sector	χ/Q (s/m^3)	Distance (m)	Sector
Site boundary	1.03E-5	1250	SE	5.0 E-5	1208	SSE
Residence and Garden	4.32 E-6	1524	SSE	3.5 E-5	1401	SE
Farm and Milk Animal	2.58 E-6	1981	SSW	9.9 E-6	2238	SSW

2.5 ECOLOGY

2.5.1 Terrestrial Ecology

As indicated in the FES, extensive clearing of the site occurred during the construction phase but terrestrial biological communities outside the immediate construction area have not been materially impacted. This includes several wetland areas which have been identified since the FES was released. Based on TVA staff observations and the U.S. Fish and Wildlife Service National Wetlands Inventory map of the WBN vicinity, several small areas of permanently, seasonally, and temporarily flooded, palustrine forested wetlands have been identified within the upper end of sloughs off Yellow Creek and another unnamed slough at the southwest end of the plant site. Additionally, there are areas of intact shoreline riparian zones along the southwest river boundary of the site, as well as in the above mentioned slough areas. No future land use changes on the WBN site have been identified or are anticipated which would impact these wetlands/riparian resources.

The FES reported that the southern Bald Eagle is a fairly common visitor to Watts Bar and Chickamauga Reservoirs. Bald eagles remain fairly common winter residents and rare summer residents in the WBN area. They forage primarily on fish and roost on wooded hillsides adjacent to the reservoirs. Their regional population has greatly increased in the last two decades. The first reported eagle nest attempt in the Watts Bar and Chickamauga Reservoirs area was in 1994, about 4 miles (6.4 kilometers) south-southwest of the plant site.

An additional endangered terrestrial animal, the gray bat (*Myotis grisescens*), occurs in the vicinity of WBN. The nearest cave occupied by gray bats is about 4 miles downstream from WBN. Gray bats from this and other more distant caves likely forage on adult aquatic insects over the reservoir downstream from the plant.

REFERENCES:

U.S. Fish and Wildlife Service. 1982. Gray bat recovery plan. U.S. Fish and Wildlife Service, Washington, DC.

U.S. Fish an Wildlife Service. 1984. Southeastern states bald eagle recovery plan. U.S. Fish and Wildlife Service, Atlanta, GA.

Harvey, M. J., and Pride, T. E. 1986. Distribution and status of endangered bats in Tennessee. Tennessee Wildlife Resources Agency Technical Report 88-3.

Harvey, M. J. 1993. Personal communication to C. P. Nicholson, TVA.

Hatcher, R. M. 1992. Tennessee bald eagle breeding territories - 1992. Tennessee Wildlife Resources Agency. Unpublished report. 2 pp.

2.5.2 Aquatic Ecology

The tailwater area of Chickamauga Reservoir in general is important in reproduction and early growth of fish. However, targeted studies, completed since the release of the FES, have shown that little reproduction occurs in the 2.2 mile stretch between WBN and Watts Bar Dam. Most eggs and larvae that pass the plant are spawned in Watts Bar Reservoir. Similarly, most plankton that passes the plant originates in the upstream reservoir. A diverse and abundant macrobenthic community exists in the vicinity of WBN, including a variety of mussel species.

As indicated in the FES, TVA committed to conduct comprehensive environmental monitoring. Preoperational aquatic monitoring was conducted at WBN from 1973-1979. The results of much of this initial monitoring effort were summarized in TVA's 1976 Environmental Information Statement and in the NRC FES. Because of WBN construction delays, TVA initiated a program to update the WBN preoperational aquatic data base. That program was completed in 1986 when a sufficient amount of broad baseline ecosystem information had been obtained. In 1986, a comprehensive report was issued entitled "Preoperational Assessment of Water Quality and Biological Resources of Chickamauga Reservoir, Watts Bar Nuclear Plant, 1973-1985." This report provides a detailed description of aquatic ecological conditions in upper Chickamauga Reservoir prior to the operation of WBN. A summary of the components of the WBN Preoperational Aquatic Monitoring Program is provided in Table 1.

Beginning in 1986, the emphasis of the Chickamauga Reservoir aquatic monitoring program was shifted from baseline ecosystem studies to studies directed at specific issues which were identified in concert with regulatory and resource management agencies of the State of Tennessee. These studies generally focused on Chickamauga Reservoir aquatic resources and took into account the potential effect of two nuclear plants (WBN and Sequoyah) operating on the same reservoir. The studies (listed in Table 2) addressed questions concerning mussel populations, fish species of special concern, and dissolved oxygen dynamics. A program of toxicity biomonitoring at WBN has also been carried out and those results are summarized in Tables 3 and 4. The results of all of the baseline and special aquatic monitoring studies from 1972 to the present were also reviewed as indicated in Section 5.4 of this document. The results of these studies support the conclusion that discharges from WBN pose no risk of aquatic impacts.

2.5.2.1 Mussel Communities

Various sections of the FES include information about freshwater mussels in the reach of the Tennessee River adjacent to WBN. Since 1978, TVA aquatic biologists have conducted substantial additional mussel field work in the Tennessee River downstream from Watts Bar Dam. Starting in 1983, TVA began monitoring the status of mussel stocks in three relatively dense areas ("mussel beds") located just upstream, just downstream, and several miles downstream from the WBN discharges. Also since 1978, the mussel sanctuary in the area has been extended nearly seven miles downstream (to Tennessee River Mile (TRM) 520.0) by the Tennessee Wildlife Resources Agency.

Native mussel resources are now known to occur in various concentrations throughout the Watts Bar tailwater. A "mussel bed" exists along the right (descending) shoreline between TRM 526 and 527, just downstream from the mouth of Yellow Creek and the WBN discharges. Since 1978, a total of 31 freshwater mussel species has been reported from this tailwater. The most abundant of these are the elephantear (Elliptio crassidens), Ohio pigtoe (Pleurobema cordatum), and pimpleback (Quadrula pustulosa). The results of several recent studies indicate that very few mussel species have reproduced successfully in this river reach during the last 30 or more years.

2.5.2.2 Aquatic Endangered and Threatened Species

Following the passage of the Endangered Species Act in 1973, several Tennessee River freshwater mussels, and a few large-river fish have been listed by the U. S. Fish and Wildlife Service as endangered or threatened (E&T). The FES reported on the existence of two endangered mussel species in the vicinity of the plant, the pink mucket (Lampsilis orbiculata) and the dromedary pearly mussels (Dromus dromas). Information collected since the FES indicates that one threatened fish (the snail darter, Percina tanasi), and two other endangered freshwater mussels (the fanshell, Cyprogenia stegaria; and the rough pigtoe, Pleurobema plenum) occur in the first ten miles of the Tennessee River downstream from Watts Bar Dam.

Various recent mussel surveys in the Watts Bar tailwater provide additional information about the distribution and relative abundance of the four endangered mussel species (see Table 5). The dromedary pearly mussel is the most uncommon of these species. Only four specimens of this species have been collected -- three in 1978 and one in 1983. No other specimens have been found in subsequent surveys. All four specimens were encountered on Hunter Shoals, between TRM 520 and 521 (approximately 7.6 miles from the WBN site). Surviving populations of this mussel species occur in the Cumberland River in middle Tennessee and in the Clinch and Powell rivers in northeast Tennessee and southwest Virginia.

The fanshell and rough pigtoe were both found consistently in very low numbers (1 to 3 per year) in the Watts Bar tailwater between 1983 and 1985; however, neither species has been encountered during any subsequent survey. Both species were found more consistently on Hunter Shoals but a few specimens of each species also have been found between TRM 528 and 529 (above WBN's diffuser discharge point). Reproducing populations of the fanshell persist in the Green River, central Kentucky; the Licking River, eastern Kentucky; and the Clinch River, northeast Tennessee and southwest Virginia. The rough pigtoe persists in the Green and Barren rivers, central Kentucky; the Cumberland River, central Tennessee; and the Clinch River, northeast Tennessee and southwest Virginia.

At least a few specimens of the pink mucket have been found during each mussel survey conducted in the Watts Bar tailwater since 1978. Representatives of this species have been found on all three beds involved in the preoperational monitoring program as well as upstream toward the dam and at intermediate sites. In terms of relative abundance, the pink mucket consistently accounts for 0.3 to 0.7 percent of the mussel community encountered. Besides the Watts Bar tailwater, the pink mucket is known to exist at scattered locations from the Kanawha River, West Virginia, west to the Osage and Meramec rivers, Missouri, south to the Black River, Arkansas, and east to the Tennessee and Cumberland rivers in Tennessee. The most upstream site in the Tennessee River watershed where this species has been found is the Clinch River, northeast Tennessee.

In 1981, snail darters were discovered in Sewee Creek, a small stream which enters the Tennessee River at TRM 524.6. This is now one of six known snail darter populations, all of which occur in direct tributaries to the Tennessee River. The core of each population apparently exists in the smaller streams but young snail darters routinely drift down into the river during their first year of life.

TABLE 1

Summary of WBN Baseline Preoperational Aquatic Monitoring Programs - 1972-1993

PROJECT	TYPE OF SAMPLING	YEARS CONDUCTED
Adult Fish (Results through 1985 in TVA 1986; through 1993 in TVA 1994a)	Population Inventory using fish toxicant (rotenone)	1970-1993
	Fish (Electrofishing, Gill-netting, Hoop-netting)	76-79, 82-85
(Results of the following projects are reported in TVA 1986)		
Larval Fish	Trawling	76-79, 82-85
WBN Benthic	Bottom-dwelling organisms	73-77, 82-85
WBN Zooplankton	Planktonic animal life	73-77, 82-85
WBN Phytoplankton	Planktonic plant life (algae)	73-77, 82-85
WBN Periphyton	Attached algae	73-77, 82-85
WBN Chlorophyll	Phytoplankton biomass	73-77, 82-85
WBN Primary Productivity	Phytoplankton photosynthesis	73-77, 82-85
WBN Autotrophic Index (AI)	Indicator of organic pollution	73-77, 82-85

TABLE 2

Summary of WBN/SQN Chickamauga Special Aquatic Monitoring Program Issues - Directed Studies

PROJECT	TYPE OF SAMPLING	YEARS CONDUCTED
WBN Mussel Survey (TVA 1989b, 1991b)	Diver conducted population survey (biennial)	1983-1992
Sauger Population Study (TVA 1988, 1989a, 1990a, 1991a)	Electrofishing, Gillnetting Larval sampling	1986-1991 1987
White Crappie Invest. (TVA 1990c)	Larval netting, Light Traps Electrofishing, Trapnetting	1986-1989 1987-1989
White Bass Population Study (TVA 1994a)	Electrofishing,Tagging, Larval Sampling	1990-1992 1990-1991
Channel Catfish Study (TVA 1994b)	Review of available data	1990-1992
Dissolved Oxygen Study (TVA 1990b)	Reservoir-wide O_2 Dynamics	1987-1989

Table 3

SUMMARY OF NPDES TOXICITY TEST REQUIREMENTS FOR WATTS BAR NUCLEAR PLANT (WBN)

PROJECT	NPDES PERMIT NO.	OUTFALL	TEST* TYPE	FREQUENCY/ SAMPLE TYPE	TEST EFFLUENT CONCENTRATIONS	DILUTION/ CONTROL WATER	OTHER TEST SAMPLES	REPEAT REQUIREMENT
WBN✓	TN0020168	101	ACUTE/ CHRONIC (with 96-h & 7-d endpoints)	SEMI-ANNUAL DAILY GRABS	100% 9.8%† (96-h) 7.8%§ 2.9%† (7-day) 2.3%§	Synthetic Water	• WBN intake	Follow-up test reported within 30 days of a significant test failure§
		102 (Only if 101 cannot be tested during the period)	ACUTE/ CHRONIC (with 96-h & 7-d endpoints)	SEMI-ANNUAL DAILY GRABS	100% 10.7%† (96-h) 8.6%§ 3.2%† (7-day) 2.6%§	Synthetic water	• WBN intake	Follow-up test reported within 30 days of a significant test failure§
		112	ACUTE/ CHRONIC (with 96-h & 7-d endpoints)	SEMI-ANNUAL DAILY GRABS	100%† 80%§ 50% 25% 12.5%	Synthetic Water		Follow-up test reported within 30 days of a significant test failure§

✓Currently testing under NPDES permit, permit letter, agreement with a State, or approval from Generating Group.
*Tests evaluate responses of both *Ceriodaphnia dubia* (daphnids) and *Pimephales promelas* (fathead minnows).
†Compliance concentration.
§Represents significant toxicity (4/5 of compliance limit). New language for toxicity biomonitoring being incorporated into Tennessee NPDES permits will base retest requirements and conditions for conducting a Toxicity Reduction Evaluation (TRE) on this value.

