Ray Blanton
Governor

STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH
NASHVILLE 37219
621 Cordell Hull Building

Eugene W. Fowinkle, M.D., M.P.H.
Commissioner

April 17, 1978

Mr. George L. Harlow
Chief, Water Enforcement Branch
Enforcement Division
U.S. Environmental Protection Agency, Region IV
345 Courtland Street
Atlanta, Georgia 30308

Re: Watts Bar Nuclear Plant
NPDES Permit Number TN0020168
Draft State Certification

Dear Mr. Harlow:

As requested in your letter of March 24, 1978, to Mr. Jack McCormick of our Chattanooga Office, attached is a draft State Certification for the Watts Bar Nuclear Plant, Units One and Two. We appreciate the responses and explanations offered in your letter based upon our previous comments on this project. Although your letter offered an explanation, we feel that several of our previous requests were not adequately addressed by the new draft NPDES Permit, and a number of these have been included in our draft Certification. There are a number of other items on which we also still disagree, but we do not believe anything would be gained by attempting to include them in the Certification at this time. We would, however, like to offer the following additional comments for the record on both the technical details of this project and the NPDES Permitting process for projects of this type in general. Our comments are as follows:

1. In our earlier review of this project, we failed to notice one possible significance of the fact that the water intake strainer backwash and screen backwash are directed to the holding pond. Since the ports in the diffusers are only one inch in diameter, we feel that the solids contained in the backwash may present a clogging problem in being discharged through the diffusers. Although the impingement studies which are a part of the Operational Monitoring Program will indirectly assess this situation, diffusion problems could conceivably develop early in the operating history of the plant, prior to availability of information developed from the studies. Removal of solids from at least the screen backwash prior to its introduction into the holding pond may be desirable. Also, screening the effluent from the holding pond may be necessary.

2. Although required in general terms by the draft Permit under the section on "Removed Substances", we feel that adequate documentation has not been provided concerning ultimate means of disposal for the sludge from the water treatment plant and the cooling tower desilting basins.

3. We note that additional monitoring has been included at Serial Numbers 002 and 019. This partially satisfies some of our comments on the previous draft Permit, and we support the inclusion of these additional monitoring requirements. We would suggest that consideration also be given to requiring monitoring, at least initially, for total chromium, dissolved aluminum and ammonia nitrogen.

4. With regard to our previous statements concerning the desirability of more stringent limitations on suspended solids and the addition of limitations and monitoring requirements on additional materials and pH at several of the serial number locations in the Permit, we recognize the constraints imposed by the Federal Guidelines for this Point Source Category. However, we still believe that these Guidelines do not require treatment of all concentrated waste streams within the plant based on best practicable technology and that they were, therefore, not promulgated within the spirit of the "Declaration of Goals and Policy" of the Federal Water Pollution Control Act Amendments. Of course, we cannot show any demonstrable effects on water quality in the Tennessee River at this location, but we feel that the limits which have been established generally allow excessive dilution of concentrated waste streams into large volumes of cleaner water. This statement applies to Serial Numbers 002, 004, 007, 008, 009, 010, 011, 012, 013, 014, 015, 016, 017, and 018 as presently designated.

5. We also feel that the questions regarding the toxic chemical properties of radioactive metals and other materials which were raised in Item 15 of our letter of August 5, 1977, have not been adequately addressed. With the new emphasis by the Environmental Protection Agency on the control of toxic materials, we feel that this is an issue which will in time have to be considered in greater depth.

We have reviewed the Tentative Determination prepared by your office pursuant to Section 316 (a), and can concur with its findings. We also concur with the mixing zone which has been proposed and documented in the TVA submittals. Incidentally, a typographical error has been made and carried throughout the 316 (a) Determination and the draft NPDES Permit. The proposed mixing zone is 240 feet by 240 feet, whereas all references in your documents record it as 225 feet by 225 feet.

April 17, 1978
Mr. George L. Harlow
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We appreciate you cooperation on the preparation and review of this NPDES Permit. Should you have any questions concerning this letter or the draft Certification, please advise.

Sincerely,

Stephen E. Anderson
Assistant Director for
Enforcement and Planning
Division of Water Quality Control

SEA/mmd 1-2

Enclosure

cc: Division of Water Quality Control - Chattanooga - Mr. Jack McCormick
Tennessee Valley Authority - Chattanooga - Mr. Jim Morris
Rhea County Health Department
Southeast Regional Health Office

Division of Water Quality Control
Tennessee Department of Public Health
Certification of NPDES Permit Number TN0020168

Tennessee Valley Authority Watts Bar Nuclear Plant, Units One and Two
Spring City, Rhea County, Tennessee
Receiving Waters - Tennessee River, Mile 527.8, and Yellow Creek, Mile 1.3

Pursuant to Section 401 of the Federal Water Pollution Control Act (33 U.S.C. 466 et. seq.), as amended, the State of Tennessee hereby issues certification to the Tennessee Valley Authority for a National Pollutant Discharge Elimination System (NPDES) Permit for its Watts Bar Nuclear Plant.

The State of Tennessee is not aware of any condition or limitation under Section 301, Section 302, or Section 303 of the Federal Act that would be violated by issuance of the proposed NPDES Permit; additionally, the State of Tennessee is not aware of any standard of performance under Section 306 or Section 307 that would be violated by issuance of the proposed Permit.

Certification of this NPDES Permit is contingent upon the following conditions:

1. Permittee is in no way relieved from any liability for damages which might result from the discharge of wastewater.

2. Permittee must additionally comply with all requirements, conditions, or limitations which may be imposed by any provision of the Tennessee Water Quality Control Act (TCA Sections 70-324 through 70-342) or any regulations promulgated pursuant thereto.

3. The State of Tennessee reserves the right to modify or revoke this Certification or to seek revocation or modification of the NPDES Permit issued subject to this Certification should the State determine that the wastewater discharge violates the Tennessee Water Quality Control Act, or any applicable water quality criteria, or any rules or regulations which may be promulgated pursuant to the Clean Water Act of 1977, Public Law 95-217.

4. The State requests that the following discharge limitations, criteria, and requirements be included in the NPDES Permit:

   a. With regard to Serial Number 002, the State requests the following wording to govern direct overflows from the yard drainage holding pond to the Tennessee River:

      "Direct overflow from the yard holding pond to the Tennessee River is allowed under emergency conditions to protect dike stability, but only to the minimum extent necessitated by the emergency. Notification of such overflow shall be provided to the Director, Enforcement Division, and to the State Director within five days after any occurrence. On each occurrence, a grab sample shall be collected for suspended solids analysis and the results of such analysis shall be reported with the notification of overflow."

DRAFT

b. With re, ard to Serial Numbers 001, 002, 003, 004, 005, 006, 007, 008, 009, 010, 011, 012, 013, 014, 015, 016, 017, 018, the State requests that the following statement be included to govern discharge of floating materials:

"The wastewater discharge must contain no distinctly visible floating scum, oil sheen, or other floating matter."

c. With regard to Serial Number 003, the State requests that the discharge limitations and monitoring requirements set out in Attachment A to this Certification be included in the NPDES Permit.

d. With regard to Serial Number 004, the State requests that the following additional language be included to govern the possible disposal of this wastewater by means of land application or spray irrigation:

"Permittee must obtain approvals from the Tennessee Division of Water Quality Control and EPA prior to any land disposal or spray irrigation of these wastes. Said approvals shall be based upon site inspections and review of appropriate engineering submittals."

e. With regard to Serial Number 005, the State requests that the discharge limitations and monitoring requirements set out in Attachment B to this Certification be included in the NPDES Permit.

f. With regard to Part I B.1.c., and Part III c., control of polychlorinated biphenyl materials, the State requests that the PCB Control Report be submitted no later than thirty (30) days from the effective date of the NPDES Permit.

g. With regard to all wastewater discharges from the facility, the effluent quality as relates to radioactive constituents shall meet the requirements specified in the operational technical specifications issued by the U.S. Nuclear Regulatory Commission for this facility under 10 CFR 20.

5. With regard to the various studies and reports required of the applicant pursuant to Part I B. of the NPDES Permit, the State reserves the right to modify or revoke this Certification or to seek revocation or modification of the NPDES Permit issued subject to this Certification as may be required to protect water quality based upon the results of these studies and reports.

luent Characteristic	Discharge Limitations						Monitoring Requirements	
	Daily Average		Weekly Average		Daily Maximum			
	mg/l	kg/day (lbs/day	mg/l	kg/day (lbs/day)	mg/l	kg/day (lbs/day)	Measurement Frequency	Sample Type
ow - M^3/day (MGD)				136 (0.036)			1/day	Instantaneous
D_5	30	4.1 (9.0)	40	5.4 (12)	45	6.4 (14)	1/2 weeks	Grab
spended Solids	30	4.1 (9.0)	40	5.4 (12)	45	6.4 (14)	1/2 weeks	Grab
cal Coliform - (#/100ml)		See below					1/2 weeks	Grab
tal Chlorine Residual		See below					1/day	Grab
ttleable Solids (ml/l)		See below					1/day	Grab
		See below					1/week	Grab
ssolved Oxygen		See below					1/day	Grab

ie pH of the wastewater discharge must, at no time, be less than 6.0 nor greater than 9.0.

ie concentration of settleable solids in the wastewater discharge must, at no time, exceed 1.0 ml/l as measured by the standard ie-hour Imhoff cone test.

ie wastewater discharge must contain no distinctly visible floating scum, oil sheen, or other floating matter.

ie wastewater discharge must be disinfected to the extent that viable coliform organisms are effectively eliminated. The con- entration of the fecal coliform group shall not exceed 200 per 100 ml. as the geometric mean based on a minimum of 10 samples ollected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected t intervals of not less than 12 hours. For the purpose of determining the geometric mean, individual samples having a fecal oliform group concentration of less than one per 100 ml. shall be considered as having a concentration of one per 100 ml. In ddition, the concentration of the fecal coliform group in any individual sample shall not exceed 1000 per 100 ml. The use of hlorine as a disinfecting agent must be controlled to the extent that the total chlorine residual does not exceed 2.0 mg/l.

he concentration of dissolved oxygen in the wastewater discharge must be greater than 1.0 mg/l.

ny sludge or other materials removed by any treatment works must receive disposal adequate to prevent their entrance into or ollution of any surface or subsurface waters.

Attachment 8
Serial Number 005

Effluent Characteristic	Discharge Limitations						Monitoring Requirements	
	Daily Average		Weekly Average		Daily Maximum		Measurement	Sample
	mg/l	kg/day (lbs/day)	mg/l	kg/day (lbs/day)	mg/l	kg/day (lbs/day)	Frequency	Type
Flow - M^3 /day (MGD)				45 (0.012)			1/day	Instantaneous
BOD_5	30	1.4 (3.0)	40	1.8 (4.0)	45	2.0 (4.5)	1/2 Weeks	Grab
Suspended Solids	30	1.4 (3.0)	40	1.8 (4.0)	45	2.0 (4.5)	1/2 Weeks	Grab
Fecal Coliforms (#/100 ml)				N/A			N/A	
Total Chlorine Residual				N/A			N/A	
Settleable Solids (ml/l)				N/A			N/A	
pH				N/A			N/A	
Dissolved Oxygen				N/A			N/A	

The wastewater discharge must contain no distinctly visible floating scum, oil sheen, or other floating matter.