Table 4

SUMMARY OF TOXICITY BIOMONITORING RESULTS
TENNESSEE VALLEY AUTHORITY, WATTS BAR NUCLEAR PLANT (WBN)
JANUARY 1991-MARCH 1994

TEST DATE	ORGANISM	CONTROL/ DILUTION	TREATMENT RESPONSE	TREATMENT CONC. (%)	COMMENTS
Jan. 11-18, 1991					Initial baseline test of Outfall 101. Isco composite 24-h samples.
Outfall 101*	*Pimephales promelas*	TR[†]	Not toxic, s & g[§]	100, 50	
	Ceriodaphnia dubia	TR	Not toxic, s & r[§]	100, 50, 25	
	Selenastrum capricornutum	TR	Not toxic, g[§]	100, 50, 25	
Apr. 9-21, 1991 Outfall 101*					Test conducted during discharge of ice melt water w/ 2,000 ppm sodium tetraborate (20 gpm). Boron concentration range = 0.22-2.20 mg/L. Also effluent spiked with 9.0 ppm boron (nominal concentration). Isco composite 24-h samples.
	Pimephales promelas	TR	Not toxic, s & g	100, 30, 9, 2.7	9.0 ppm boron not toxic (12-d embryo-larval test).
	Ceriodaphnia dubia	TR	Not toxic, s & r	100, 30, 9, 2.7	9.0 ppm boron toxic (reproduction only)
	Selenastrum capricornutum	TR	Toxic (NOEC = 9%), g	100, 30, 9, 2.7	*Intake source of toxicity*; 9.0 mg B/L was not toxic.
Jul. 31- Aug. 9, 1991 Outfall 101*					Tested 100% Outfall 101 alone (treatment 2) and with respective high & low concentrations each of: A. TVA06[#], TVA07[#], Betz 30K[#] (treatments 3 & 4) B. TVA06, TVA07, Betz 30K, Copper-Trol[#] (treatments 5 & 6) C. TVA06, TVA07, Betz 30K, Clam-Trol[#] (treatments 7 & 8) Treatments 5-8 were exposed to Copper-Trol & Clam-Trol only during the initial 24 hours of testing.
	Ceriodaphnia dubia	WBN Intake/ Outfall 101	Acute (24-h) toxicity of treatments 7 & 8 Chronic toxicity of treatments 5 (s) and 3 (r)	See Study Comments	100% mortality in 24-h for treatments 7 & 8. Only high concentrations of A & B affected.

Table 4

TEST DATE	ORGANISM	CONTROL/ DILUTION	TREATMENT RESPONSE	TREATMENT CONC. (%)	COMMENTS
(Cont.)	*Anodonta imbecillis* (Juvenile freshwater mussels, Paper Pondshell, 8-9 days old post transformation, 9-day test exposure)	WBN Intake/ Outfall 101	Not toxic, s	See Study Comments	9-day survival in ranged from 89% (reference) to 98% (treatment 7). All treatments contained ~ 600-800 mg silt/L (dry weight).
Sept. 19-26, 1991 Outfall 101*					Follow up study that Tested 100% Outfall 101 alone (treatment 2) and with respective high & low concentrations each of : A. TVA06, TVA07, Betz 30K (treatments 3 & 4) B. TVA06, TVA07, Betz 30K, Clam-Trol (5 & 6) Treatments 5 & 6 were exposed to CT-1 only during the initial 24 hours of testing.
	Pimephales promelas	WBN Intake/ Outfall 101	Not toxic, s, g	See Study Comments	
	Ceriodaphnia dubia	WBN Intake/ Outfall 101	Acute (24-h) toxicity of treatment 5 and chronic (6-day) toxicity of treatment 6 (s)	See Study Comments	CT-1 toxic at both high and low concentrations tested. No other toxicity observed.
Apr. 9-16, 1992 Outfall 101*					Second baseline evaluation of Outfall 101 alone and spiked w/ Copper-Trol® for the algal test.
	Pimephales promelas	WBN Intake	Toxic (NOEC < 50%), s	100 & 50	*Intake source of toxicity;*
	Ceriodaphnia dubia	WBN Intake	Not toxic, s, r	100, 75, 50, 25	
	Selenastrum capricornutum	WBN Intake	Toxic (NOEC = 50%; IC25 = 63%), g 100%-spiked Outfall 101 not toxic, g	100, 75, 50, 25 Also, with Copper-Trol®-spiked & trsted @ 100, 30, 9	Instream acute and chronic (CMC & CCC) toxicity criteria not exceeded due to dilution (1:83 minimum for the study).

Table 4

TEST DATE	ORGANISM	CONTROL/ DILUTION	TREATMENT RESPONSE	TREATMENT CONC. (%)	COMMENTS
June 25-July 2, 1992					Third baseline assessment of Outfall 101.
Outfall 101*	*Pimephales promelas*	WBN Intake	Not toxic, s, g	100, 50	
	Ceriodaphnia dubia	WBN Intake	Not toxic, s, r	100, 75, 50, 25	
	Selenastrum capricornutum	WBN Intake	Toxic (NOEC = 75%), g	100, 75, 50, 25	Instream acute and chronic (CMC & CCC) toxicity criteria not exceeded due to dilution (1:117 minimum for the study).
Oct. 15-22, 1992					First operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	TR	Not toxic, s, g	100, 50, 25, 12.5	
	Ceriodaphnia dubia	TR	Not toxic, s, r	100, 50, 25, 12.5	
Nov. 18-25, 1992					Second operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	TR	Not toxic, s, g	100, 50, 25, 2	
	Ceriodaphnia dubia	TR	Not toxic, s, r	100, 50, 25, 2	
	Selenastrum capricornutum	TR	Toxic (NOEC = 2%), g	100, 50, 25, 2	Instream acute and chronic (CMC & CCC) toxicity criteria not exceeded due to dilution (1:404 minimum for the study).
Dec. 16-23, 1992					Third operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 50, 25, 2	
Jan. 15-22, 1993					Fourth operational assessment during injection of anti fouling chemicals. *CT-1 injected during study.*
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 50, 25, 2	

Table 4

TEST DATE	ORGANISM	CONTROL/ DILUTION	TREATMENT RESPONSE	TREATMENT CONC. (%)	COMMENTS
Feb. 11-18, 1993					Fifth operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 50, 25, 2	
	Selenastrum capricornutum	TR	Toxic (NOEC = 2%), g	100, 50, 25, 2	Instream acute and chronic (CMC & CCC) toxicity criteria not exceeded due to dilution (1:831 minimum for the study).
Mar. 19-26, 1993					Sixth operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 50, 25, 2	
Apr. 16-23, 1993					Seventh operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 50, 25, 2	
May 12-19, 1993					Eighth operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 50, 25, 2	
	Selenastrum capricornutum	Intake/TR	Toxic (NOEC = 2%), g	100, 50, 25, 2	Instream acute and chronic (CMC & CCC) toxicity criteria not exceeded due to dilution (1:159 minimum for the study).
Jun. 9-16, 1993					Ninth operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	

Table 4

TEST DATE	ORGANISM	CONTROL/ DILUTION	TREATMENT RESPONSE	TREATMENT CONC. (%)	COMMENTS
(Cont.)	*Ceriodaphnia dubia*	Intake/ Synthetic water	Not toxic, s, r	100, 50, 25, 2	
Jul. 15-22, 1993					Tenth operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 50, 25, 2	
Aug. 19-26, 1993					Eleventh operational assessment during injection of anti fouling chemicals.
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 50, 25, 2	
	Selenastrum capricornutum	Synthetic water	Toxic (NOEC = 1.1%), g	100, 50, 25, 2	Instream acute and chronic (CMC & CCC) toxicity criteria not exceeded due to dilution (1:424 minimum for the study).
Sep. 25-Oct. 2, 1993					Twelfth operational assessment during injection of anti fouling chemicals. *CT-1 injected during study.*
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 50, 25, 2	Growth reduction in 25% & 50% treatments but not in undiluted Outfall 101.
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 50, 25, 2	
Feb. 2-9, 1994					First semi-annual compliance monitoring of Outfalls 101 and 112 under renewed NPDES permit TN0020168.
Outfall 101*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 9.8, 7.8, 2.9, 2.3	
	Ceriodaphnia dubia	Synthetic water	Toxic (NOEC = 9.8%), r	100, 9.8, 7.8, 2.9, 2.3	*Permit limit not exceeded.*
Outfall 112*	*Pimephales promelas*	Synthetic water	Toxic (NOEC = 25%), s	100, 80, 50, 25, 12.5	*Permit limit exceeded.*

Table 4

TEST DATE	ORGANISM	CONTROL/ DILUTION	TREATMENT RESPONSE	TREATMENT CONC. (%)	COMMENTS
(Cont.)	*Ceriodaphnia dubia*	Synthetic water	Not toxic, s, r	100, 80, 50, 25, 12.5	
Feb. 18-25, 1994					Repeat test of Outfall 112 due to fish toxicity exceeding permit limit.
Outfall 112*	*Pimephales promelas*	Synthetic water	Toxic (NOEC = 25%), g	100, 80, 50, 25, 12.5	*Permit limit exceeded* (based on 0.1 μg of fish weight in 100% Outfall 112 treatment).
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 80, 50, 25, 12.5	
Mar. 23-30, 1994					Repeat test due to fish toxicity exceeding permit limit in the previous test.
Outfall 112*	*Pimephales promelas*	Synthetic water	Not toxic, s, g	100, 80, 50, 25, 12.5	
	Ceriodaphnia dubia	Synthetic water	Not toxic, s, r	100, 80, 50, 25, 12.5	

Test types: 3-brood *Ceriodaphnia dubia* chronic test (EPA protocol), 7-day *Pimephales promelas* chronic test (EPA protocol), 9-day *Anodonta imbecillis* acute test (TVA protocol).

*Outfall 101 = Diffuser pipe at TRM 527.9; Outfall 112 = Runoff holding pond to unnamed tributary to Yellow Creek
†TR = Non-toxic dilution water collected from outdoor channels at TVA's Toxicity Testing Laboratory, Wheeler Reservoir once-through water pumped from upstream of the Browns Ferry Nuclear Plant (TRM 293).
§s = survival (fish, daphnids, & mussels), g = growth (fish & algae), r = reproduction (daphnids).
#Chemical additives:
TVA06 = HPS-1 copolymer dispersant
TVA07 = zinc sulfate
Betz 30K = tetra potassium pyro phosphate
Copper-Trol = tolyltriazole
Clam-Trol = CT-1 (DGH/QUAT).

Table 5

Recent Endangered Mussel Records from Watts Bar Tailwater

(Entries include number found each year and River Miles from which they came)

Year	*Dromus dromas* dromedary		*Cyprogenia stegaria (= irrorata)* fanshell		*Pleurobema plenum* rough pigtoe		*Lampsilis abrupta (= orbiculata)* pink mucket	
	No.	River Mi.	No.	River Mi.	No.	River Mi.	No.	River Mi.
1978 (random survey)	**3**	520(3)	**4**	520 521(2) 524	**[NR]**		**19**	516 518 520(5) 521(5) 525 527 528(5)
1983	**1**	520	**3**	520 528(2)	**2**	520(2)	**10**	520(2) 526 528(7)
1984			**1**	520	**2**	520(2)	**8**	520 526(3) 528(4)
1985			**1**	520	**1**	528	**8**	520(2) 528(6)
1986							**8**	520(4) 526 528(3)
1988							**12**	526(2) 528(10)
1990							**4**	526 528(3)
1990 (lock survey)							**6**	528(2) 529(4)
1991 (Mead survey)							**2**	525(2)
1992							**6**	526(2) 528(4)

NR - species may have been present but was not recognized.

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2.6 BACKGROUND RADIOLOGICAL CHARACTERISTICS

The information and analyses in this section has not significantly changed from that discussed in the FES.

2.7 HISTORICAL AND ARCHAEOLOGICAL SITES

As noted in the TVA Final EIS, a December 1970 archaeological reconnaissance/survey identified "areas of potential archaeological significance" on the WBN plant site. These areas consisted of a single Early Mississippian platform mound (Leuty Mound 40RH6) and a group of five Late Woodland period Hamilton mounds (McDonald sit 40RH7). Mitigation of potential adverse project impacts to these mounds was undertaken in 1971 (Schroedl, G. F., 1978, Excavation of the Leuty and McDonald Site Mounds). Two open habitation areas adjacent to the Mississippian platform mound were noted in the 1971 excavations and mitigation of potential adverse project impacts was undertaken in 1972 (Clabrese, F. A., 1976, Excavations at 40HR6, Watts Bar area, Rhea County, Tennessee). Results of both data recovery excavations were coordinated with and concurred in by the Tennessee State Historical Preservation Office (SHPO).

Archaeological sites exist along the reservoir shoreline, downstream from the plant construction area. These sites were avoided by plant construction activities and will not be impacted by plant operations; they will continue to be protected/preserved by TVA.

All transmission line corridors associated with the project were surveyed and no sites were encountered that were potentially eligible for the National Register of Historic Places. No effect results regarding transmission line construction and subsequent maintenance/operation impacts were concurred with by the Tennessee SHPO.

No unknown archaeological sites and no structures of historical significance have been encountered during any phase of project construction.

3.0 THE PLANT

3.2 DESIGN AND OTHER SIGNIFICANT CHANGES

3.2.1 Water Use

WBN's planned water use has not changed significantly since release of the FES. Steam generator makeup, service water, and condenser cooling water are still expected to be obtained from the Tennessee River. Potable water continues to be obtained from a groundwater system which is now operated by the Watts Bar Utility District. This possibility was alluded to in the FES.

3.2.2 Heat Dissipation Systems

The FES description of the heat dissipation system at WBN remains accurate. The WBN discharge diffuser is located at Tennessee River Mile (TRM) 527.8 in the tailwater area of Chickamauga Reservoir, 2.2 miles below Watts Bar Dam. The plant has a completely closed mode cooling system with a maximum makeup water intake of 143 cfs (0.7% of the mean river flow past the plant) and a maximum discharge through multiport diffusers of approximately 173 cfs (previously 170 cfs). The maximum area of the mixing zone for the diffusers was not changed in the renewal of the plant's NPDES permit in 1993 and remains 240 feet x 240 feet. This influences an estimated maximum of 38% of the cross sectional area of the river. The maximum expected temperature rise at the edge of the mixing zone is 2.3°F.

As stated in the FES, WBN operates in closed-mode using one natural draft cooling tower per nuclear unit. The water losses due to evaporation and blowdown are replenished with the makeup water which is supplied via an intake channel and pumping station at TRM 528.0. The average and maximum intake flow rates are 111 to 134 cfs and 143 cfs, respectively, with a dilution ratio of approximately twice that of the blowdown. The blowdown from closed-mode operation is discharged into the Tennessee River through a multiport diffuser system. WBN is designed to route the blowdown either to the diffusers or to a 234,390 cubic meter (190 acre feet) yard holding pond for temporary storage. Plant operation procedures and design related to the heat dissipation system (i.e., cooling towers and blowdown) and the operating characteristics of the diffusers are described in the FES.

The 1993 NPDES permit continues to stipulate that the discharge diffusers may operate only when release from Watts Bar Hydro Plant (WBH), located about 2 miles upstream of WBN, is greater than 3,500 cfs. This limitation and the use of the yard holding pond was discussed in the FES. Whenever less than 3,500 cfs is discharged from WBH, the two diffuser legs are automatically closed and blowdown flow is diverted to the yard holding pond. An overflow weir on the south side of the pond allows discharge to the Tennessee River at TRM 527.2 in emergency situations. The 1993 NPDES identifies this overflow as Outfall 102 (Emergency Overflow). The discharge from this outfall or operation is infrequent.

The 1993 NPDES permit also establishes monitoring requirements and/or limits for the diffuser discharge into the Tennessee River. The NPDES permit required that TVA conduct temperature modeling studies to determine the appropriate daily average discharge temperature limit from Outfall 101 and Outfall 102. These studies were completed and a report submitted to Tennessee in December 1993. The report identified a daily average discharge temperature limit of 35° (95°F) for the diffusers with the 240 feet x 240 feet mixing zone. The report identified a temperature limit for emergency overflows from Outfall 102 of 40° (104°F) (measured by a daily grab sample at the overflow weir during an overflow event). A mixing zone of 1,000 feet wide by 3,000 feet downstream was also identified for emergency overflows. TVA's analyses showed that these temperature limits would ensure that Tennessee's thermal water criteria would be met. Those criteria are:

> The receiving water shall not exceed (1) a maximum water temperature change of 3° (5.4°F) relative to an upstream control point, (2) a maximum temperature of 30.5° (86.9°F), except when upstream [ambient] temperatures approach or exceed this value, and (3) a maximum rate of change of 2° (3.6°F) per hour outside a mixing zone.

The estimates of cooling tower evaporation and makeup and blowdown flows remain the same as those in the FES. Blowdown water meets the 1993 NPDES permit limits for temperature and chemical levels. Treatment of the raw water is described in Section 3.2.4.

3.2.3 Radioactive Waste Treatment Systems

TVA is committed to monitoring doses to the public from radioactive releases as low as reasonably achievable (ALARA) at WBN by employing state-of-the-art waste treatment systems and other passive methods. The TVA Final EIS recognized that identified treatment systems would be modified or supplemented to take advantage of technological improvements and evolving regulatory requirements. Consistent with this expectation, design of these systems has evolved to reflect TVA's and the nuclear industry's operating experiences. Based on operational data from the systems employed at Sequoyah Nuclear Plant, TVA expects the modified treatment systems at WBN to result in radioactive releases and resulting doses less than or of no greater magnitude than those projected in the FES.

3.2.3.1 Liquid Radioactive Waste Treatment Systems

The liquid waste processing system collects and processes potentially radioactive wastes before releasing to the Tennessee River. Provisions are made to sample and analyze fluids for batch type releases before they are discharged. Based on laboratory analyses, these wastes are either released under controlled conditions via the cooling tower blowdown or retained for further processing. A simplified flow diagram is shown in the update to the FES Figure 3.4.

The FES reported on TVA's then-current plans to use the boron recovery system (BRS) (which included boric acid evaporators (BAE)) and condensate demineralizer waste evaporator system (CDWE) in the liquid waste processing system. Both the BRS and the CDWE are installed and connected to the waste disposal system but are not planned for use in support of Unit 1 operation. Liquid waste will be processed, as necessary, through the demineralizer. A new mobile demineralizer system is being installed to replace the existing atmospheric demineralizer. The new mobile demineralizer system removes most soluble and suspended radioactive materials from the waste stream via filtration, media/activated carbon, and ion exchange resin. Once the resin media is expended, it is sluiced to a container for storage and subsequent off-site disposal.

Under plant procedures, minor radioactive releases may be discharged from the plant through the cooling tower blowdown as indicated in the FES. An additional release could occur from the discharge of low level radioactive liquid effluents from the Turbine Building station sump (TBSS) to the yard holding pond (YHP) via the low volume waste treatment pond (LVWTP). This release would occur only in the unlikely event of a primary to secondary leak and is not considered a major release pathway. Monitoring of this release path is controlled in accordance with the WBN Offsite Dose Calculation Manual (ODCM) which was approved by NRC in a letter dated July 26, 1994.

Releases from the liquid waste processing system are procedurally controlled in compliance with the NPDES permit and 10 CFR 20, Appendix B as described in the FSAR. Releases have been evaluated and are expected to be well within the limits described in the NPDES permit and 10 CFR 20.

A detailed description of the liquid waste processing system and any potential radiological releases are described in Chapter 11 of the FSAR. The radiological releases are summarized in Section 5.5.

3.2.3.2 Gaseous Radioactive Waste Treatment Systems

The gaseous waste processing system is designed to remove fission product gases from the Nuclear Steam Supply System and to permit operation with periodic discharges of small quantities of fission gases through the monitored plant vent. The system has not changed significantly from that depicted in the FES.

Gaseous effluent releases during normal operation of the plant are limited at the site boundary not to exceed 10 CFR 50, Appendix I and 40 CFR 190 limits as specified in the ODCM. The 10 CFR 50 Appendix I limits provide assurance that the exposures to individuals in unrestricted areas are as low as reasonably achievable.

A detailed description of the gaseous waste processing system and any potential radiological releases are described in Chapter 11 of the FSAR. The radiological releases are summarized in Section 5.5.

3.2.3.3 Solid Wastes

The description of wet and dry wastes in this section of the NRC FES is accurate. The waste forms listed are all expected to be generated at Watts Bar. In lieu of solidification, "wet" solid wastes are transferred to an approved container and are dewatered prior to shipment offsite. As discussed in Section 3.2.3.1, waste evaporators will not be utilized in support of Unit

1 operation, and therefore evaporator bottoms will not be generated at Watts Bar.

Current information indicates that the FES estimates of the amount of waste which WBN anticipates that will be generated, were conservative. The volume of wet waste assumed in the FES (17,000 cubic feet annually) is high compared to that currently produced by Sequoyah Nuclear Plant (less than 580 cubic feet in calendar 1993) and the average volume produced by a two-unit pressurized water reactor plant (about 2,500 cubic feet). This reduction in wastes is due in part to industry efforts to reduce the amount of waste generated because of high disposal cost. Another reason for the decrease is that most plants do not operate evaporators (and therefore do not generate evaporator bottoms) as was assumed in the FES. The volume of wet waste from Watts Bar is expected to be lower (580 to 2,500 cubic feet) than that assumed in the FES (17,000 cubic feet).

Wet waste activity is estimated at 2,000 curies per year in the FES. Actual activity in the wet radwaste shipped from Sequoyah in 1993 was about 80 curies, although the activity in years in which CVCS resin has been shipped has approached 1,800 curies. Therefore, the FES estimates of wet waste activity, are considered to be accurate. The FES estimated that about 4,100 cubic feet of dry waste would be generated with a total activity of less than 5 curies. Based on Sequoyah experience for 1993, a significantly smaller amount, about 1,400 cubic feet of dry waste, is expected to be generated at Watts Bar with an activity of 5 to 7 curies. The difference in waste volume reflects the use of dry waste incineration, which is conducted offsite by a vendor in accordance with applicable Federal and State radiological and environmental regulations. Dry waste incineration is a technology that was not in use at the time of the FES.

It should be noted that dry waste will not be shipped in cardboard or wooden boxes, as assumed in the FES. Only steel and polyethylene containers will be used for disposal.

The total volume of waste that is now expected to be generated at WBN will be lower than that assumed in the FES by a factor of about 5 to 10. This would result in fewer shipments to disposal facilities. Based on this information, it is concluded that the solid waste impact from operation of WBN will be less than that predicted in the FES.