Any sludge or other materials removed by any treatment works must receive disposal adequate to prevent their entrance into or pollution of any surface or subsurface waters.

TENTATIVE
DETERMINATION
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV

IN THE MATTER OF	)	NPDES No. TN0020168
Tennessee Valley Authority Watts Bar Nuclear Plant Spring City, Tennessee	)	Findings under 33 U.S.C. 1326

Pursuant to Section 316(a) of the Federal Water Pollution Control Act, as amended, and 40 CFR Part 122, the Director, Enforcement Division comes now and makes the following findings relative to the Watts Bar Nuclear Plant (WBNP) of the Tennessee Valley Authority:

1. WBNP is a proposed two unit generating station with a total nameplate capacity of approximately 2540 megawatts, and is located adjacent to Chickamauga Lake at Tennessee River Mile 528.
2. The plant site is approximately two miles downstream from Watts Bar Dam and associated Hydroelectric Plant with a total nameplate capacity of 150 megawatts and 1-1/3 miles downstream from the coal-fired Watts Bar Steam Plant with a total nameplate capcity of 240 megawatts.
3. Average flow from the Dam has been approximately 750 cubic meters per second (26,500 cfs); however, periods of zero release of up to 12 hours can be expected, generally at night when the Steam Plant is at low loading.
4. Minimum flow during periods of operation of one of the five generators at the Hydroelectric Plant is 99 cubic meters per second (3500 cfs) and no releases from WBNP will occur unless at least one hydroelectric generator is in operation.
5. The Steam Plant is expected to increase the Tennessee River temperature a maximum of

1.7°C(3.0°F) at the upper edge of the proposed WBNP mixing zone even after periods of zero release from Watts Bar Dam.

6. The discharge temperature from WBNP is expected to be a maximum of 35.0°C(95.0°F).

7. The proposed WBNP mixing zone is 240 feet wide and extends 240 feet downstream from the diffuser and occupies a maximum of 31 to 38 percent of the cross-sectional area of the river as a function of water surface elevation.

8. The diffuser system for WBNP is designed to assure a minimum dilution factor of 10 at all river flow conditions above 99 cubic meters per second (3500 cfs)

9. The WBNP diffuser can assure compliance with the Tennessee Water Quality Standards maximum temperature criterion of 30.5°C(86.9°F) for all river temperatures of less than or equal to 30.0°C(86.0°F) at the upper edge of the proposed WBNP mixing zone. Diffuser design will assure conformance with the 3°C(5.4°F) maximum thermal rise criterion for all conditions.

10. The Steam Plant discharge will not increase the temperature at the edge of the proposed WBNP mixing zone above 30.0°C(86.0°F), if Watts Bar Hydroelectric Plant tailrace temperatures are less than or equal to 28.3°C(83.0°F).

11. Tailrace temperatures have exceeded 28.3°C(83.0°F) in eight of the 1320 weekly observation obtained between February 1950 and September 1977.

12. No tailrace temperature above 28.3°C(83.0°F) has occurred since August 30, 1955.

13. No more than three consecutive observations exceeded 28.3°C(83.0°F).

14. Occurrance of the maximum tailrace temperature observed, 30.5°C(86.9°F), could result in the following maximum temperatures at the downstream edge of the proposed WBNP mixing zone, if the Hydroelectric Plant had not been operated for 12 hours:

    a. 31.0°C(87.7°F) if only WBNP was operating at maximum discharge temperature;

    b. 32.2°C(89.9°F) if only the Steam Plant was operating at maximum expected conditions; and

    c. 32.4°C(90.4°F) if both plants were operating.

15. Continuous releases from the Hydroelectric Plant or no-flow periods of less than 12 hours could result in temperatures of 0.2°C(0.3°F) to 0.3°C(0.6°F) less than noted in Item 14 above.

16. The above temperatures, although exceeding the maximum criterion of the Tennessee Water Quality Standards, are not expected to adversely affect the aquatic life of Chicamauga Lake.

It is therefore concluded, based on the above-stated findings and the Administrative record in this matter that discharges from the Watts Bar Nuclear Plant with a maximum instantaneous temperature of 35.0°C(95.0°F) and a mixing zone of dimensions 240-foot width and 240-foot downstream length will assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on Chickamauga Lake, even when upstream temperatures approach or exceed 30.5°C (86.9°F).

April 14, 1978

Paul J. Traina
Director, Enforcement Division
Pursuant to Authority Delegated by
the Regional Administrator on
August 11, 1977

APPENDIX F

Final Environmental Statement
related to the proposed

Watts Bar Nuclear Plant
Units 1 and 2

TENNESSEE VALLEY AUTHORITY

ENVIRONMENTAL STATEMENT

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2

TVA-OHES-EIS-72-9

Tennessee Valley Authority
Office of Health and Environmental Science

FINAL ENVIRONMENTAL STATEMENT
WATTS BAR NUCLEAR PLANT
UNITS 1, 2, AND 3

Chattanooga, Tennessee
November 9, 1972

SUMMARY SHEET

ENVIRONMENTAL STATEMENT

WATTS BAR NUCLEAR PLANT UNITS 1 AND 2

[ ] Draft [X] Final Environmental Statement Prepared by the Tennessee Valley Authority

1. [X] Administrative Action [ ] Legislative Action

2. This action is the construction and operation of a two-unit nuclear power generating station in Rhea County, Tennessee.

3. Environmental impacts associated with the construction and operation of the Watts Bar Nuclear Plant include:

   (1) Minute additions of radioactivity to the air and water.
   (2) Release of major quantities of heat to the atmosphere and minor quantities to Chickamauga Reservoir.
   (3) Change in approximately 967 acres of land for the plant site from farming to industrial use and easements on 3,165 acres of land for transmission lines.
   (4) Release of small quantities of nonradioactive materials to the air and water.
   (5) Temporary stress on social infrastructure (schools, roads, housing, and similar services).
   (6) Stimulus to area economic development (jobs, attraction of visitors, etc.).

   No significant adverse environmental effects are expected to occur as a result of these impacts.

4. To meet projected peak loads, TVA considered the following alternatives: (1) base-loaded coal-fired units and (2) nuclear-fueled units. The second alternative provides the lowest cost of generating power and the least environmental impact. The purchase of power in the quantities needed is not a realistic alternative.

   Alternative systems were considered for waste heat dissipation and reduction of releases of radioactive products from the plant.

   Alternative heat dissipation systems considered included:

   (1) Mechanical draft cooling towers
   (2) Natural draft cooling towers
   (3) Spray canal system
   (4) Cooling lake

   Considering feasibility, environmental impact, and cost, the natural draft cooling towers represent the best balance and have been adopted.

SUMMARY SHEET (continued)

Alternatives considered in addition to the original 45-day holdup system to further reduce gaseous radioactive emissions included:

(1) 60-day holdup system
(2) Hydrogen recombiners
(3) Solvent absorption system
(4) Cryogenic distillation system

Selection of a 60-day holdup system was made as a result of balancing feasibility, environmental benefit, and cost.

Tritium recycle by segregating drains and steam generator blowdown treatment by an evaporator were adopted instead of controlled releases as alternate means to further reduce radioactive liquid discharges. Consideration of feasibility, environmental benefit, and cost shows that tritium recycle and the evaporator for blowdown treatment represents the best balance and TVA is proceeding with plans to install this alternative.

5. Comments have been received from the following agencies:

   Atomic Energy Commission
   Department of Agriculture
   Department of the Interior
   Department of Housing and Urban Development
   Department of the Army
   Department of Health, Education, and Welfare
   Southeast Tennessee Development District
   Environmental Protection Agency
   Department of Transportation
   Office of Urban and Federal Affairs, State of Tennessee
      Tennessee Department of Conservation
      Tennessee Department of Public Health
      Tennessee Historical Commission
      Department of Highways
      Tennessee State Planning Commission
      Tennessee Game and Fish Commission
   Department of Commerce
   Federal Power Commission

6. The draft statement was sent to the Council on Environmental Quality and made available to the public on May 14, 1971. Supplements and additions to the draft was sent to the Council and made available to the public on April 7, 1972. The final statement was sent to the Council and made available to the public on November 9, 1972.

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Page No.

PREFACE

This detailed statement of environmental considerations, prepared by the Tennessee Valley Authority, evaluates the effects on the environment of the construction and operation of the Watts Bar Nuclear Plant (AEC Docket Nos. 50-390, 50-391) and is made in accordance with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. Section 4331 et seq).

TVA, a corporate agency of the Federal government, and the Atomic Energy Commission, a regulatory agency of the Federal government, have agreed that TVA is the lead agency for the preparation and circulation of detailed statements of environmental considerations for TVA nuclear plants. For the Watts Bar plant a draft statement was circulated for review and comments by other government agencies on May 14, 1971. This was supplemented on April 7, 1972, with additional information responding to AEC's revisions to 10 CFR Part 50, made pursuant to the Calvert Cliffs decision (<u>Calvert Cliffs' Coordinating Committee</u> v. <u>Atomic Energy Commission</u>, 449 F.2d 1109 (D.C. Cir. 1971)).

On May 18, 1971, TVA filed an application for a construction permit for units 1 and 2. At the same time TVA submitted the draft environmental statement along with the preliminary safety analysis report to the AEC in support of the application. In accordance with the lead agency agreement, TVA has consulted AEC in the preparation of this final detailed environmental statement. AEC has concluded that this statement satisfies applicable requirements and that it is adequate to support the licensing action. AEC's letter to this effect follows the preface.

Comments have been received on both the draft and supplement. The information contained in the draft and supplement as well as the agency comments and TVA's response thereto have been incorporated into this statement.

1.0 INTRODUCTION

TVA is a corporate agency of the United States created by the Tennessee Valley Authority Act of 1933 (48 Stat. 58, as amended, 16 U.S.C. §§ 831-831dd (1964; Supp. V, 1965-69)). In addition to its programs of flood control, navigation, and regional development, TVA operates a power system supplying the power requirements for an area of approximately 80,000 square miles containing about 6 million people. Except for direct service by TVA to certain industrial customers and Federal installations with large or unusual power requirements, TVA power is supplied to the ultimate consumer by 160 municipalities and rural electric cooperatives which purchase their power requirements from TVA. TVA is interconnected at 26 points with neighboring utility systems.