3.2.4 Chemical, Sanitary, and Other Waste Treatment

There have been several changes in planned use of chemicals at WBN. The potential sources of chemicals and chemical quantities are now controlled by a site Chemical Traffic Control Program. Potential discharges of chemicals at WBN are controlled by the NPDES permit. Information regarding WBN's chemical uses is provided in the update to the attached FES Table 3.6 and described below:

Steam Generator Feedwater Treatment

As stated in the FES, WBN's original design would have used sodium phosphate, ammonia, and hydrazine as additives to the steam generator feedwater. Based on the latest advances in pure water treatment, ethanolamine (ETA) and ammonia for pH control, hydrazine for oxygen scavenging, and boric acid for crevice chemistry control will be used in place of the phosphate treatment.

Raw Water Treatment

WBN has a comprehensive chemical treatment program for treating raw water systems. This treatment is a major part of the WBN Raw Water Corrosion Program. Chemical treatment is used to control corrosion in carbon steel and yellow metals, to control organic fouling, including slime, to minimize the effect of microbiologically induced corrosion (MIC) and inhibit growth of Asiatic clams. Raw water treatment chemicals currently used at WBN consist of:

a. A Copolymer dispersant to control deposition and fouling;
b. Tetrapotassium Pyrophosphate, a corrosion inhibitor and sequestrant, to remove existing corrosion deposits;
c. Zinc Sulphate to control carbon steel corrosion;
d. Butyl Benzotriazole to protect yellow metal;
e. Dodecylguanidine Hydrochloride (DGH) and n-alkyl dimethyl benzyl ammonium chloride (quat) to kill clams, and prevent MIC; and
f. 1-Bromo-3-chloro-5, 5-dimethylhydantoin (BCDMH) - a biocide to reduce MIC and control clams.

Component Cooling Water Treatment

Sodium chromate will not be used as a corrosion inhibitor in the closed component cooling water system as initially planned. Because of advancements in corrosion inhibition, WBN will use tolytriazole and sodium molybdate for corrosion control and pH adjustment.

Reactor Coolant System Treatment

TVA still plans to use boric acid, lithium hydroxide, hydrogen peroxide and hydrazine during plant startup, operation, and shutdown to treat the reactor cooling system.

Auxiliary Steam Generator System Treatment

Current plant design still calls for the use of two (2) 40,000 pounds per hour oil-fired boilers to supply building heat and steam for unit startup. Hydrazine and ammonia will be used for oxygen scavenging and corrosion inhibition, respectively, in these boilers.

Miscellaneous Treatment

As planned, plant components may be chemically cleaned prior to initial startup and during plant operation to remove corrosion product buildup. Various chemicals may be utilized as metal cleaning compounds (e.g., trisodium phosphate, ethylene diamine tetra acetic acid (EDTA), hydrochloric acid, and hydrazine). Wastewater from cleaning processes will be discharged to holding ponds on site and treated in compliance with the NPDES permit.

Sanitary Waste Treatment

Per the FES, sanitary waste from WBN is treated in an extended aeration plant with four separate units which have a combined treatment capacity of 120,000 gallons per day. Treated effluent is routed to the runoff holding pond and eventually discharged to the river. Discharge are controlled and monitored in accordance with the NPDES permit.

Water Filtration, Demineralization, and Condensate Polishing

Water processing, including clarification, demineralization, and condensate polishing (including waste neutralization), continues to be feasible for steam system water makeup requirements at WBN. The basic engineering theory and processes employed in the nuclear industry today for processing and treatment of raw water closely parallel the methods anticipated by the FES.

Yard Drainage System

Plant grounds drain into a yard holding pond. This pond serves as an intermediate collection point and is equipped with skimming capability to facilitate removal of floating debris and oil.

Erosion Control/Storm Water Monitoring Program

The goal of the WBN Erosion/Stormwater Pollution Prevention Plan is to improve water quality by reducing pollutants contained in storm water discharges. Appropriate management practices are applied to site areas to control erosion and sediment runoff. Runoff from the site is sampled and monitored in accordance with the NPDES General Industrial Storm Water Permit.

Transformers and Electrical Machinery

Consistent with applicable regulations, WBN has prepared a Spill Prevention Control and Countermeasure (SPCC) plan which addresses potential spills into waters of the United States from equipment or machinery at the plant. Such spills could include diesel fuel oil, gasoline, insulating oil, lube oil, and other lubricating oils.

Earlier environmental reviews contemplated that PCB transformers would be used at the plant; however, all such equipment are being removed from the site or retrofilled with mineral oil or silicon fluid. Transformers that still contain PCBs are indoors and located in secondary containments. The retrofill project is scheduled to be complete in late 1994. Upon completion of the retrolfill project, there will no longer be PCB transformers on site.

Solid Wastes

Nonradioactive and nonhazardous solid waste, including construction debris, office waste, and any asbestos waste that may be generated at the plant are disposed in State-approved sanitary landfills or in onsite approved landfills depending on the waste and type. Most of the pipe insulation containing asbestos has or will be removed from WBN and has been replaced with asbestos-free insulation. Hazardous wastes are disposed of or treated offsite at State or EPA-approved treatment/disposal facilities.

3.2.5 Power Transmission System

The FES description of the transmission system lines into and out of WBN remains accurate. The Watts Bar-Volunteer transmission line was placed into service on July 19. 1981. No additional transmission lines into or out of WBN are currently planned.

SUMMARY OF ADDED CHEMICALS AND RESULTING END PRODUCT CHEMICALS

Watts Bar Nuclear Plant

Item No.	System	Chemical Treatment Source Chemical and Waste Products	Estimated Maximum Annual Use kg	(lbs)	Waste End Product Chemical	Resulting End Product[a] Average Annual kg	(lbs)	Mean Daily kg	(lbs)
1	Makeup water filter plant	Alum $Al_2(SO_4)_3 \bullet 18H_2O$	35,743	(78,800)	$Al(OH)_3^b$	7,489	(16,510)	20	(45)
					SO_4^{2-}	13,880	(30,600)	38	(84)
					Settled Solids[b,c]	32,114	(70,800)	88	(194)
2	Makeup water demineralizer	Sulfuric Acid H_2SO_4 (93% solution)	104,780	(231,000)	SO_4^{2-} (Neutral pH)	98,430	(217,000)	270	(595)
		Sodium Hydroxide NaOH (50% solution)	195,498	(431,000)	Na^+ (Neutral pH)	56,245	(124,000)	154	(340)
	Natural Minerals Removed by Demineralizers	Sodium Na^+	4,590	(10,120)	Na^+	4,590	(10,120)	13	(28)
		Chloride Cl^-	8,936	(10,700)	Cl	8,936	(10,700)	75	(54)
		Sulfate SO_4^{2-}	9,866	(21,750)	SO_4^{2-}	8,866	(21,750)	27	(60)
		Total Dissolved Solids	53,298	(117,500)	Dissolved Solids	53,297	(117,500)	146	(322)
3	Secondary Steam System Condensate Polishing Demineralizers	Sulfuric Acid	267,665	(590,100)	SO_4^{2-} (Neutral pH)	262,176	(578,000)	717	(1580)
		Sodium Hydroxide NaOH	160,665	(353,500)	Na^+ (Neutral pH)	92,197	(203,260)	254	(560)
	Ionized Soluble Species Removed by Demineralizers	Carbonates (CO_3^{2-})	11,521	(25,400)	CO_3^{2-}	11,521	(25,400)	32	(70)
		Metallic Salts	d	d		d	d	d	d
		Ethanolamine	44,019	(97,820)	$EtONH_2^+$	44,019	(97,820)	121	(268)
		Boric Acid	45,000	(100,000)	H_3BO_3	45,000	(100,000)	122	(273)

Table 3.6

SUMMARY OF ADDED CHEMICALS AND RESULTING END PRODUCT CHEMICALS

Watts Bar Nuclear Plant

Item No.	System	Chemical Treatment Source Chemical and Waste Products	Estimated Maximum Annual Use kg	(lbs)	Waste End Product Chemical	Resulting End Product[a] Average Annual kg	(lbs)	Mean Daily kg	(lbs)
4	Auxiliary Steam Generators	Ammonia NH_3	1.4	(3)[e]	NH_3	1.4	(3)	<.05	(<0.1)
		Hydrazine $H_2N_2H_2$	4.5	(10)[f]	NH_3	4.5	(10)	<.05	(<0.1)
5	Condenser Circulating Water Systems	<<Copper (corrosion product only)[h]			Cu	2,812	(6,200)	8	(17)
		<<Nickel (corrosion product only)[h]			Ni	313	(690)	0.9	(1.9)
6	Raw Cooling Water[g]	Pyrophosphate	34,088	(75,752)	$H_2PO_4^{-}$	34,088	(75,752)	93	(207)
		Organic Co-Polymer Dispersant	7,953	(17,673)	N/A	7,953	(17,673)	22	(48)
		Zinc Sulfate	18,182	(40,405)	Zn^{2+}	7,340	(16,312)	20	(45)
					SO_4^{2-}	10,841	(24,092)	30	(66)
		Coppertrol	261	(581)	Benzotriazole	261	(581)	22	(48)
		Clamtrol	1,386	(3,080)	DGH	69	(154)	14	(31)
					Quat	110	(246)	22	(49)
		Bromo-Chloro-Hydantoin	3,611	(8,024)	HOCl	1,264	(2,808)	3.5	(7.69)
					HOBR	2,347	(5,216)	6.4	(14.3)
7	Raw Service Water[g]	Pyrophosphate	3,787	(8,417)	$H_2PO_4^{-}$	3,787	(8,417)	10	(23)
		Organic Co-Polymer Dispersant	883	(1,964)	N/A	883	(1,964)	2.4	(5.4)
		Zinc Sulfate	2,020	(4,489)	Zn^{2+}	815	(1,812)	2.3	(5.0)
					SO_4^{2-}	1,204	(2,677)	3.3	(7.3)
		Coppertrol	29	(65)	Benzotriazole	29	(65)	2.4	(5.3)
		Clamtrol	154	(342)	DGH	8	(17)	1.5	(3.4)
					Quat	12	(27)	2.5	(5.5)
		Bromo-Chloro-Hydantoin	401	(891)	HOCl	140	(312)	0.4	(0.9)
					HOBR	260	(579)	0.7	(1.6)

Item No.	System	Chemical Treatment Source Chemical and Waste Products	Estimated Maximum Annual Use kg	(lbs)	Waste End Product Chemical	Resulting End Product[a] Average Annual kg	(lbs)	Mean Daily kg	(lbs)
8	Essential Raw Cooling[g] Water	Pyrophosphate	151,011	(335,581)	$H_2PO_4^{-}$	151,011	(335,581)	413	(919)
		Organic Co-Polymer Dispersant	35,231	(78,291)	N/A	35,231	(78,291)	97	(215)
		Zinc Sulfate	80,547	(178,994)	Zn^{2+}	32,518	(72,262)	89	(198)
					SO_4^{2-}	48,028	(106,728)	131	(292)
		Coppertrol	1,158	(2,574)	Benzotriazole	1,158	(2,574)	96	(214)
		Clamtrol	6,139	(13,644)	DGH	307	(682)	61	(136)
					QUAT	490	(1,091)	98	(218)
		Bromo-Chloro-Hydantoin	15,996	(35,546)	HOCl	5,598	(12,439)	15	(34)
					HOBR	10,398	(23,107)	28	(63)

a Items 1, 2, 4, 5, 6, 7, and 8 are based on 365 days/year operation at rated capacity. Item 3 based on 292 days/year operation at rated capacity.
b Precipitated material that will make up the water treatment sludge on a day weight basis. Ultimately put in landfill. No discharge.
c Estimates based on maximum suspended solids data observed at TRM 529.9.
d The quantities of ionized soluble species continuously removed by the condensate demineralizers are predicated upon a primary to secondary leak rate or a condenser tube leak. These constituents will be discharged in the form of neutral salts of sodium, oxides of iron, or suspended solids. High crud filters will treat the backwash waste prior to discharge.
e Ammonia will be added as needed to maintain pH of 9.0 in the system.
f Hydrazine will be added as needed as a DO scavenger. Hydrazine conservatively assumed to decompose to ammonia.
g Based on chemical feed rates at maximum cooling water usage and treatment schedule.
h Although copper and nickel will not be added to the system, the values shown represent high estimates of corrosion losses. Actual losses are expected to be immeasurable.

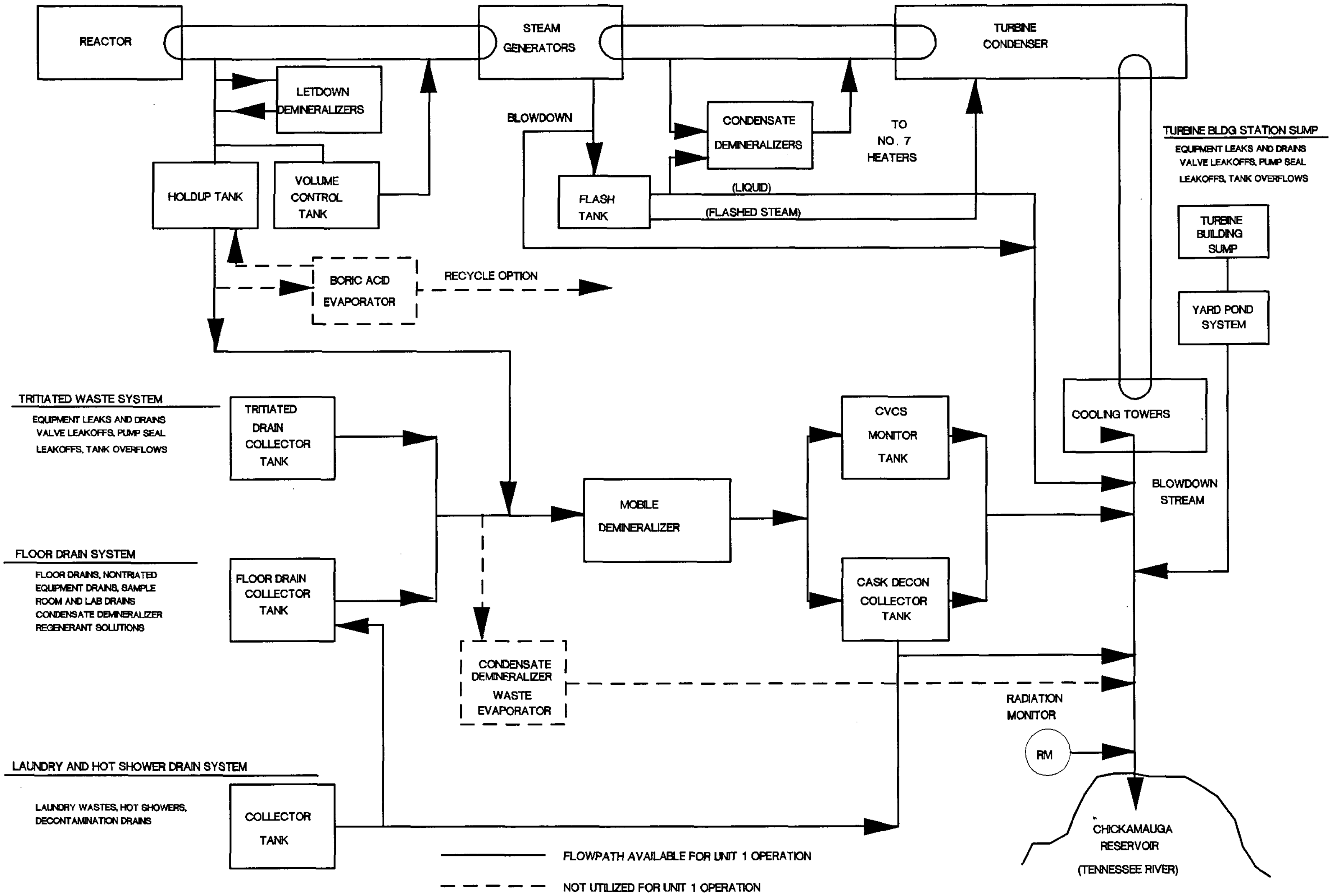

Figure 3.4 Watts Bar Nuclear, Unit Nos. 1 and 2 Liquid Radwaste Treatment System

4.0 ENVIRONMENTAL IMPACTS OF THE SITE PREPARATION AND CONSTRUCTION

4.2 IMPACTS ON TERRESTRIAL ENVIRONMENT

4.2.1 Facility Construction

The impacts on the terrestrial environment from site preparation and construction are accurately depicted by the FES. Construction of Unit 1 and associated facilities is essentially complete and no additional impacts due to construction activities are expected.

4.2.2 Transmission Facility Construction

During construction of the WBN transmission line system, soil erosion was controlled by the procedures and practices summarized in the FES. Since the lines were placed in service, TVA has periodically inspected the line rights of way. If erosion is occurring that would endanger the line, immediate steps are taken to control and repair the erosion. Erosion which occurs on a right of way that does not pose a risk to line operation or safety is handled as the property owner sees fit with TVA's assistance if requested by the property owner.

4.3 IMPACTS ON AQUATIC ENVIRONMENT

4.3.1 Effects on Water Use

Potential discharges of chemicals at WBN are controlled by the NPDES permit and by the WBN Chemical Traffic Control Program. Section 3.2.4 of this document provides a detailed discussion of this information.

4.3.2 Effects on Aquatic Biota

Construction of the intake channel, discharge diffuser, and other in-water facilities has been completed. No additional construction is proposed and no new construction effects on aquatic communities (including mussel resources or endangered or threatened species) are anticipated.

5.0 ENVIRONMENTAL EFFECTS OF STATION OPERATIONS

5.2 IMPACTS ON LAND USE

Offsite Impacts

Transmission lines produce the only direct offsite land use impacts. These impacts were evaluated in the FES. The transmission lines were built as planned so there are no other impacts to evaluate. See Section 5.4.1.2 for more discussion of transmission lines.

Onsite Impacts

The FES evaluated the impact of the conversion of 967 acres (the site area) to industrial use. The site boundaries have not been changed. Site development has essentially occurred as planned and evaluated in the FES with the exception of the visitors center and a training center for nuclear plant operators. The visitors center originally was to include an overlook and a freestanding visitors lobby. It is now a small part of the 90,000 square foot training center. The training center is an additional facility that has been in use for about seven years.

5.3 IMPACTS ON WATER USE

5.3.1 Thermal

The thermal water quality standards which are applicable to WBN are described in Section 3.2.2 of this document. In accordance with the plant's 1993 NPDES permit, which was issued by the State of Tennessee, TVA was required to conduct temperature modeling studies in order to determine an appropriate thermal standard. These studies were conducted during the State's development of the final NPDES permit and submitted to the State in December 1993. The report identified a daily average discharge temperature limit of 35°C (95°F) for the diffusers with the 240 feet x 240 feet mixing zone (the same mixing zone which was the basis for the FES analysis). This limit is expected to meet Tennessee's thermal water criteria and Tennessee has approved it (and the thermal limit for Outfall 102).

As further discussed in Section 3.2.2, the 1993 NPDES permit continues to prohibit discharges through the diffuser unless water releases from TVA's Watts Bar Hydro Plant exceed 3,500 cfs. If the release from the dam is not greater than this amount, the diffuser legs automatically close and blowdown is diverted to the 190-acre feet yard holding pond where it is to be stored until the release from the dam exceeds the minimum release limit.

The FES also addressed the potential "worst case" thermal situation in which both WBN and TVA's Watts Bar Steam Plant are operating and discharging heated water simultaneously. TVA put the steam plant into cold standby in the early 1980's and its future operation and mode of operation are uncertain. Thus, the risk of this "worst case" situation occurring has been lessened compared to the FES.

5.3.2 Operational Chemical Wastes

Potential chemical wastes and discharges to the Tennessee River are described in Section 3.2.4 of this document. WBN's NPDES permit control permissible chemical waste discharges to the Tennessee River and applicable limits are expected to protect aquatic biota. See Section 5.4.2 of this document. Under the NPDES permit, TVA is required to conducting biomonitoring of WBN discharges which adds an additional safeguard against any unexpected, adverse impacts from chemical waste discharges.

5.3.3 Sanitary Wastes

WBN's sanitary waste system is addressed in Section 3.2.4 of this document. As discussed in the FES, WBN sanitary waste is treated in an extended aeration plant. Treated effluent is routed to the runoff holding plant and discharges from this pond to the Tennessee River are controlled and monitored in accordance with the plant's NPDES permit.

5.3.4 EPA Effluent Guidelines and Limitations

EPA Effluent Limitation Guidelines 40 CFR Part 423 - Steam Electric Power Generating Point Source Category promulgated November 19, 1982, are now applicable to WBN. The reference for BPT limitations is 40 CFR Part 423.12, and the reference for BAT limitation is 40 CFR Part 423.13. The new NPDES permit limits, monitoring requirements, and the associated storm water permit are included in the 1993 NPDES permit for the plant (NPDES Permit TN0020168).

5.3.5 Effects on Water Users Through Changes in Water Quality

The conclusion reached in this section of the FES that operation of WBN will not preclude any of the current or projected uses of the Tennessee River, remains correct. The plant's NPDES permit controls potential discharges to the reservoir system and Tennessee water quality criteria should not be adversely affected. See Sections 5.3.1, 5.3.2, and 5.3.3 of this document.

5.3.6 Effects on Surface Water Supply

This section of the FES concluded that WBN's consumption of water during operation would have no discernible impact on Chickamauga Reservoir. This conclusion remains valid. As discussed Section 3.2.1 of this document, WBN's planned water use has not significantly changed from that discussed in the FES.

5.3.7 Effects on Groundwater

As anticipated in the FES, WBN continues to use a groundwater system to provide potable water but this system is now operated by the Watts Bar Utility District. The FES conclusion that local ground water users would not be affected by WBN operation remains correct.

5.4 ENVIRONMENTAL IMPACTS

5.4.1 Terrestrial Environment

As indicated earlier, two terrestrial species, the bald eagle and the gray bat, are known to be in the vicinity of the plant. A bald eagle pair recently tried to nest within four miles of WBN. Plant operations are not expected to impact either of these species either directly or indirectly through impacts on their prey bases.

5.4.1.2 Transmission Lines

The transmission lines into and out of WBN have been constructed and energized. The FES reported on several studies and ongoing research into the potential effects of high voltage power lines on humans. Since release of the FES, concerns about potential health effects from exposure to electromagnetic fields (EMF) continued to be raised. Research into potential EMF health effects is ongoing. Research quality has improved, but available results continue to be contradictory. Opposite results are being obtained from the most comprehensive efforts when the same health effect end point is examined using the same methods. Among the studies are several which have been interpreted as suggesting a weak statistical association between magnetic fields and some forms of rare cancers. Other studies show no such statistical association. No study to date has found a causal relationship between EMF and human cancer, nor is there any pattern suggesting a relationship to other long-term health effects.

5.4.2 Aquatic Environment

The potential impact of WBN operation on aquatic communities is primarily controlled by the plant's NPDES permit. This permit, which is renewed on a five-year schedule, regulates the discharge of chemicals from the facility and includes toxicity biomonitoring to assure protection of aquatic organisms in the receiving waters. It also includes thermal limitations and specifies both effluent and instream biotic and abiotic monitoring and reporting requirements.

TVA conducted a number of studies designed specifically to address toxicity of chemical use described in Section 5.3.2 of the FES and Section 3.2 of this document. These studies included a year of monthly whole effluent toxicity (WET) testing of NPDES Permit Outfall 101 effluent to the Tennessee River during chemical use by the facility. Based on these studies, applicable limitations should be fully protective and the levels of these chemicals in the discharges are not expected to have adverse impacts.

Special studies also were conducted to compare the sensitivity of organisms used regularly in NPDES biomonitoring with the sensitivity of freshwater mussels (juvenile life stage) which are part of the benthic community downstream from the facility. Results indicate that Ceriodaphnia dubia, a daphnid included in NPDES toxicity biomonitoring, is significantly more sensitive than any other species evaluated, including juvenile mussels.