The TVA generating system consists of 29 hydrogenerating plants and 11 fossil-fueled steam-generating plants now in operation. In addition, power from Corps of Engineers' dams on the Cumberland River and dams owned by the Aluminum Company of America on Tennessee River tributaries is made available to TVA under long-term contracts. Figure 1.2-1 shows the location of TVA's present generating facilities and those under construction, as well as the location of the above Corps and Alcoa dams. The approximate area served by municipal and cooperative distributors of TVA power is also shown.

Power loads on the TVA system have doubled in the past 10 years and are expected to continue to increase in the future. In order to keep pace with the growing demand it has been necessary to add substantial capacity to the generating and transmission system on a regular basis. The major system capacity additions since 1949 are shown on Table 1.2-1.

As part of TVA's construction program designed to meet increased requirements for generation, in August 1970 the TVA Board tentatively approved the Watts Bar Nuclear Plant. An application to construct and operate units 1 and 2 was filed with the Atomic Energy Commission (AEC) on May 18, 1971. After extensive review of the Preliminary Safety Analysis Report and other documents by the AEC regulatory staff and the independent Advisory Committee on Reactor Safeguards, an Atomic Safety and Licensing Board is expected to grant a construction permit late in 1972. The Final Safety Analysis Report will be submitted to AEC at a later date, along with a request for authorization to operate both units of the plant at full power level. Under the current schedule, TVA expects to begin to load the nuclear fuel for unit 1 in December 1976. Full operation of unit 1 is expected in the summer of 1977; unit 2 is expected to go into operation in the winter of 1977-78.

As a Federal agency, TVA is subject to the requirements of the National Environmental Policy Act of 1969 (NEPA) which became effective on January 1, 1970. In carrying out its responsibilities under the TVA Act, TVA follows a policy designed to develop a quality environment. As a result of this policy, TVA has long considered environmental matters in its decision making. Offices and divisions within TVA employ personnel with a wide diversity of experience and academic training which enables TVA to utilize a systematic, interdisciplinary approach to ensure the integrated use of the natural and social sciences and the environmental design arts in planning and decision making as required by NEPA. The draft statement on the environmental considerations relating to the Watts Bar Nuclear Plant has been sent to State and Federal agencies for review and comment pursuant to NEPA as implemented by guidelines issued by the Council on Environmental Quality (CEQ) and Office of Management and Budget Circular A-95.

It should be noted that although the two units at Watts Bar will begin operation at different times, this environmental statement considers the plant as operating with both units, in order to accurately assess the impact of the plant on the environment, and so that consideration of the cumulative effects of the plant can be assured.

This statement is arranged in nine principal sections. The first section provides a baseline inventory of environmental information. The following eight sections cover the environmental considerations set out in Section 102(2)(C) of NEPA, as implemented by the CEQ and AEC guidelines. After weighing and balancing the environmental costs, and the technical, economic, and environmental, and other benefits of the project and adopting alternatives which affect the overall balance of costs and benefits by lessening environmental impacts, TVA has concluded that the overall benefits of the project far outweigh the monetary and environmental costs, and that the action called for is the construction and operation of the Watts Bar Nuclear Plant.

1.1 General Information - The purpose of this section is to provide a basic knowledge of the existing environment and the important characteristics and values of the Watts Bar site as it now exists in order to establish a basis for consideration of the environmental impact of the facility.

1. Location of the facility - The plant will be in Rhea County, Tennessee, located on a tract of land adjacent to the TVA Watts Bar Dam Reservation at Tennessee River mile (TRM) 528 on the west shore of Chickamauga Lake about 8 miles southeast of Spring City, Tennessee. The Watts Bar Dam Reservation, together with the 967 acres of additional land required, will comprise approximately 1,770 acres. The proximity of the site to local towns, rivers, and county boundaries is indicated on the vicinity map. (Figure 1.1-1)

2. Physical characteristics of the facility - The plant will consist of the following principal structures: two reactor containment buildings, turbine building, service building, diesel generator building, intake pumping station, water treatment plant, two cooling towers, auxiliary building, transformer yard, 500-kV and 161-kV switchyard, and sewage treatment plant. Figure 1.1-2 shows the general arrangement of these facilities. Figure 1.1-3 is an artist's concept of how the plant will appear on completion of construction. A further description of the site and structures is in Section 2.10, Other impacts.

The 2-unit plant will have a total nameplate electrical generating capacity of approximately 2,540 megawatts. The two reactor containment buildings each house a Westinghouse pressurized water reactor. Nuclear fuel is contained inside each reactor pressure vessel. The fuel is in sealed metal tubes and consists of slightly enriched uranium dioxide pellets. The fission process in the fuel produces heat. Water serves as both the moderator of the fission process and the coolant. The primary coolant water is pumped through the reactor from below the fuel and is heated by contact with the fuel element tubes. The heated coolant flows in four closed-loop circuits through tubes in steam generators and then is pumped back into the reactor. In each steam generator a separate body of water flows in contact with the outside surfaces of the tubes and absorbs heat from the reactor coolant, producing steam to power the turbine generator. The reactor power is controlled by control rods and a soluble neutron absorber boric acid.

The principal ways in which the plant will interact with the environment, discussed later in detail, are:

1. Release of minute quantities of radioactivity to the air and water;
2. Release of minor quantities of heat to Chickamauga Reservoir and major quantities to the atmosphere; and
3. Change in land use from farming to industrial.

3. Environment of the area - The following summary description provides a baseline inventory of the important characteristics of the region.

(1) Topography - The Watts Bar Reservation is a moderately wooded area with rolling hills, located in a valley approximately 10 miles wide, flanked on the west by Walden Ridge (900 to 1,800 feet) and by a series of lower ridges (800 to

1,000 feet) on the east, on the west bank of a bend in the Tennessee River. The nuclear plant will be located in the less-wooded southern portion of the reservation. In the vicinity of the plant the land rises from the water surface (normal maximum level elevation 682.5 feet above mean sea level) to approximately 735 feet above mean sea level.

The highest point on the reservation (elevation 900 feet MSL) is approximately 1/2 mile to the north of the plant.

(2) History - The Watts Bar site is in Rhea County in east Tennessee. Prior to settlement, the area had been lands of the Cherokee, Chickamauga, and Creek Indians. The county was formed by an act of the Tennessee legislature on December 3, 1807. The county boundaries fluctuated frequently in the early years following formation, but eventually stabilized to contain an area of approximately 360 square miles. The original county seat was at Washington, but in 1890 the county seat was removed to Dayton, its present location. To the west and nearer the site location is Spring City, which developed in the latter half of the nineteenth century.

In 1939 TVA authorized construction of the Watts Bar Dam, at a point about 2 miles upstream of the nuclear plant site. The dam has five generators with a total nameplate capacity of 150 MW. All units were operational by 1944.

In 1940 TVA authorized construction of the Watts Bar Steam Plant, 2/3 mile downstream from the Watts Bar Dam. The total nameplate capacity of this 4-unit coal-fired plant is 240

MW. All units were operational by 1945. The plant was seldom used during the 15-year period from 1955 to 1969 due to the availability of more efficient generating units. In the past three years operation has increased but this higher level of use is not expected to continue when Watts Bar Nuclear Plant begins operation.

(3) Geology - Geological studies of the bedrock at the site show that it is overlain by approximately 40 feet of unconsolidated terrace deposits laid down by the Tennessee River when flowing at a higher level. Drilling has shown that the upper half of the terrace deposits consist of sandy, silty clay. The lower half is much coarser, consisting of pebbles, cobbles, and small boulders of quartz or quartzitic sandstone embedded in a sandy clay matrix.

Beneath the terrace cover are the interbedded limestone and shales of the Conasauga Formation of Middle Cambrian Age. Stratigraphically, the Conasauga is overlain to the southeast by 2,500 to 3,000 feet of massive limestone and dolomite of the Knox Group and is underlain to the northwest by 800 to 1,000 feet of sandstone and shale of the Rome Formation. During the geologic past, folding and faulting compressed the Conasauga Formation between the more competent overlying Knox and underlying Rome Formations with the result that the thin-bedded limestones and shales of the Conasauga are complexly folded, crumpled, contorted, sheared, and broken by small faults.

In spite of the structural complexities, the Conasauga Formation will provide a satisfactory and competent foundation for the plant structures. Cores from 56 holes drilled in the plant area indicate no evidence of weathering below the upper

5 feet of rock which will be removed under normal construction procedures. Physical testing, both static and dynamic, has shown that the unweathered rock is capable of supporting loads in excess of those that will be imposed by the plant structures.

The Conasauga Formation at the site is relatively unfossiliferous and has no known areas of unique paleontologic significance.

(4) Seismology - The Watts Bar site lies within the borders of the Southern Appalachian seismotectonic province. Figure 1.1-4 locates the nearest faults in the region.

The nearest local quakes with Modified Mercalli intensities of V were centered 20 miles from the site. The nearest known epicenter of a damaging quake (MM VII) is 75 miles northeast of the site. The maximum intensity to have been felt at the site in the recorded history of the area is probably MM V and certainly no more than MM VI. On the basis of present knowledge, the maximum historic felt intensity was derived from major earthquakes centered at distant points, especially in the Mississippi Valley. Accelerations at the site from a recurrence of any of these shocks would be far less than the proposed design accelerations.

(5) Geography - The Watts Bar site is located in the western portion of the Appalachian Valley physiographic province in the Valley and Ridge subprovince, known locally as the Great Valley of east Tennessee. The Valley and Ridge differ greatly from the adjacent physiographic provinces in geography, physiography,

stratigraphy, and structure. As a physiographic unit, the area is well defined and rather consistent throughout. It is outlined sharply on the southeast by the high front of the Blue Ridge and on the northwest by the abrupt escarpment of the Cumberland Plateau. Its surface is characterized by long narrow ridges and somewhat broader intervening valleys having a northeast-southwest trend. The ridges are roughly parallel and fairly even-topped. They are developed in areas underlaid by resistant sandstones and the more siliceous limestones and dolomites. The valleys have been excavated in the areas underlaid by the easily erodible shales and the more soluble limestone formations.

In the vicinity of the Watts Bar site, the Tennessee River, prior to the impoundment of Chickamauga Lake, had entrenched its course to an elevation of 670 feet above mean sea level. The small tributary valley floors slope from the river up to around elevation 800, while the crests of the intervening ridges range between 900 and 1,000 feet above sea level.

At present no mineral deposits are being worked in the Watts Bar area and there is no basis for assuming that any will be developed in the future. In the early part of the present century there was sporadic mining of low-grade iron ore 5 to 15 miles northeast of the site, but these deposits are uneconomical under present market conditions. Even if they should become economically attractive sometime in the future, they are far enough removed from the area that the presence of the plant would not affect them. Commercially valuable deposits of zinc ores exist in the lower portions of the Holston River basin between Knoxville and Jefferson City, Tennessee. At present these deposits are being actively mined at three locations. The mining operation closest to the Watts Bar

Nuclear Plant is located near Mascot, Tennessee, about 138 miles upstream from the plant site. Coal is produced from the Cumberland Plateau to the northwest of the site, but here again the distance--10 to 15 miles--precludes any interference from the plant.