Monthly WET testing has failed to show any deleterious lethal or sublethal effects to either daphnids or Pimephales promelas (fathead minnows) exposed to undiluted effluent from Outfall 101 (permitted toxicity limit: 96-h LC_{50} = 9.8% effluent, 7-day NOEC = 2.9% effluent). WET testing of Outfalls 101 and 112 (runoff holding pond) is currently being conducted and reported semiannually under NPDES biomonitoring requirements. These requirements are to ensure that chemicals discharged from WBN are not present in toxic amounts in the receiving waters.

Earlier environmental reviews identified certain other aspects of plant operation as having potential for impacts on aquatic communities. The preoperational studies which TVA has completed support and reinforce the conclusions of the FES with regard to potential aquatic biological impacts. The following paragraphs list these potential impacts and update the conclusions in the context of presently available information.

Entrainment of phytoplankton and zooplankton in the intake cooling water - Little has changed to alter the conclusion that entrainment will not result in irretrievable losses to the aquatic ecosystem in the vicinity of WBN. Studies to date (Reference - TVA 1986) indicate that virtually all plankton that passes WBN originates in Watts Bar Reservoir and passes through the turbines at Watts Bar Hydro. There is no reason to suspect that the plankton is not uniformly distributed so that entrainment losses will be proportionately equal to hydraulic entrainment, which will be a maximum of 0.7% of average summer flow past the plant.

Preoperational monitoring has shown that plankton populations at the plant vary enormously over short periods of time, so the loss of less than 1% of the plankton population would not be statistically detectable and would be insignificant to the ecosystem. Extensive plankton entrainment studies at Sequoyah Nuclear Plant, which at times entrains up to 30% of the flow past the plant, have detected measurable effects on the population only during periods of low flows coupled with maximum plant operation. Even then recovery occurs a short distance below the discharge, and no ecosystem effects are demonstrable.

Entrainment of larval fish in the intake cooling water - The entrainment and destruction of larval fish will occur in essentially the same proportion as other planktonic organisms. Targeted studies have confirmed that the primary spawning site for Sauger in Chickamauga Reservoir is at Hunter Shoals located at TRM 520-522, some 6 to 7 miles below the WBN site (Reference - TVA 1988). Hunter Shoals is also a major White Bass spawning area (Reference - TVA 1994b). There is no major spawning activity by either species in the tailwater reach from Watts Bar Dam to Hunter Shoals. Based on this information, the conclusion that entrainment of fish larvae of these migratory species will not result in a significant impact is reinforced.

Impingement of juvenile and adult fish on the cooling water intake screens - Nothing has changed that will alter the conclusion that fish impingement will be insignificant due to the low intake velocity (0.4 ft/sec maximum through intake openings) and relatively small makeup water volume (143 cfs maximum) required by the closed cycle cooling system.

Thermal effects due to discharge of heated cooling tower blowdown water from multiport diffusers - The thermal characteristics of the discharge have not changed. The temperature of the blowdown discharge will be 85°F under normal summer conditions with an average daily temperature of up to 95°F (the State of Tennessee recently approved this as the plant's thermal limits). The maximum mixed temperature rise will be 2.3°F at the edge of the discharge mixing zone. Any thermal effects should be limited to the mixing zone, which extends less than 100 meters downstream from the diffusers and influences less than 40% of the cross-sectional area of the river at normal summer elevations.

The FES described a worst-case scenario that could result in the current maximum allowable temperature of 86.9°F being exceeded at the edge of the mixing zone when the heat release from Watts Bar Steam Plant is included in the calculation. Future operation of the steam plant and the mode of operation is uncertain since the plant was placed in cold standby condition in the early 1980s. Thus, the risk that upstream temperatures could approach or exceed the maximum allowable temperature is less than that identified in the FES.

Effects of plant discharges on mussel communities - Operational impacts to mussel resources could occur through the release of radioactive or non-radioactive discharges to the river as identified in the FES. Other sections of this review identify the procedures in place or proposed to be used to minimize the risk of adverse environmental impacts from these discharges. These procedures are likely to provide similar protection for mussel species. It is possible that mussel species living in or near the discharge mixing zone could be affected by levels of some plant effluents which could otherwise be allowed under typical NPDES permit limits. This would include such chemicals as molluscicides that are used to control Asiatic clams or zebra mussels at WBN. TVA has been aware of this potential impact and has been working with the State of Tennessee to better determine safe discharge concentrations of these chemicals. Recent studies indicate that existing NPDES limits, coupled with required biomonitoring, will provide an ample margin of safety for mussel species and other aquatic organisms.

Two studies have been conducted to evaluate the potential impact of chemical use by WBN on freshwater mussels using the paper pondshell, *Anodonta imbecillis*. An initial study, conducted in 1991 jointly by the TVA Toxicity Testing Laboratory and Presbyterian College, Clinton, South Carolina, evaluated toxic responses of daphnids (an NPDES toxicity biomonitoring species) and 8-10 day old juvenile freshwater mussels to WBN Outfall 101 effluent that was spiked with chemicals used by the facility. The daphnids were determined to be sensitive to the spiked effluent samples, especially treatments containing DGH/QUAT. In contrast, juvenile mussels were not affected by any treatment over the 9-day test period. A repeat of the study using effluent spiked with DGH/QUAT showed toxicity to daphnids but not to the fathead minnow (another NPDES biotoxicity monitoring species).

A second study was conducted by TVA and two laboratories under contract with the State of Tennessee (EMPE, Nashville, Tennessee, and Presbyterian College). This 1994 study evaluated the impact of synthetic water spiked with DGH/QUAT on non-target species (daphnids, fathead minnows, Anodonta imbecillis, Elliptio arctata (another freshwater mussel), and Brachionus calyciflorus (a rotifer)). Results were similar to the spiked effluent test in that daphnids were the most sensitive organisms tested (see Table 5.4.2). The 96-hour LC_{50} for daphnids was 0.07 mg/L (whole product), compared with the 9-day LC_{50} for A. imbecillis of 0.14 mg/L without silt present and 1.07 mg/L with silt (silt is a detoxifying agent used for DGH/QUAT). The 9-day LC_{50} for E. arctata was 8.74 mg/L with silt present. This shows that the more sensitive mussel species (A. imbecillis) was 15 times less sensitive than daphnids to DGH/QUAT under conditions comparable to those which would occur in the river (i.e., when silt was included in the test).

Monthly toxicity biomonitoring tests conducted over a 12-month period when chemicals were being used by WBN did not identify toxicity in undiluted Outfall 101 effluent based on response of either daphnids or fathead minnows. It is concluded from these studies and monitoring data that the NPDES limits protect mussel species in the vicinity of WBN from adverse impacts. The large dilution which occurs as the discharge enters the river and the detoxifying effect of suspended solids in site water and sediment associated with mussel beds, add an additional margin of safety to resident mussels.

In order to ensure that plant operations have minimum adverse effects on mussel populations, as concluded in the FES, TVA will continue to monitor the area mussel beds to identify any adverse effects and, as necessary, will appropriately alter plant operations to reduce any unacceptable effects.

Buildup of existing heavy metal concentrations in the blowdown water due to evaporative losses with subsequent direct or indirect effects on aquatic life - The TVA Final EIS stated that no heavy metals would be added to the plant discharge and that a twofold concentration factor for the metals already existing in the raw intake water would be the only concern. However, zinc sulfate is now being added to control corrosion of carbon steel. Results of monthly toxicity testing confirm that the discharge of zinc and other corrosion inhibitors do not result in toxic effects. Toxicity biomonitoring under the current NPDES permit will continue to evaluate toxicity of chemical application. If toxic effects are observed, preventive measures, such as altering the plant's corrosion control methods, would be employed.

Use of molluscicides to control biofouling mollusks - The non-oxidizing molluscicide Clam-Trol (CT-1) is being used at WBN for control of Asiatic clams and would likely be used in the future to control zebra mussels. TVA has conducted toxicity tests on the active ingredients in this molluscicide (DGH/QUAT) on several aquatic species including juvenile mussels to identify the levels below which no adverse effects would occur. The results of this work are presented in earlier subsections of this document. Based on these studies, TVA does not anticipate significant effects of this molluscicide on aquatic life due to the amounts used, the frequency of use, and the rapid dilution once this material reaches the river. If ongoing biomonitoring indicates adverse effects do occur, a different clam control method would be employed following appropriate effects tests.

The threat posed by zebra mussels and possible means of controlling these and other biofouling mollusks was addressed in a TVA-U.S. Corps of Engineers Environmental Assessment, "Control of Attached Biofouling Mollusks (Zebra Mussels and Related Species) At Facilities Operated by USACE-Nashville District and Tennessee Valley Authority." Use of chemical biocides is controlled by the NPDES permit and potential impacts should be insignificant. However, to confirm this, TVA will further evaluate the potential effects of any measure proposed for zebra mussel control and will coordinate this with the State of Tennessee and the U.S. Fish and Wildlife Service.

Endangered and Threatened (E&T) Species - Other sections of this review identify the controls in place or proposed to be used to minimize potential environmental impacts from WBN discharges. These procedures are likely to provide similar protection for E&T species. As in the case for aquatic species generally, it is possible that E&T aquatic species living in or near the discharge mixing zone could be affected by levels of some plant effluents which could, otherwise, be allowed under typical NPDES permit limits. The toxicity testing studies, described above in the discussion on mussel communities, were designed, in part, to address these potential effects. Although the sensitivity of the mussel species tested have not been compared with sensitivity of E&T mussels, the order of magnitude greater sensitivity of daphnids compared to the most sensitive mussel species tested (Anodonta imbecillis) indicates the current whole effluent toxicity (WET) biomonitoring requirement at WBN (using daphnids as a test organism) is a conservative approach for evaluating potential effects to E&T mussel species occurring downstream from the discharge.

For the reasons discussed above, recent studies demostrate that plant operations should have no adverse effects on E&T mussel species or the snail darter. This is consistent with the conclusion set forth in the FES.

In order to ensure that plant operations do have minimal adverse effects on E&T populations, TVA will continue to monitor the mussel beds and perform toxicity tests required under the NPDES permit to identify any adverse effects. If unanticipated adverse effects are detected, steps will be taken to eliminate such effects including altering plant chemical uses.

Table 5.4.2

DGH/QUAT Toxicity to Non-Target Organisms*

Product (mg/L)	TOXICITY IN LABORATORY WATER WITHOUT SILT				TOXICITY WITH SILT PRESENT†		
	C. dubia *3-brood test*	*P. promelas* 7-day test	*A. imbecillis* 9-day test	*B. calyciflorus.* *24-hour test*	*A. imbecillis* 9-day test	*A. imbecillis* 9-day test	*E. arctata* *9-day test*
	EMPE* (Survival)	**EMPE*** (Survival)	**TVA*** (Survival)	**TVA*** (Survival)	**TVA*** (Survival)	**PC*** (Survival)	**PC*** (Survival)
Control	**NOEC-r (100%)**	**(100%)**	**(97.5%)**	**(100%)**	**(97.6%)**	**(97.6%)**	**(97.5%)**
0.05	**NOEC-s (100%)**						
0.07	**96-h LC$_{50}$**						
0.10	**(0%)**	**NOEC-s,g (100%)**	**(67.5%)**	**(100%)**	**(95%)**	**(87.8%)**	**(97.5%)**
0.12			**9-d EC$_{50}$**				
0.14			**9-d LC$_{50}$**				
0.20	**(0%)**						
0.40	**(0%)**	**(85%)**	**(0%)**	**(100%)**	**(97.5%)**	**(82.5%)**	**(100%)**
0.67		**96-h LC$_{50}$**					
0.80	**(0%)**						
0.96					**9-d EC$_{50}$**		
1.07					**9-d LC$_{50}$**		
1.60	**(0%)**	**(0%)**	**(0%)**	**(60%)**	**(25%)**	**(90%)**	**(97.5%)**
1.80§				**24-h LC$_{50}$**			
2.85						**9-d LC$_{50}$**	
3.20				**(0%)**			
6.40		**(0%)**	**(0%)**	**(0%)**	**(0%)**	**(0%)**	**(97.5%)**
8.74							**9-d LC$_{50}$**
12.80		**(0%)**	**(0%)**		**(0%)**	**(0%)**	**(0%)**
26.00					**(0%)**	**(0%)**	**(0%)**

*Testing conducted by EMPE, Inc., Nashville, Tennessee; Tennessee Valley Authority (TVA), Water Management; and Presbyterian College (PC), Clinton, South Carolina. Species tested were < 24-h old *Ceriodaphnia dubia* (daphnids), *Pimephales promelas* (fathead minnows), and *Brachionus calyciflorus* (rotifers), and 8-9 day old *Anodonta imbecillis* and *Elliptio arctata* (freshwater mussels).