There is no indicated potential for any oil or gas production in the Watts Bar area. The nearest test wells that have been drilled, without production, are about 10 miles from the plant site. Location of the plant on the Watts Bar site would not interfere with recovery of oil or gas should it be discovered in the area.

(6) Climatology and meteorology - The Watts Bar site is in the eastern Tennessee portion of the Southern Appalachian Region, which is dominated much of the year by the Azores-Bermuda anticyclonic circulation. This circulation is more pronounced in the fall (October) and is accompanied by extended periods of fair weather.

The probability of tornado occurrence at the Watts Bar site is extremely low. For nearly a half-century, 1916-64, there have been no tornadoes recorded in this area of Rhea County. Two tornadoes were recorded in the adjacent Meigs County. Tornadoes in that area generally moved northeastward up the Great Valley, covering an average surface path 5 miles long and 100 feet wide.

Severe windstorms may occur several times a year, particularly during winter, spring, and summer, with winds reaching 35 mi/h and on occasion exceeding 60 mi/h. High wind may accompany moderate-to-strong cold frontal passages 30 to 40 times a year, with maximum frequency in March and April. Strong winds may also accompany thunderstorms which occur approximately 60 times a year, with maximum frequency in July.

The climate of the Watts Bar site is interchangeably continental and maritime in winter and spring, predominantly maritime in the summer, and continental in the fall. Data collected over a 3?-year period in Decatur, Tennessee, indicate the average annual temperature is 59°F, with monthly averages ranging from 35.4°F in January to 77.6°F in July. The maximum annual range, from 108°F in July to -20°F in February, is 128°F. Detailed air temperature data are shown in Table 1.1-1.

About 60 percent of the annual average precipitation in the site area results from migratory storms in late November through April. Detailed precipitation information is shown in Table 1.1-2. Table 1.1-3 contains snowfall data.

Based on a U.S. Public Health Service study of 21 years of data,[3] it is anticipated that, on the average, the Watts Bar site will experience each year two atmospheric stagnations lasting for 4 or more days.

The Watts Bar site data are supplemented by data from Chattanooga and Knoxville airports, Kingston Steam Plant, and Oak Ridge National Laboratory which show a predominant northeast-southwest alignment. Kingston Steam Plant data also indicate that the highest occurrence of directional persistence is with southwest winds. Wind speed data from Chattanooga and Knoxville indicate an average wind speed of 7 and 9 mi/h respectively and a fall wind speed of 5 and 6 mi/h respectively. Tables 1.1-4, 1.1-5, and 1.1-6 contain wind data for Kingston Steam Plant, Chattanooga, and Knoxville, respectively.

Wind data collected from 130-foot tower level at the Watts Bar temporary meteorological facility during the first year of operation (July 1, 1971 through June 28, 1972) indicate a predominantly southwesterly and northeasterly flow which parallels the local valley-ridge terrain. Data also indicate the longest periods of directional persistence are associated with south-southwest winds (Table 1.1-7). Annually, and during the winter and summer, winds are predominantly from the south-southwest (Tables 1.1-8, 1.1-9, and 1.1-10). During the spring winds are predominantly from the southwest (Table 1.1-11) and during the fall from the northeast (Table 1.1-12).

Periods of calm (wind speeds less than 0.6 mi/h) occur about 8 percent of the time, and wind speeds in the 1-3 mi/h range and the 4-7 mi/h range occur about 36 and 34 percent of the time, respectively (Table 1.1-8). The strongest wind recorded onsite during this period was 35 mi/h.

The one year of onsite measurements indicates that surface-based inversions occur 55 percent of the time. Inversions occur most frequently in spring and summer (63 percent and 59 percent, respectively) and least often in fall and winter (55 percent and 48 percent, respectively). The 8- to 16-hour period between early to midevening (6 to 10 p.m.) and early to midmorning (7 to 10 a.m.) are normally associated with calm conditions or wind speeds less than about 6 miles per hour which are conducive to surface-based inversions.

( ) **Hydrology** -

(a) **Ground water** - Ground water at Watts Bar is derived principally from precipitation which, over the past 30 years of record, has averaged 52.9 inches per year. There is no distinct aquifer in the Conasauga Formation at the Watts Bar site. The shales and limestones are essentially impervious, and the majority of the ground water flows through the terrace deposits overlying bedrock. Water level readings made in the exploration holes show that the water table stands approximately 20 feet above rock in the terrace material.

Preliminary ground water investigations made by measuring ground water levels in exploratory holes in the proposed plant area indicate a ground water gradient sloping toward Chickamauga Lake through the terrace deposits overlying bedrock. Migration of ground water through bedrock is insignificant as shown by the refusal of the rock to accept water at pressures of 50 lb/in^2 by water testing the exploratory holes. TVA will install a series of monitor wells to determine the seasonal ground water fluctuations and to provide baseline data.

(b) Surface water - Surface water is derived from precipitation remaining after losses due to evaporation and transpiration. It can be generally classified as local surface runoff or streamflow.

(c) Water use - The Tennessee River from its head near Knoxville to its mouth near Kentucky Dam is a series of highly controlled multiple-use reservoirs. The primary uses for which this chain of reservoirs was built are flood control, navigation, and the generation of electric power. In addition to these, other industrial and public uses have developed, such as sport and commercial fishing, industrial and public water supply, recreation, and waste disposal.

There are five public water supplies taken from Watts Bar and Chickamauga Reservoirs within the reach from Lenoir City, Tennessee, 43 miles upstream of the site, to

Savannah Utility District, 44 miles downstream of the site. The intakes for two of these systems, Lenoir City, Tennessee, and TVA's Watts Bar Reservation, are located on Watts Bar Reservoir some 43 miles and 2.0 miles, respectively, upstream from the Watts Bar Nuclear Plant site. In the future the Watts Bar Reservation will discontinue using a surface supply and will obtain its potable water supply from the ground water system to be developed to serve the nuclear plant. There are no public water supplies taken from the Tennessee River between the Watts Bar Dam and plant site. The closest downstream surface water supply is Dayton, Tennessee, at TRM 503.8 (25 miles downstream), which serves 6,900 people. The Daisy-Soddy-Falling Water Utility District, which serves about 8,750 people, has a water intake on Soddy Creek embayment of Chickamauga Reservoir about 45 miles below the plant site. The present water intake for the Savannah Utility District, which serves about 1,610 persons, is located on the Tennessee River (TRM 483.6) some 44 miles downstream from the plant site. However, the Savannah intake is to be relocated in conjunction with the construction of TVA's Sequoyah Nuclear Plant, located at TRM 484.5.

The present water supply intake for the City Water Company, which serves a population of about 290,000 in the metropolitan Chattanooga area, is located in the headwaters of Nickajack Reservoir at TRM 465.5 approximately 62 miles downstream from the site and 6 miles downstream from Chickamauga Dam. Studies are being made by a task force organized by the Tennessee Department of Public Health to evaluate the present water supply source and intake location for the City of Chattanooga and recommend any needed action to the State Health Department.

The East Side Utility District had developed plans to locate a surface water supply intake on the Wolftever Creek embayment of Chickamauga Reservoir about 52 miles downstream from the site. However, the district has subsequently decided to continue using its present ground water supply (wells) and has abandoned any definite plans to develop a surface water supply in the foreseeable future.

There are 19 public water systems within a 20-mile radius of the proposed site that depend either totally or in part on ground water as a source of supply. The City of Decatur now obtains its supply from Breedenton Spring, located near the left bank of the Tennessee River about 5 miles downstream from the site. Engineering studies have been made to evaluate the feasibility of a proposed regional water system that would serve both the cities of Decatur and Spring City, as well as numerous small communities and outlying areas. The engineer's report recommends that the intake for such a regional system be located on Watts Bar Reservoir (TRM 532L) about 4 miles upstream from the site. Watts Bar Dam, located between the proposed intake location and the plant site, would preclude any adverse impact resulting from the discharge of liquid effluents from the plant. The ground water supply and the distribution system to be developed for the nuclear plant and the Watts Bar Reservation have been designed so as to be readily incorporated within the regional system whenever it is developed. Public water supply information is included in Table 1.1-13 and the locations are shown on figure 1.1-5.

There are five industrial water supplies taken from Watts Bar and Chickamauga Reservoirs between Tennessee River mile 592 and mile 473. This includes the supply for TVA's Watts Bar Steam Plant which is taken from the Tennessee River at mile 529.3 just downstream from Watts Bar Dam. The industrial water supplies located within a 20-mile radius of the plant and those industrial supplies obtained from the Tennessee River between miles 592 and 473 are summarized in Table 1.1-14. Those industrial supplies in the table marked with a double asterisk also use the supply for potable water within the plant. All other industrial users purchase potable water.

The major industrial water users are downstream from the plant site. These industries withdraw a total of about 53 million gallons of process water from Chickamauga Reservoir each day. Seven industrial water supplies are taken from wells and springs within a 20-mile radius of the plant site. Olin Mathieson Chemical Corporation and Bowaters Southern Paper Corporation obtain water from the Hiwassee River, 22 and 23 miles upstream from its mouth, respectively. The Watts Bar Nuclear Plant will use a maximum of about 86 million gallons of process water each day.

(8) Land use - The existing land use around the Watts Bar Nuclear Plant site reflects the trends of development taking place within the larger Great Valley of east Tennessee. This pattern is essentially the development of small satellite cities focusing on the major metropolitan centers of Knoxville and Chattanooga.

The smaller cities within the economic orbit of these larger centers are growing up along the major transportation routes.

The area around the Watts Bar site is predominantly rural as shown in figure 1.1-3. A 1970 survey of McMinn, Meigs, and Rhea Counties by the TVA Division of Forestry, Fisheries, and Wildlife Development indicates that approximately 57 percent of the land is forested, 38 percent is nonforested, and 5 percent is covered with water.

The minimum exclusion distance for the site is 1,200 meters (~3,940 feet). No one will be allowed to reside in the exclusion area (figure 1.1-2). The nearest domestic residence is approximately 1,460 meters (~4,800 feet) from the nuclear plant.

Specific land uses in the surrounding area are discussed below.

(a) Industrial operations - Scattered industry, including two TVA steam plants and a dam, Oak Ridge National Laboratory, and several small industrial plants, have begun to shift the region from an agricultural to a mixed land usage.

The major portion of the Watts Bar Nuclear Plant site will be located on a large tract of land that for many years has been designated by local communities and by state industrial development groups as a potential industrial area. The remainder will be on land best adapted to agriculture.

(b) Transportation - Two highways, Tennessee Highway 29 (U.S. 27) and Highway 58, connecting Chattanooga and Knoxville pass within 10 miles of the site. I-75, when completed, will pass 12 miles to the east of the plant. A Southern Railway spur terminates at the Watts Bar Steam Plant. The nearest airport is located about 9 miles southeast of the plant. The 9-foot navigation channel provides access to the plant by barge traffic.

(c) Farming - The total area of Rhea County and nearby Meigs County is 558 square miles, about 8 percent of which is occupied by Watts Bar and Chickamauga Reservoirs. Forested land in these counties occupies 336 square miles, or 65 percent of the land area. Nonforested farmland accounts for an additional 25 percent, leaving 10 percent (about 50 square miles) of the land area around the plant site for purposes other than farming or forest.

According to the 1964 Census of Agriculture, there were 988 farms in the two counties with gross sales of $2,894,169. Of these, 476 were classified as commercial and 512 as subsistence farms. The commercial farms accounted for gross sales of $2,493,117, while subsistence farms had gross sales of only $501,052. There were 72 dairy farms with gross sales of $722,070.

(d) Forestry - Forests in the area tend to be scattered along narrow ridges. The Walden Ridge area in western Rhea County contains extensive forests (figure 1.1-6). Approximately one-third of forested land consists of Virginia and loblolly pine, the latter being planted during various reforestation programs. Hardwood forests, chiefly of the oak-hickory type, cover 44 percent of forested land; the remainder supports mixtures of pine, cedar and hardwoods. Volume of timber in the 3-county unit has increased markedly since 1956. The increase includes growing stock of softwoods and hardwoods and an increased volume of sawtimber.

(e) Recreation - Watts Bar and Chickamauga Reservoirs are attractive to water-based recreation. During April 15 through October 15, recreational activities around the site increase substantially. A privately operated resort and restaurant are located on Watts Bar Dam Reservation. Meigs County Park is located on the left bank of the reservoir just upstream from the dam. A short distance upstream from this park is Fooshee Bend, a 890-acre peninsula, which is under consideration as a potential state park site. Several other resorts are located within a 25-mile radius. TVA has provided a boat-launching ramp and parking area on each side of the river below Watts Bar Dam. A public-use area upstream on the left bank of Watts Bar Dam Reservation provides an improved swimming beach, turnouts with picnic tables, toilet facilities, boat-launching ramp, and parking area. Demand for recreation results in a large influx of daytime and overnight users.

(f) Wildlife management areas and preserves - The Hiwassee Waterfowl Refuge, Ocoee Wildlife Management Area, and the Yellow Creek Wildlife Management Area are located within

40 miles of the Watts Bar site. There are also three state forests and one national forest within 40 miles of the site: Fall Creek Falls State Park and Forest, Bledsoe State Forest, Mt. Roosevelt State Forest, and the Cherokee National Forest.

(g) Population distribution - Rhea and Meigs Counties are sparsely settled. The net population growth in these counties between 1960 and 1970 totaled only 400. Dayton, the county seat of Rhea County, is the largest city in the area with a 1970 population of 4,225. The 1970 population distribution within 10 miles of the plant site is shown in figure 1.1-7. Figures 1.1-8 and 1.1-9 show the projected population distribution for years 1980 and 2000, respectively. The projected population distribution out to 50 miles for the year 2000 is shown on Table D-3 of Appendix D.

Between 1960 and 1970 the regional population grew 6.5 percent--from 893,674 to 955,752. Several small towns and the Chattanooga and Knoxville metropolitan areas are located within a 60-mile radius from the site.

Socioeconomic impacts due to the construction and operation of the plant are discussed in section 2.9.

(h) Waterways - Tennessee River traffic at the Watts Bar Lock for 1970 was estimated to be about 435 thousand tons, exclusive of sand and gravel. For the Tennessee River the total tonnage in 1971 was estimated to be about 27.5 million tons.

(i) Government reservations and installations - The Tennessee Valley Authority's reservations which contain the Watts Bar Steam Plant and Dam are the only Government installations in the immediate vicinity of the plant.

(9) Ecology - The region around Watts Bar supports wildlife, waterfowl, fish, and other aquatic life. The important species are discussed in the paragraphs below. The three counties around the site--Rhea, Meigs, and McMinn--contain a large percentage of upland wildlife habitat, as noted in Table 1.1-15. These evaluations of suitable land were based on several factors, including type, distribution, and quality of cover, presence of travel lanes, presence of food and water, and suitable den and nesting sites.

The possible ecological impacts which the plant may have on upland wildlife, waterfowl, and aquatic life, and the ecological monitoring programs are described in Sections 2.4 and 2.7.

(a) Waterfowl - The Yellow Creek Waterfowl Management Area is located approximately 1 mile south-southwest of the present TVA reservation boundary and is separated from the reservation by a ridge line having an elevation about 150 to 200 feet above the elevation of the management area. The area, used by the Tennessee Game and Fish Commission, is one of only three such state areas in east Tennessee which now has the capability for control of water levels for waterfowl management purposes. Its location, 27 river miles north of the principal waterfowl refuge area (Hiwassee Island, TRM 501) enhances its significance in attracting waterfowl flights upstream from the principal refuge, thus contributing to more successful

hunting on all waterfowl management units between Hiwassee Island and Watts Bar Dam. Data on hunting use and kill success over the period 1965-71 indicate that Yellow Creek has furnished 25 percent of hunting recreation and has, through its influence on other management area, accounted for approximately 58 percent of ducks harvested on Chickamauga Reservoir.

(b) Fish and other aquatic life - There is an abundance of aquatic life in the tailwater area of Watts Bar Dam. This area is characterized by a bedrock substrate with interstices filled with gravel, rock, clay, and other sediment. The substrate and characteristics of waterflow provide favorable habitat for fish and larger invertebrates such as the eight species of mussels of which the pigtoe mussel is probably the most abundant.[2] A 3-mile area of the river from the dam (TRM 529.9) downstream to TRM 526.9 was designated a mussel sanctuary by the State of Tennessee on July 1, 1965. Records show mussel beds at the following Tennessee River miles:

503.0 to 503.5	519.5 to 520.5
504.0 to 504.5	527.5 to 528.0
517.0 to 518.0	528.5 to 529.0 (wing wall of dam)

Historic harvests have been large, but there have been no harvests from Chickamauga Reservoir since 1970 when about $3,000 worth of pigtoe mussel shells were harvested. Recent harvests have been limited and no harvesting is legal in the sanctuary reach.

The Asiatic clam has become prominent in the benthos communities of the river during the past 10 years. Densities vary from a few individuals to approximately 2,000 per square meter, depending on type of substrate and waterflow. Generally, open water populations of Asiatic clams are smaller, a few to many individuals per square meter. Bottom fauna populations in the reservoir are not diverse. The most abundant insects are the burrowing mayfly, Hexagenia, and the midges of the family Tendipedidae which occur at densities approaching 200 per square meter.

The water entering Chickamauga Reservoir through Watts Bar Dam contains a moderate concentration of suspended phytoplankton and zooplankton. The phytoplankton populations are dominated by diatoms of the genus Melosira. The generic diversity includes more than 10 genera of diatoms depending on the season, as many as 22 genera of green algae, and as many as 4 genera of bluegreen algae. Representative grab samples of phytoplankton taken several miles downstream contained more than 500 cells per milliliter.

Zooplankton near Watts Bar Dam is commonly dominated by rotifers and cyclopoid copepods except during April and May when a predatory cladoceran, Leptodora kindtii, exceeds all other forms. In general, seasonal zooplankton abundance exceeds 100,000 individuals per cubic meter in the spring. Zooplankton and phytoplankton species observed in the Watts Bar Dam forebay are listed in Table 1.1-16.

Upstream in Watts Bar Reservoir macrophyte production and standing crop have reached exceedingly high levels in the past when Eurasian watermilfoil invaded the reservoir. Chickamauga Reservoir has not had this problem; only persistent, non-expanding, and native macrophyte colonies occur on overbanks, a distance of 12 to 20 miles below the nuclear plant.

The tailwater area is considered favorable spawning habitat for sauger, white bass, and smallmouth bass and may prove favorable for yellow perch. Species of fish taken in the 1970 fish population inventory on Chickamauga Reservoir are listed in Table 1.1-17. The list is prepared from the results of 12 cove-rotenone samples taken between July 6 and August 5, 1970; although it is not a complete species list for the reservoir, it identifies the important game, rough (including commercial), and forage species. The inclusion of yellow perch represents an invasion via the Hiwassee River from stock introduced in Chatuge and Nottely Reservoirs. Results of cove samples indicate that yellow perch are successfully reproducing in Chickamauga Reservoir; their ultimate importance to the sport fishery and to the total piscine community is unknown. Watts Bar tailwater has supported approximately 6.1 percent of fishing trips to 12 TVA tailwaters which were inventoried over the period 1965-69.

Fish population surveys based on complete sampling of 12 coves in 1970 yielded an average total of 182 pounds of fish per acre; of this, game and pan fish contributed 12 percent, forage fish 33 percent, and rough and commercial fish 55 percent. Bluegill and other sunfishes, largemouth bass, spotted bass, white crappie, and white bass dominated the game fish. Gizzard and threadfin shad were the dominant forage fish; two species of buffalo and freshwater drum dominated the rough (commercial) fish.

In a 1970 fish inventory, total fish poundage was significantly greater in the 3-cove area (approximately TRM 505-509) nearest the plant site. Although specific conclusions cannot be made, the data indicate that the upper end of Chickamauga Reservoir plays a significant role in production of the fisheries resource of the reservoir, especially in terms of the reproduction and early growth of game and forage species.

Data for 1971-72 indicate an annual commercial fish harvest of approximately 307,000 pounds in Chickamauga Reservoir and the principal commercial species were catfish, buffalo, and carp.[3]

(10) Chemical and physical characteristics of air and water -

(a) Air - The general physical characteristics were described previously under Climatology and Meteorology. The only air quality data collected from the vicinity of the plant are from two settled particulate samplers that were placed in operation in April 1969. The location of these samplers is shown in figure 1.1-10. The data collected to date are summarized in Table 1.1-18 and represent measurement of settled particulate from all sources. The highest monthly reading registered was 21 tons per square mile and occurred in June 1971.

Additional baseline data on the chemical and physical characteristics of the air in the vicinity of the plant will be gathered as monitoring programs are instituted prior to plant operation.

(b) Water - The Watts Bar Nuclear Plant will be located on Chickamauga Reservoir approximately 2 miles below Watts Bar Dam. The drainage area of the Tennessee River

at the site amounts to 17,320 square miles. At the plant site Chickamauga Reservoir is about 1,100 feet wide with the depths ranging up to 25 feet at normal pool, elevation 682.5. A 9-foot navigation channel is maintained past the site. The reservoir lies generally in a northeast-southwest direction with flow toward the southwest.