†Silt provided by TVA from non-toxic reference site. Include in test at 600-800 mg dry wt./L.

§Graphically determined.

[ ] = Concentration tested. [shaded box] = Toxicity test endpoint.

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5.5 RADIOLOGICAL IMPACT

5.5.1 Radiological Impact on Man

Exposure Pathways

The exposure pathways used in the FES analysis remain valid. The most recent pathway analysis have been updated in WBN FSAR Chapter 11, Amendment 77, using the updated demographic data presented in WBN FSAR Chapter 2, Amendment 83, and indicate that several of the pathways included in the FES analysis do not presently exist around the WBN site. These pathways are ingestion by man and milk animals of vegetation irrigated with water from the Tennessee River and ingestion by man of invertebrates from the Tennessee River. The FSAR analysis also does not include any dose received from swimming in and boating on the Tennessee River because these doses have been found at Sequoyah Nuclear Plant to be several orders of magnitude lower than the dose received from shoreline recreation. The exclusion of these external dose pathways from the analysis does not significantly change the calculated dose commitments to individuals or populations since essentially all of the total body dose is accounted for by air inhalation and ingestion of food and water.

Dose Commitments from Radioactive Releases to the Atmosphere

Estimates of gaseous and particulate releases presented in the FES remain valid since there have been no substantial changes in the design or planned operation of the gaseous radwaste treatment system described in the FES. The validity of the site boundary dispersion data used for the dose estimate (presented in Table 5.3 of the FES) is discussed in Section 2.4.4.

Radiation Dose Commitments to Individuals

The table below compares the estimated annual airborne releases and resulting doses as presented by the TVA EIS, the WBN FSAR (Amendment 77), the WBN FES (NRC), and recent historical data from TVA's Sequoyah Nuclear Plant (as submitted in the Semi-Annual Radioactive Effluent Reports). The SQN data is relevant since the WBN plant radioactive waste system design is essentially the same as SQN and the WBN radwaste systems are expected to be operated in much the same manner as those at SQN.

	WBN EIS (Table 2.4-2)	WBN FSAR (Table 11.3-9 and Table 11.3-13)	WBN FES (Table 3.4 and Table 5.9)	SQN History (1987-93 Average)	10 CFR 50 Appendix I Guidelines
Particulate Activity	3.0E-01 Ci	7.6E+00 Ci	1.3E-01 Ci	4.8E-01 Ci	10 Ci
Noble Gas Activity	7.0E+03 Ci	1.4E+04 Ci	1.4E+04 Ci	8.4E+02 Ci	N/A
External Dose	6.6E+00 mrad	6.2E+00 mrad	6.2E+00 mrad	1.3E-01 mrad	10 mrad
Organ Dose	3.5E+00mrem (inhalation and milk only)	1.1E+01 mrem (all pathways)	7.8E+00 mrem (all pathways)	2.0E-02 mrem (all pathways)	15 mrem

The following conclusions can be drawn from the data in the table: 1) the WBN FSAR estimates, even though based on very conservative (worst-case) assumptions, indicate that estimated doses continue to meet the dose guidelines given in 10 CFR Part 50, Appendix I; and 2) Recent SQN operational data for airborne effluents indicates that actual releases and resulting dose estimates to the public are a small fraction of the Appendix I guidelines (averaging about 1% or less). Based on these conclusions, the analyses of radiological impact from airborne releases in the FES continue to be valid, although conservative.

<u>Dose Commitments from Radioactive Liquid Releases to the Hydrosphere</u>
<u>Radiation Dose Commitments to Individuals</u>

The table below compares the estimated annual liquid releases and resulting doses as presented by the TVA EIS, the WBN FSAR (Amendment 77), the WBN FES (NRC), and recent historical data from TVA's Sequoyah Nuclear Plant (as submitted in the Semi-Annual Radioactive Effluent Reports). The SQN data is relevant since the WBN plant radioactive waste system design is essentially the same as SQN and the WBN radwaste systems are expected to be operated in much the same manner as those at SQN. The period chosen most closely represents expected WBN operation of its liquid radwaste system (i.e., the use of demineralizers versus evaporators to treat liquid radwaste).

	WBN EIS (Table 2.4-2)	WBN FSAR (Table 11.2-7 and Table 11.2-11)	WBN FES (Table 3.3 and Table 5.9)	SQN History (1987-93 Average)	10 CFR 50 Appendix I Guidelines
Tritium Released	1.46E+02 Ci	5.2E+03 Ci	1.04E+03 Ci	8.7E+02 Ci	N/A
Activity Released	3.2E-01 Ci	2.2E+01 Ci	4.4E-01 Ci	4.8E-01 Ci	10 Ci
Total Body Dose	1.7E-02 mrem	1.1E+00 mrem	2.0E-01 mrem	8.0E-02 mrem	3 mrem
Maximum Organ Dose	5.5E-02 mrem	1.3E+00 mrem	1.9E-01 mrem	1.0E-01 mrem	10 mrem

The following conclusions can be drawn from the data in the table: 1) the WBN FSAR estimates, even though based on very conservative (worst-case) assumptions, indicate that estimated doses continue to meet the dose guidelines given in 10 CFR Part 50, Appendix I; and 2) Recent SQN operational data for liquid effluents indicates that actual releases and resulting dose estimates to the public are a small fraction of the Appendix I guidelines (averaging about 2% or less). Based on these conclusions, the analyses of radiological impact from liquid releases in the FES continue to be valid, although conservative.

Radiation Dose Commitments to Populations

The estimated year 2000, 50-mile population used in the FES analyses was 1,050,000. Current estimates (from WBN FSAR Amendment 83) estimate the year 2030, 50-mile population as 1,100,000. These values indicate that the expected 50-mile population at the planned expiration of the operating license has not significantly changed from that used in the original analyses. The table below presents the estimated population doses as presented by the TVA EIS, the WBN FSAR (Amendment 83), the WBN FES (NRC), and recent historical data from TVA's Sequoyah Nuclear Plant (as submitted in the Semi-Annual Radioactive Effluent Reports).

WBN EIS (Table 2.2-4)	WBN FSAR (Table 11.2-11 and 11.3-14)	WBN FES (Table 5.5)	SQN History (1987-93 Average)	10 CFR 50 Appendix I Guidelines
3.1E+01 man-rem	2.2E+01 man-rem	9.0E+00 man-rem	5.0E+00 man-rem	N/A

The SQN operational data, which is based on similar operation and population distributions as WBN, supports the FES conclusions.

The estimated natural radiation background dose equivalents used in the FES analysis remain valid. Updated background radiation dose data has been published (National Council on Radiation Protection and Measurements Report No. 94 Exposure of the Population in the United States and Canada from Natural Background Radiation). The FES established the natural radiation background dose as 106,050 man-rem. Using the updated natural radiation background dose equivalents and the estimated year 2030, 50-mile population yields an estimated annual population dose from natural background of 330,000 man-rem. This increase adds an additional level of conservancy to the FES conclusions.

DIRECT RADIATION

Radiation from the Facility

The estimated plant related environs direct radiation dose rates used in the FES analysis remain valid. The FES estimates of the radiation fields produced in the environs as a result of radioactivity contained within the reactor and its components (less than 5 mrem/y) remain valid. Data from the SQN 1993 Annual Radioactive Effluent Release Report Section VII demonstrated that there was no identifiable increase in dose rate levels attributable to direct radiation from plant equipment and/or gaseous effluents.

Occupational Radiation Exposure

The FES estimates of the projected occupational radiation exposure of 500 man-rem per year per reactor remain valid. Data from SQN, 1984-1993, as submitted in the annual 10 CFR 20.407 Report indicate a mean value of 372 man-rem per reactor year and a median value of 329 man-rem per reactor year. These lower values add conservancy to the FES conclusions.

Transportation of Radioactive Material

The FES contemplated that TVA would ship spent fuel offsite for disposal. Any such shipments would comply with applicable transportation guidelines issued by NRC and/or the U.S. Department of Transportation. TVA's plans remain the same but it now contemplates storing spent fuel on site until the U.S. Department of Energy completes construction of permanent disposal facilities in accordance with the Nuclear Waste Policy Act of 1982. If necessary, TVA will provide additional storage capacity on site until DOE begins accepting spent fuel. There are several methods available for expanding on site storage capacity including higher density spent fuel storage racks, fuel rod consolidation, or dry storage outside the Auxiliary Building. Prior to selecting one of these alternatives, if it becomes necessary, TVA would conduct an appropriate environmental review. Numerous examples of safe environmentally acceptable storage capacity increases have already been implemented at domestic nuclear utility sites.

This section references Table 5.8, "Environmental Impact of Transportation of Fuel And Waste To And From One Light-Water-Cooled Nuclear Power Reactor." This table is now part of NRC regulations, 10 CFR 50.52, Table S-4. While some numbers in the table have been updated since release of the FES, the FES's conclusion that the impact of transportation is "small" remains valid. TVA's assessment of the analyses in the EIS of these kinds of impacts confirm this conclusion.

Evaluation of Radiological Impact

As discussed above and based on operational data from the systems employed at TVA's Sequoyah Nuclear Plant (SQN), TVA expects the radwaste treatment systems at WBN to result in radioactive releases and resulting doses of the same magnitude or less than those projected in the FES.

Comparison of Calculated Doses with NRC Design Objectives

TVA has determined that the doses to the public resulting from the discharge of radioactive effluents from WBN will be less than 2% of the NRC guidelines given in 10 CFR 50, Appendix I and that there will be no new or different effects on the surrounding environment due to these releases than those discussed in the FES.

5.5.2 Radiological Impacts on Biota Other Than Man

The statements made in the FES regarding radiological impacts in biota other than man remain valid.

5.5.3 Uranium-Fuel-Cycle Impacts

The FES estimates of the projected impact of the uranium fuel cycle remain valid. The assumptions used in the FES are consistent with the requirements established in 10 CFR 51.51 (January 1, 1994 edition).

5.6 SOCIOECONOMIC IMPACTS

The FES projected that the onsite workforce at commercial operation of both units would be fewer than 200, and concluded that no significant impacts would occur. Current projections indicate that total onsite employment at commercial operation of Unit 1 in the Summer of 1995 will total about 1,800 including personnel associated with Unit 2. However, socioeconomic impacts are still not expected to be significant for a variety of reasons.

First, TVA implemented a socioeconomic impact mitigation program early in the construction period. The FES (p. 2-13) described the initial stages of the program which was begun in 1973 and continued until 1984. During the course of that program, TVA provided $1.6 million directly to local governments in Rhea and Meigs Counties to assist in the provision of local government services and facilities. Law enforcement and education received the largest amounts of assistance at $698,000 and $675,000 respectively. The remaining $237,000 was distributed among a number of other functional area such as fire protection, solid waste, and health recruitment.