The Watts Bar Dam discharge records, maintained since its closure on January 1, 1942, indicate that the average discharge at the dam has been 26,480 ft^3/s. The maximum discharge occurred on December 30, 1942, and was 187,000 ft^3/s. Flow data for water years 1951-65 indicate an average flow of about 21,500 ft^3/s during the summer months and about 35,500 ft^3/s during the winter months. These data reflect for all practical purposes the volume of water that passes the plant site since there is less than 1 percent difference between the drainage areas at the plant site and the Watts Bar Dam.

Channel velocities at the plant site average 2.3 feet per second under average winter flow conditions and 1.0 foot per second under average summer conditions.

A year-long water quality survey of Chickamauga Reservoir was made by TVA beginning in May 1960.[4] In addition, some special sampling was continued into January 1962. At 6-day intervals during July, August, and September 1960, and again during May and June 1961, 22 locations along the main stem and principal tributaries of the reservoir were sampled for bacteriological determinations. In general, the bacteriological quality of water in Chickamauga Reservoir was found to be good. The water at Hamilton County

Park, 56 river miles below the plant site, was of exceptionally good bacteriological quality.

Monthly sanitary-chemical analyses of samples from 13 stations show the water in the main stem of the reservoir to be relatively low in organic content. Color and odor concentrations were also low.

During the winter and spring months, the dissolved oxygen concentrations in Chickamauga Reservoir are quite high. However, during the summer and fall months, the dissolved oxygen concentration in the upper 20 miles of Chickamauga Reservoir are depressed because of low DO concentrations occurring in the release from Watts Bar Dam. The dissolved oxygen concentrations of the Watts Bar Dam releases for the years 1960-71 are summarized in Table 1.1-19.

The principal reasons for the low DO releases from Watts Bar Dam are (1) inadequate waste treatment of organic waste discharges originating in the vicinity of Knoxville, Tennessee, and (2) the release of water low in DO through the low-level intakes from the much deeper headwater reservoirs located farther upstream. The recent installation of secondary treatment at Knoxville should result in somewhat higher DO concentrations in the release at Watts Bar Dam. TVA is now investigating methods of increasing the DO levels in the releases from its headwater reservoirs.

The mineral quality of water in Chickamauga Reservoir was determined by monthly samples collected from four locations in the reservoir. The water in the main stem of

the Tennessee River of Chickamauga Reservoir during the sampling period was slightly hard (about 60 to 80 mg/l) but satisfactory for practically all industrial uses. The water quality data observed at the two sampling points nearest the proposed plant site are shown in Tables 1.1-20 and 1.1-21. A summary of observed DO concentrations in the Watts Bar Dam tailrace are listed in Table 1.1-19.

The trace metal concentrations observed in the Fort Loudoun Dam Tailrace (TRM 602.3) for the period from January 1971 to December 1971 are summarized in Table 2.5-3. As indicated, background concentrations of zinc and other trace metals associated with zinc deposits are higher than would normally be expected in surface streams because of the mining of the zinc deposits in the lower Holston River basin.

Radiological determinations made on samples collected daily at both Watts Bar and Chickamauga Dams and composited into weekly samples for examination, together with determinations from other available samples, showed the concentrations of all radionuclides present were well below the permissible drinking water concentrations.

(e) <u>Temperature</u> - Water temperature observations at selected Tennessee River stations were included in the data collected during the 1960-61 survey. These observations indicate that Chickamauga Reservoir is stratified during summer months, although stratification does not occur in the 20 miles immediately downstream from Watts Bar Dam. Bottom temperature observed at TRM 487.7 (Table 1.1-22) ranged from 41.5°F in January (1961) to 77.9°F in August

(1960); surface temperatures ranged from 41.7°F in January (1961) to 81.9°F in July (1960). Temperature data at TRM 487.5 (Table 1.1-23) collected over a 5-year period (1943-48) by TVA indicate little variation in these temperature patterns. It may be concluded that water in Chickamauga Reservoir is well mixed except during the summer period when stratification occurs in the downstream one-half of the reservoir.

Water temperature records for releases from Watts Bar Hydro Plant for 1967-71 are shown in Table 2.6-1 and show a maximum natural water temperature of 80.6°F.

(11) Historical and archaeological significance of the Watts Bar site - No sites listed in the National Register of Historic Places, or known to be under consideration for such listing, are located at or near the proposed Watts Bar Nuclear Plant.

The project has been reviewed by the Tennessee Historical Commission and other appropriate agencies, and no specific items of particular historical significance have been identified.

An archaeological survey of the site was made in December 1970 by the University of Tennessee, Department of Anthropology. Investigations to determine archaeological significance of the site are discussed in Section 2.10, Other impacts.

Table 1.1-1

AIR TEMPERATURE DATA[a]

Month	Average Temp. (°F)	Average Max. Temp. (°F)	Average Min. Temp. (°F)	Extreme Max. Temp. (°F)	Extreme Min. Temp. (°F)
December	40.3	50.8	29.9	76	- 4
January	35.4	50.6	29.4	76	- 9
February	41.6	53.0	30.3	73	- 20
Winter	39.1	51.5			
March	50.5	63.0	38.1	91	2
April	58.5	72.0	45.0	94	20
May	67.1	80.8	53.5	99	30
Spring	58.7	71.9			
June	74.6	87.2	62.0	103	40
July	77.6	89.8	65.3	108	48
August	76.9	89.3	64.5	107	49
Summer	76.4	88.8			
September	71.9	85.1	58.7	106	34
October	60.0	74.1	45.9	96	19
November	48.4	61.3	35.5	82	7
Fall	60.1	73.5			
Annual	58.6	71.4	46.5	108	- 20

a. U.S. Weather Bureau, Cooperative Observer Station, Decatur, Tennessee; period of record, 35 years (1896-1930).

Table 1.1-2

PRECIPITATION DATA[a]

Month		Avg. No. of Days With 0.01 Inch or More	Monthly Average (Inches)	Extreme Monthly Maximum (Inches)	Extreme Monthly Minimum (Inches)	Max. In 24 Hrs. (Inches)
December		10	5.24	16.08	0.47	4.15
January		11	5.44	11.67	2.12	5.31
February		10	5.49	9.79	0.74	3.50
	Winter	31	16.17			
March		11	5.77	10.93	2.28	5.00
April		10	4.49	8.66	1.28	2.81
May		9	3.71	7.48	0.56	2.00
	Spring	30	13.97			
June		9	3.90	9.13	0.90	3.73
July		10	5.17	12.13	0.53	4.80
August		9	3.34	7.13	0.52	3.19
	Summer	28	12.41			
September		7	3.58	14.78	0.45	3.58
October		6	2.67	7.91	0.00	3.05
November		8	4.10	14.06	0.94	3.57
	Fall	21	10.35			
	Annual	110	52.90			

a. TVA raingage station 421, Watts Bar Dam, Tennessee, located on roof of Control Building at Watts Bar Dam; period of record about 30 years from station activation September 1939-69.

Table 1.1-3

SNOWFALL DATA

-INCHES-

Month	Monthly Average[a]	Maximum Total[b]	Maximum Total in 24 Hrs.[b]
January	2.4	14.5	8.0
February	2.4	18.5	13.0
March	1.3	12.0	8.0
April	T	-	T
May	0	T	0
June	0	0	0
July	0	0	0
August	0	0	0
September	0	0	T
October	0	T	T
November	0.6	8.0	6.0
December	2.0	15.0	7.0
Annual	8.7		

a. Climatography of the United States No. 10-77; Climatic Summary of the United States; U.S. Department of Commerce Weather Bureau, Decatur, Tennessee, 1896-1930.

b. Cooperative Observer Meteorological Records, Form 1009; Decatur, Tennessee, 1896-1940, Obtained from National Climatic Center, Asheville, North Carolina, on November 24, 1970.

Table 1.1-3

AVERAGE WIND SPEED DATA[a]

CHATTANOOGA 1951-60

Average Wind Speeds (mi/h)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Avg.	% Calm
Dec.	8.6	8.2	6.7	4.8	4.1	4.1	4.3	7.4	8.4	8.2	7.2	8.0	9.1	10.6	9.6	10.8	6.4	22.0
Jan.	9.9	8.7	7.0	5.3	4.1	3.3	4.0	7.2	8.8	8.7	7.9	9.3	8.7	10.7	10.8	11.1	7.4	17.0
Feb.	8.7	8.0	7.3	5.4	4.6	4.4	5.0	8.6	9.7	9.2	8.3	9.7	9.8	10.5	10.4	10.7	7.5	16.1
Winter	9.1	8.[illegible]	7.0	5.2	4.3	3.9	4.4	7.7	9.0	8.7	7.8	9.0	9.2	10.6	10.3	10.9	7.1	18.4
March	8.5	8.0	7.2	6.2	4.[illegible]	5.2	5.3	8.6	9.4	9.6	9.0	10.5	11.6	11.3	10.8	10.9	8.0	13.2
April	8.7	8.7	7.1	5.9	4.8	5.5	6.7	10.5	10.0	10.0	8.9	11.5	10.3	11.9	10.8	9.8	7.8	17.8
May	7.4	8.0	6.4	6.2	4.1	5.3	5.4	7.7	8.0	7.5	7.1	9.1	9.4	10.1	8.5	8.8	5.9	24.4
Spring	8.2	8.2	6.9	6.1	4.4	5.3	5.8	8.9	9.1	9.0	8.3	10.4	10.4	11.1	10.0	9.8	7.2	18.5
June	6.6	6.7	6.0	5.4	4.[illegible]	5.3	5.0	6.3	7.3	7.3	6.6	8.4	8.0	8.4	8.4	7.2	5.2	24.5
July	[illegible].4	7.0	6.0	5.3	4.9	4.6	5.0	6.2	6.6	6.6	6.4	8.1	7.2	7.5	7.1	7.1	4.9	23.8
Aug.	6.2	6.8	6.[illegible]	5.4	4.5	4.5	4.7	5.7	6.0	6.[illegible]	5.4	6.8	6.9	[illegible].0	6.6	6.8	4.3	30.6
Summer	6.4	6.8	6.1	5.4	4.7	4.8	4.9	6.1	6.6	6.[illegible]	6.1	7.8	7.4	7.6	7.4	7.0	4.8	26.3
Sept.	6.8	7.6	6.9	5.4	4.4	4.7	5.0	7.3	7.0	6.6	5.2	7.4	6.2	6.5	5.9	7.3	4.7	30.1
Oct.	7.9	8.0	7.5	6.2	4.4	4.3	5.6	7.2	7.0	6.2	5.4	7.5	7.0	7.8	7.7	8.8	4.8	33.1
Nov.	8.7	8.[illegible]	6.8	5.7	3.9	3.6	4.8	8.3	9.0	8.2	6.6	7.9	8.2	9.9	9.3	10.4	6.1	27.2
Fall	7.8	8.0	7.1	5.8	4.2	4.2	5.1	7.6	7.7	7.0	5.7	7.6	7.1	8.1	7.6	8.8	5.[illegible]	30.1
Annual	8.1	7.9	6.8	5.6	4.5	[illegible].7	5.1	7.5	8.2	8.1	7.2	8.8	8.7	9.8	9.3	9.6	6.1	23.4

a. Climatography of the United States No. 82-40, Decennial Census of United States Climate - Summary of Hourly Observations, Chattanooga, Tennessee, Lovell Field, 1951-60, U.S. Department of Commerce, Weather Bureau.