Second, TVA made tax-equivalent payments to the State of Tennessee a portion of which was redistributed to local governments in the Watts Bar area. For example, in fiscal year 1993, local governments in Rhea County received a total of $751,000 in redistributed tax-equivalent payments, of which $431,000 was attributable to WBN. Similarly, local governments in Meigs County received a total of $580,000 of which $383,000 was due to WBN. WBN has had a similar fiscal impact since 1980 when Tennessee implemented its current redistribution formula. The totals in 1980 were $216,000 to Rhea County and $138,000 to Meigs County.

Third, the area has a great deal of experience accommodating large changes in employment at WBN. Employment data from January 1981 through June 1994 indicates that most of the fluctuation and the very large peaks of employment occurred after 1984 without any reported or observed adverse socioeconomic impacts. In addition, construction employment at WBN has substantially exceeded the revised estimate of WBN operation employment, ranging from approximately 4,000 in 1981, peaking at approximately 5,500 in 1990, and back to approximately 4,000 in mid 1994.

6.0 ENVIRONMENTAL MONITORING

6.2 PREOPERATIONAL MONITORING PROGRAM

6.2.1 Preoperational Onsite Meteorological Program

Onsite meteorological facilities have been in operation since 1971 when a temporary 40-meter instrumented tower was installed. It was located about 760 meters west-southwest of the Unit 1 Reactor Building and had a base elevation of 220 meters MSL. The temporary facility collected wind speed, wind direction, and temperature data at the 10-meter and 40-meter levels until it was decommissioned in September 1973 following installation of the permanent facility. A description of the permanent facility is presented in Section 6.3.1 of this document.

6.2.2 Preoperational Water Quality Studies

The preoperational water quality studies were carried out as originally outlined in the FES, and the results are presented in the preoperational monitoring report (See TVA, 1986 in Section 2.5 reference list).

6.2.3 Preoperational Groundwater Monitoring

The information and analyses in this section has not significantly changed from that stated in the FES.

6.2.4 Preoperational Aquatic Biological Monitoring

The preoperational aquatic biological monitoring was carried out as outlined in the FES, except that additional baseline monitoring was done from 1982 through 1985, and a number of special studies focusing on specific issues were accomplished during the period from 1985 through 1994. A listing of those studies with references is presented in Section 2.5.2 of this document.

6.2.5 Preoperational Terrestrial Monitoring

TVA complete the preoperational terrestrial monitoring program and provided the results to NRC April 22, 1980.

6.2.6 Preoperational Radiological Monitoring

TVA began an offsite preoperational radiological monitoring program in December 1976 to provide for measurement of background radiation levels and radioactivity in the plant environs. Changes in the program have been made since issuance of the FES to reflect experience gained over the years and minor changes in land use. A summary description of the program is presented in Table 6.2.

Table 6.2

PREOPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Sample Types	Sampling Frequency	Sample Analysis
Air Filter	Continuous collection change filter weekly	Gross beta weekly, gamma on monthly composite, Sr-89,90 on quarterly composite
Charcoal Filter	Same as air filter	Gamma for I-131 weekly
Heavy Particle Fallout	Monthly	Gross beta
Rainwater	Monthly	Gamma and Sr-89,90
Soil	Annually	Gamma and Sr-89,90
Surface Water	Monthly	Gross beta, gamma & I-131(2) monthly, Sr-89,90 & tritium on quarterly composite samples
Well Water	Monthly	Gamma monthly, tritium on quarterly composite samples
Public Water	Monthly	Gross beta, gamma & I-131(3) monthly, Sr-89,90 & tritium on quarterly composite samples
Sediment	Semiannually	Gamma & Sr-89,90
Shoreline Sediment	Semiannually	Gamma & Sr-89,90
Asiatic Clam Flesh	Semiannually	Gamma
Plankton	Semiannually	Gross beta, gamma & Sr-89,90 (analysis performed if quantities are sufficient)
Milk	Semimonthly	I-131 semimonthly, gamma & Sr-89,90 monthly
Vegetation	Quarterly	Gamma & Sr-89,90
Fish	Semiannually	Gamma & Sr-89,90 on commercial species and gamma on game species
Food Crops	Annually at time of harvest	Gamma
Meat and Poultry	Annually	Gamma
TLD	Quarterly	Direct Radiation

(1) Monthly implies every 4 weeks. Semimonthly implies every 2 weeks.
(2) I-131 performed only on sample from TRM 529.3 location.
(3) I-131 performed only on samples from Dayton and C. F. Industries locations.

6.3 OPERATIONAL MONITORING PROGRAMS

6.3.1 Operational Onsite Meteorological Program

The onsite meteorological monitoring program will continue during the operation of the plant. The permanent meteorological facility consists of a 91-meter instrumented tower and an environmental data station (EDS), which houses the data processing and recording equipment. A system of lighting and surge protection circuitry and proper grounding is included in the facility design. This facility is located approximately 760 meters south-southwest of the Unit 1 Reactor Building and has a base elevation of 217 meters MSL.

Data collection at the permanent facility began May 23, 1973, with measurements of wind speed and wind direction at 10 and 93 meters, temperature at 1, 10, 46, and 91 meters and dewpoint, solar radiation, atmospheric pressure and rainfall at 1 meter. The 1-meter dew point measurements were discontinued September 30, 1977, and the 93-meter wind sensors were moved to their present height on May 18, 1978. Measurements of 1-meter temperature and atmospheric pressure were discontinued on April 2, 1981.

6.3.2 Operational Water Quality Studies

This remains unchanged from the FES except that the demonstration of a sufficiently low corrosion/erosion rate to assure protection of aquatic organisms will be accomplished by the toxicity testing program required by the NPDES permit.

6.3.3 Operational Groundwater Studies

The information and analyses in this section has not significantly changed from that stated in the FES.

6.3.4 Operational Chemical Effluents Monitoring

The effluent monitoring requirements are specified in the NPDES permit.

6.3.5 Operational Aquatic Biological Monitoring

The operational aquatic biological monitoring plan as outlined in the FES has been revised in light of additional information obtained from extensive biological studies conducted in Chickamauga Reservoir since that plan was prepared in 1977. Those additional studies are listed and discussed in Section 2.5.2 of this document. The revised plan was submitted to the State of Tennessee in a letter dated September 8, 1993. The plan was subsequently approved and incorporated as a requirement of the WBN NPDES permit. The approved plan is described below.

FISHERY MONITORING

Fish Impingement--Monitoring will commence when Unit 1 becomes operational. Numbers and species of fish impinged on the intake screens during a 24-hour period will be determined once each week during the period December through May, and once every two weeks during the period June through November. The low volume of water entering the intake combined with low intake velocity considerably reduces the possibility that fish impingement will be a problem at WBN. Appropriate modifications will be made in the sampling program as results dictate.

Larval Fish Entrainment Sampling--Samples will be collected biweekly March through August at five stations along a transect perpendicular to flow at TRM 528. Samples will also be collected in the WBN cooling water intake channel.

Reservoir-Wide Creel Survey--Total catch, and fishing pressure and success for Chickamauga Reservoir will be estimated by counting and interviewing fisherman during five randomly selected days per week. These surveys are conducted by TWRA.

WBN Vicinity Creel--Catch rate, average weight and percent composition of each species harvested, fishing pressure and distribution of fishing effort will be estimated by collecting angler harvest data three days per week in the river reach between Watts Bar Dam (TRM 529.9) and Yellow Creek (TRM 526.8). This survey will be conducted by TVA. The purpose of this survey will be to document any effects from operation of WBN on the popular sport fishery below Watts Bar Dam and to provide an indication of sport fish attraction to the WBN intake and discharge areas. It will be designed to provide comparison with preoperational data and assess the tailwater fishery in terms of fisherman success and satisfaction.

Cove Rotenone Sampling--Five coves in Chickamauga Reservoir will be sampled every other year to document long-term trends in reservoir fish standing stocks and species composition. The cove rotenone sampling contributes to a long term data base on reservoir fish populations that is a part of both WBN and Sequoyah operational monitoring.

WATER QUALITY AND AQUATIC ECOLOGY (NON-FISH) MONITORING

Water Quality--Water quality samples will be taken at four locations in the vicinity of WBN six times between March and August during appropriate flow and operational conditions. Three of the surveys will include an evaluation of selected trace metal concentrations in the water, along with general water quality and biological support parameters.

Plankton--Preoperational monitoring showed extreme natural variation in phytoplankton and zooplankton numbers in this tailwater location. Since hydraulic entrainment into the cooling water system will be less than 1% of the mean summertime flow past the plant, changes in numbers of plankters below the plant will be statistically undetectable. For that reason only chlorophyll samples will be taken as an indication of effects on phytoplankton biomass.

316(b) Intake Evaluation--The previous operational monitoring plan included provisions for a special study of the phytoplankton and zooplankton communities during different hydrological flow regimes to provide an estimate of the portion of the plankton communities being entrained in the WBN condenser cooling water. Because 1) WBN will be operating in closed mode, 2) the amount of cooling water used will be very small relative to river flow, and 3) there is no rationale for assuming that plankton is not uniformly distributed throughout the water mass, the value of such a study was considered questionable and was deleted by the State of Tennessee.

Benthic Macroinvertebrates--Benthic macroinvertebrate sampling using Hess samplers will be conducted during summer and fall quarters at five stations between TRM 521.0 and 528.8.

Mussel Surveys--Biennial surveys in the tailwater mussel sanctuary will be continued with the addition of some quadrate samples to document reproductive success. Following two unit operation, an assessment and evaluation of bioaccumulation of selected trace metals by mollusks will be done. This will continue for at least three years after Unit 2 commercial operation.

6.3.6 Operational Terrestrial Monitoring

Based upon supplemental information provided to NRC by letter dated April 22, 1980, WBN does not believe that operational monitoring of the cooling tower drift or a monitoring program for chemical control of vegetation on transmission line rights-of-way is necessary.

Over the many years since the cooling towers were constructed, WBN has not recorded any serious episodes of bird collisions, during migratory periods or otherwise. Accordingly, WBN does not expect any significant episodes of bird collisions with the site cooling towers.

6.3.7 Operational Radiological Monitoring

WBN plans to continue the preoperational radiological monitoring program during the operating period. A full description of the program is contained in the Offsite Dose Calculation Manual (ODCM), Section 9, and is summarized in Table 6.2.

7.0 REALISTIC ACCIDENT ANALYSIS

7.2 ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

Accident types and categories postulated to occur for Watts Bar have not changed since the issuance of the FES. The current accident analyses are described in the Final Safety Analysis Report (FSAR), Chapter 15, for design basis accidents. Beyond-design-basis accidents have been assessed in an Individual Plant Evaluation (IPE).[1] This study has been recently updated to include plant design changes prior to plant startup and to incorporate the updated operator training and plant procedure enhancements.[2] The probability of beyond-design-basis core damage (Class 9) events has been conservatively estimated to be 8.0×10^{-5} per reactor year. The probability estimate applies to core damage and does not constitute the probability of impact to the environment or general population. Mitigating factors that determine ultimate environmental consequence include site meteorology, population density, containment failure probability, fission product retention time, and release fractions for various isotopes. The likelihood of a large accident with fission product release remains extremely low.

Further study has been performed to determine if potential plant or operator enhancements would be cost beneficial in improvement of the risk profile for Watts Bar.[3] Two operator procedure enhancements were identified as cost beneficial for risk improvement.

The FES conclusion remains valid that the environmental risks due to postulated radiological accidents are exceedingly small and need not be considered further.

References:

1. Watts Bar Nuclear Plant Unit 1 and 2 - Generic Letter 88-20 - Individual Plant Examination (IPE) for Severe Accident Vulnerabilities - Response (TAC No. M74488), dated September 1, 1992.

2. Watts Bar Nuclear Plant Unit 1 and Common - Generic Letter 88-20 - Individual Plant Examination (IPE) - Update of Level 1 and 2 Analysis (TAC No. M74488), dated May 2, 1994.

3. Watts Bar Nuclear Plant Unit 1 and 2 - Severe Accident Mitigation Design Alternatives (SAMDAs) Evaluation from Updated Individual Plant Evaluation (IPE) (TAC Nos. M77222 and M77223), dated June 30, 1994.