Table 1.1-4

WIND DIRECTION PERSISTENCE DATA[a]

Direction	Number of Occurrences - Wind Direction Persistence Periods (Hours)															Total
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	15	
N	72	37	29	15	12	6	2	4	2	1	-	2	2	-	1	185
NNE	134	42	22	16	7	6	2	4	1	1	-	-	-	-	-	235
NE	190	83	53	34	13	7	6	5	7	-	-	-	-	-	-	398
ENE	188	96	64	26	25	17	7	3	4	2	1	2	1	-	2	438
E	98	37	11	6	2	4	-	-	-	-	1	-	-	-	-	159
ESE	97	20	12	5	3	1	-	-	-	-	-	-	-	-	-	138
SE	69	19	5	2	-	1	-	-	-	-	-	-	-	-	-	96
SSE	123	34	16	5	2	-	1	-	-	-	-	-	-	-	-	181
S	201	62	29	21	9	4	3	-	-	-	1	-	-	-	1	334
SSW	226	90	61	28	18	11	13	5	8	3	6	2	1	-	5	477
SW	257	141	71	54	27	15	21	11	13	8	9	8	5	3	13	656
WSW	209	74	32	20	8	5	3	1	1	-	1	-	-	-	-	354
W	78	34	10	5	-	2	1	-	1	-	-	-	-	-	1	130
WNW	78	44	15	8	10	3	6	2	2	1	-	-	-	-	-	169
NW	103	41	25	10	5	1	7	1	-	1	-	-	-	-	2	197
NNW	152	107	67	38	46	31	25	18	12	13	6	8	-	6	30	559
Total	2275	959	522	293	187	114	97	57	51	30	24	23	9	10	55	4706
Freq., %[b]	100	51.65	31.27	20.19	13.96	9.99	7.57	5.50	4.29	3.21	2.57	2.06	1.57	1.38	1.17	

a. TVA Kingston Steam Plant (1967-69), station elevation - 1,134 feet MSL; instrument mounted 150 feet aboveground.

b. Percent frequency of wind direction persistence equal to or greater than stated value.

Table 1.1-7

WIND DIRECTION PERSISTENCE DATA[a]

July 1, 1971-June 28, 1972
Annual

Number of Occurrences - Wind Direction Persistence Periods (hours)

Direction	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	>25	Total
N	42	26	12	8	6	1	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98
NNE	52	28	23	9	5	2	2	4	4	2	-	1	1	-	-	2	-	1	-	-	-	-	-	-	1	137
NE	70	34	18	13	7	3	2	1	1	-	-	2	-	2	1	-	-	-	-	-	-	-	-	-	1	155
ENE	62	21	9	7	3	1	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	108
E	14	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19
ESE	7	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
SE	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
SSE	22	7	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34
S	62	30	16	10	2	3	1	3	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	131
SSW	71	38	33	13	17	9	5	10	7	2	2	4	2	2	1	-	-	-	1	1	-	-	-	-	-	218
SW	48	40	17	9	2	4	3	4	-	1	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	132
WSW	36	10	5	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54
W	30	8	9	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54
WNW	21	14	6	8	4	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56
NW	27	10	3	4	7	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53
NNW	27	18	7	6	4	3	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69
Total	599	292	166	91	61	29	19	27	15	9	5	7	4	5	3	3	-	1	1	1	-	-	-	-	2	1340
Acc. Total	1340	740	449	283	192	131	102	83	56	41	32	27	20	16	11	8	5	5	4	3	2	2	2	2	2	
Acc. Freq. (%)	100	55.3	33.5	21.1	14.3	9.8	7.6	6.2	4.2	3.1	2.4	2.0	1.5	1.2	.8	.6	.4	.4	.3	.2	.2	.2	.2	.2	.2	

a. Watts Bar Meteorological Facility. Wind instrument at 130 feet aboveground.

NOTE: Persistent wind is defined in this analysis as a wind blowing continuously from one of the named 22-1/2° sectors (i.e., north-northwest) except that it is not considered to be interrupted if it departs from that sector for one hour and then returns, or if there are up to two hours of missing data followed by a continued directional persistence.

Table 1.1-6

AVERAGE WIND SPEED DATA[a]

KNOXVILLE 1951-60

Average Wind Speeds (mi/h)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Avg.	% Calm
Dec.	7.8	8.1	6.5	6.2	4.1	4.2	4.1	4.8	6.5	8.4	11.3	12.1	10.8	11.6	8.4	7.7	7.8	9.0
Jan.	8.5	9.2	7.2	7.0	4.7	4.8	4.4	4.7	6.8	10.1	12.8	11.9	11.5	11.6	9.0	8.2	8.7	7.6
Feb.	7.5	8.9	7.0	7.0	4.8	4.7	4.6	5.3	7.5	[illegible]	12.6	12.5	11.4	13.0	9.3	7.6	7.6	8.2
Winter	7.9	8.7	6.9	6.7	4.5	4.6	4.4	4.9	6.9	9.5	12.2	12.2	11.2	12.1	8.9	7.8	8.4	8.3
March	8.2	9.2	7.7	7.4	5.3	5.1	4.9	6.8	6.5	9.3	12.9	13.4	12.0	13.1	10.5	9.3	9.5	6.0
April	8.4	9.6	7.6	7.0	5.1	[illegible]	5.5	7.9	8.3	10.7	12.8	13.9	12.2	12.6	9.9	8.6	9.6	7.3
May	8.0	8.0	7.0	7.3	5.0	5.8	5.0	6.1	6.1	8.0	10.3	10.7	9.7	10.0	8.3	8.1	7.7	10.0
Spring	8.2	8.9	7.4	7.2	5.1	5.6	5.1	6.9	7.0	9.3	12.0	12.7	11.3	11.9	9.6	8.7	8.9	7.8
June	7.6	7.6	6.6	6.3	5.5	5.4	5.1	5.3	5.6	7.9	9.3	9.2	9.0	8.4	7.7	7.2	6.9	10.4
July	7.0	7.6	6.4	6.3	4.8	5.0	5.0	4.7	5.7	[illegible]	8.8	9.0	7.7	8.1	7.2	6.1	6.3	12.8
Aug.	7.1	7.5	5.9	5.9	4.8	4.5	4.7	4.7	4.9	7.4	7.8	8.5	8.3	8.2	7.3	6.8	5.8	15.1
Summer	7.2	7.6	6.3	6.2	5.0	5.0	4.9	4.9	5.4	7.6	8.6	8.9	8.3	8.2	7.4	6.7	6.3	12.8
Sept.	6.9	7.4	6.4	6.9	5.0	4.8	4.6	4.9	5.7	7.0	7.6	8.9	7.5	7.2	6.5	7.1	5.7	15.4
Oct.	7.5	8.0	6.9	6.3	4.1	4.1	4.1	4.1	5.0	7.3	8.2	8.7	8.9	8.8	8.0	7.4	6.0	14.8
Nov.	7.9	7.9	6.4	5.8	4.3	4.5	4.1	4.8	6.6	8.3	10.5	10.4	10.1	11.3	8.7	7.1	7.1	11.3
Fall	7.4	7.8	6.6	6.3	4.5	4.5	4.3	4.6	5.8	7.5	8.8	9.3	8.8	9.1	7.7	7.2	6.3	13.3
Annual	7.7	8.3	6.8	6.6	4.8	4.9	4.7	5.3	6.2	8.5	10.6	11.1	10.1	10.8	8.4	7.6	7.5	10.7

a. Climatography of the United States No. 82-40, Decennial Census of United States Climate - Summary of Hourly Observations, Knoxville, Tennessee, McGhee Tyson Airport, 1951-60, U.S. Department of Commerce, Weather Bureau.

Table 1.1-8

PERCENT OCCURRENCE OF WIND SPEED[a]

FOR ALL WIND DIRECTIONS

July 1, 1971 - June 28, 1972
Annual

Wind Direction	Wind Speed (mi/h)[b] 1-3	4-7	8-12	13-18	19-24	≥25
N	2.36	3.07	1.06	0.10	0.01	-
NNE	2.83	4.29	2.28	0.25	-	-
NE	3.25	4.37	1.58	0.06	-	-
ENE	3.48	2.38	0.63	0.07	0.01	-
E	1.40	0.45	0.15	0.02	0.01	-
ESE	0.93	0.21	0.05	0.01	-	-
SE	1.03	0.28	0.02	0.02	0.06	-
SSE	1.71	0.67	0.14	0.05	0.04	-
S	3.34	3.27	0.95	0.33	0.17	0.03
SSW	4.07	5.63	4.22	1.03	0.14	-
SW	2.96	3.25	2.00	0.52	0.09	-
WSW	2.05	1.67	0.49	0.06	-	-
W	1.82	0.93	0.78	0.26	0.04	-
WNW	1.30	1.04	1.18	0.21	-	-
NW	1.36	0.94	1.18	0.21	0.01	-
NNW	2.08	1.78	0.97	0.26	0.04	0.05
Total	35.97	34.23	17.68	3.48	0.62	0.08

Calm = 7.91

a. Watts Bar meteorological facility. Wind instrument at 130 feet aboveground.

b. Wind speed class 1-3 mi/h includes values 0.6-3.5 mi/h; class 4-7 mi/h includes values 3.6-7.5 mi/h, etc.

Valid observations only - represents 93 percent of total annual record.

Table 1.1-9

PERCENT OCCURRENCE OF WIND SPEED[a]

FOR ALL WIND DIRECTIONS

December 1, 1971 - February 29, 1972
Winter

Wind Direction	Wind Speed (mi/h)[b] 1-3	4-7	8-12	13-18	19-24	≥25
N	2.44	0.98	0.49	0.05	-	-
NNE	2.78	4.29	3.12	0.29	-	-
NE	2.15	2.88	1.46	-	-	-
ENE	2.34	1.37	0.24	-	-	-
E	0.73	0.15	-	-	-	-
ESE	0.39	-	-	-	-	-
SE	0.73	0.05	-	-	-	-
SSE	0.59	0.10	0.05	-	-	-
S	2.10	1.27	0.68	0.20	0.39	0.15
SSW	4.19	5.07	5.41	1.51	0.39	-
SW	3.27	3.27	2.15	-	-	-
WSW	2.19	1.85	0.39	-	-	-
W	1.46	1.02	0.49	-	-	-
WNW	1.02	1.02	1.71	0.05	-	-
NW	0.98	0.59	0.63	0.10	-	-
NNW	2.00	1.02	0.29	0.59	-	-
Total	29.36	24.93	17.11	2.79	0.78	0.15

Calm = 24.91

a. Watts Bar meteorological facility. Wind instrument at 130 feet aboveground.

b. Wind speed class 1-3 mi/h includes values 0.6-3.5 mi/h; class 4-7 mi/h includes values 3.6-7.5 mi/h, etc.

Valid observations only - represents 94 percent of total winter record.

Table 1.1-10

PERCENT OCCURRENCE OF WIND SPEED[a]

FOR ALL WIND DIRECTIONS

July 1, 1971-August 31, 1971 and June 1-28, 1972
Summer

Wind Direction	Wind Speed (mi/h)[b] 1-3	4-7	8-12	13-18	19-24	≥25
N	1.96	3.50	1.21	0.27	-	-
NNE	3.22	4.76	1.77	0.19	-	-
NE	3.45	4.34	1.26	0.05	-	-
ENE	3.68	2.15	0.70	0.19	0.05	-
E	1.21	0.42	0.47	0.09	0.05	-
ESE	1.31	0.14	0.19	0.05	-	-
SE	0.88	0.47	-	0.09	0.23	-
SSE	1.87	0.88	0.19	0.19	0.14	-
S	4.29	6.01	1.26	0.37	0.28	-
SSW	4.57	7.79	4.06	0.84	0.05	-
SW	2.43	2.52	0.98	[illegible]	0.05	-
WSW	1.92	1.54	0.33	[illegible]	-	-
W	1.58	0.79	0.75	0.28	-	-
WNW	[illegible].88	0.84	0.98	0.23	-	-
NW	1.16	1.12	1.17	0.28	-	-
NNW	1.87	0.79	0.79	0.28	0.14	0.19
Total	36.27	38.06	16.11	3.78	0.99	0.19

Calm = 0.19

a. Watts Bar meteorological facility. Wind instrument at 130 feet aboveground.

b. Wind speed class 1-3 mi/h includes values 0.6-3.5 mi/h; class 4-7 mi/h includes values 3.6-7.5 mi/h, etc.

Valid observations only - represents 96 percent of total summer record.

Table 1.1-11

PERCENT OCCURRENCE OF WIND SPEED[a]

FOR ALL WIND DIRECTIONS

March 1, 1972 - May 31, 1972
Spring

Wind Direction	Wind Speed (mi/h)[b] 1-3	4-7	8-12	13-18	19-24	≥25
N	1.39	2.88	1.34	0.05	0.05	-
NNE	2.35	3.22	2.83	0.43	-	-
NE	2.74	4.08	2.06	0.19	-	-
ENE	2.64	3.12	0.91	0.10	-	-
E	1.34	0.77	0.10	-	-	-
ESE	0.91	0.43	-	-	-	-
SE	1.20	0.43	0.10	-	-	-
SSE	1.73	0.91	0.29	-	-	-
S	2.83	2.69	1.15	0.58	-	-
SSW	2.74	4.37	4.90	1.58	0.10	-
SW	3.12	4.51	4.13	1.78	0.29	-
WSW	1.63	2.26	1.10	0.05	-	-
W	1.54	1.44	1.06	0.72	0.14	-
WNW	1.30	1.20	1.58	0.48	-	-
NW	1.10	1.15	2.02	0.38	0.05	-
NNW	1.49	1.63	0.91	0.10	-	-
Total	30.10	35.09	24.48	6.44	0.63	-

Calm = 3.26

a. Watts Bar meteorological facility. Wind instrument at 130 feet aboveground.

b. Wind speed class 1-3 mi/h includes values 0.6-3.5 mi/h; class 4-7 mi/h includes values 3.6-7.5 mi/h, etc.

Valid observations only - represents 94 percent of total spring record.

Table 1.1-12

PERCENT OCCURRENCE OF WIND SPEED[a]

FOR ALL WIND DIRECTIONS

September 1, 1971 - November 30, 1971
Fall

Wind Direction	Wind Speed (mi/h)[b] 1-3	4-7	8-12	13-18	19-24	≥25
N	3.70	4.91	1.16	-	-	-
NNE	2.85	4.75	1.22	.05	-	-
NE	4.65	6.13	1.48	-	-	-
ENE	5.23	2.80	0.63	-	-	-
E	2.32	0.42	-	-	-	-
ESE	1.06	0.26	-	-	-	-
SE	1.27	0.16	-	-	-	-
SSE	2.59	0.74	-	-	-	-
S	4.01	2.80	0.63	0.16	-	-
SSW	4.65	4.91	2.17	0.05	-	-
SW	2.91	2.54	0.58	-	-	-
WSW	2.43	0.90	0.11	0.16	-	-
W	2.69	0.37	0.79	-	-	-
WNW	2.01	1.06	0.32	0.05	-	-
NW	2.22	0.85	0.79	0.05	-	-
NNW	2.96	3.54	1.90	0.05	-	-
Total	47.55	37.14	11.78	0.57	-	-

Calm = 2.96

a. Watts Bar meteorological facility. Wind instrument at 130 feet aboveground.

b. Wind speed class 1-3 mi/h includes values 0.6-3.5 mi/h; class 4-7 mi/h includes values 3.6-7.5 mi/h, etc.

Valid observations only - represents 87 percent of total fall record.

Table 1.1-13

WATER SUPPLIES WITHIN 20-MILE RADIUS OF SITE INCLUDING SUPPLIES TAKEN FROM TENNESSEE RIVER BETWEEN FORT LOUDOUN AND CHICKAMAUGA DAMS

Public Supplies

Water Supply	Distance From Site* (Miles)	Estimated Population Served	Average Daily Use (Gallons)	Source
1. Athens	13.7	15,000	2,086,000	Surface (Oostanaula Cr. 50%) and Ground, spring 50%
2. Cedar Valley Elementary School	12.5	252	6,300	Ground, well
3. Dayton	24.2	4,500	1,000,000	Surface (TRM 503.8)
4. Decatur	3.3	900	101,000	Ground, spring
5. Eastview Elementary School	19.7	190	4,750	Ground, well
6. E. K. Baker School	9.2	344	8,600	Ground, well
7. Englewood	19.2	4,000	150,000	Surface (Middle Creek 1.8)
8. Evensville Elementary School	12.3	127	3,175	Ground, well
9. Fairview Elementary School	3.0	252	6,300	Ground, well
10. Frazier Elementary School	11.7	162	4,050	Ground, well
11. Idlewild Elementary School	8.6	186	4,650	Ground, well
12. Midway High School	19.2	297	7,425	Ground, spring
13. Niota	17.1	2,000	150,000	Ground, spring
14. Paint Rock Elementary School	18.9	189	4,725	Ground, well

*Radial distance to all supplies except those that take water directly from the Tennessee River which are shown as river mile distance from TRM 528.0.

Table 1.1-14

INDUSTRIAL WATER SUPPLIES

Water Supply	Distance From Site*	Number of Employees	Average Daily Use	Source
	Miles		Gallons	
1-I Athens Hosiery Mill, Inc.	13.0	185	271,350	Ground, well
2-I Athens Stove Works	13.8	405	32,100	Ground, well
3-I Cherokee Photo Finishers	12.7	92	99,000	Ground, well
4-I Crescent Hosiery Mills	15.6	120	25,000	Ground, well
5-I Edwards Laundry	18.8	42	120,000	Surface (Sweetwater Creek)
6-I Mayfield Dairy Farms, Inc.	15.0	300	81,200	Ground, well
7-I Plastic Industries, Inc.	13.4	225	10,000	Ground, well
8-I Southern Silk Mills	9.2**	680	165,000	Surface (Piney Creek)
9-I Sweetwater Hosiery Mills	16.6**	90	25,000	Ground, well
10-I Watts Bar Steam Plant	1.3	36	-	Surface (TRM 529.3)
11-I Atlas Chemical Industries, Inc. (Volunteer Army Ammunition Plant	55.0	2,000	50,000,000	TRM 473.0
12-I Charles H. Bacon Company	63.5**	600	285,000	TRM 591.5 and spring
13-I Farmers Chemical Association, Inc.	55.0**	225	2,000,000	TRM 473.0
14-I Union Carbide Corporation	64.0	430	2,000,000	TRM 592.0

*Radial distance to all supplies except those that take water directly from impounded waters of the Tennessee River which are shown as river mile distance from TRM 528.0.

**Water supply is also used for potable water within the plant.

Table 1.1-13
(Continued)

WATER SUPPLIES WITHIN 20-MILE RADIUS OF SITE INCLUDING
SUPPLIES TAKEN FROM TENNESSEE RIVER BETWEEN FORT LOUDOUN AND CHICKAMAUGA DAMS

Public Supplies

Water Supply	Distance From Site*	Estimated Population Served	Average Daily Use	Source
	Miles		Gallons	
15. Riceville Utility District	17.0	581	18,000	Ground, spring
16. Rockwood	17.6	5,500	1,200,000	Ground, spring
17. Spring City	7.6	1,900	300,000	Surface (Piney River 33%) and Ground, spring 67%
18. Sweetwater	17.5	4,300	593,000	Ground, spring 80% and Surface 20%
19. Ten Mile Elementary School	7.9	200	4,200	Ground, well
20. Union Grove Elementary	10.9	188	4,700	Ground, well
21. Watts Bar Reservation[a]	1.9	300** 40***	109,000** 40,300***	Surface, (TRM 529.9)
22. Daisy-Soddy-Falling Water Utility District	44.7	8,900	400,000	Soddy Creek 4.2 (67%) and Ground, well 33%
23. Lenoir City	73.3	6,900	995,400	TRM 601.3
24. Savannah Utility District	44.4	1,610	122,000	TRM 483.6

*Radial distance to all supplies except those that take water directly from impounded waters of the Tennessee River, which are shown as river mile distance from TRM 528.0.

a. Includes water supply to Watts Bar Resort, **Summer use and ***Winter use.

Table 1.1-15

HABITAT EVALUATION FOR SEVEN GAME SPECIES

Species	Habitat Rating (Percent of Total Land Area)			
	Suitable		Unsuitable	
	Good	Average	Poor	Nonhabitat
White-tailed deer	9	74	17	-
Gray Squirrel	13	28	39	20
Raccoon	13	51	34	2
Wild Turkey	5	77	18	-
Ruffed Grouse	4	77	18	1
Cottontail Rabbit	8	59	30	3
Bobwhite Quail	7	59	32	2

Table 1.1-16

ZOOPLANKTON AND PHYTOPLANKTON SPECIES

OBSERVED IN WATTS BAR DAM FOREBAY - JUNE 1972

Zooplankton

Rotifera

- Branchionus angularis
- Branchionus bidentata
- Branchionus budapestinensis
- Branchionus calyciflorus
- Branchionus caudatus
- Keratella bostoninensis
- Keratella cochlearis
- Keratella earlinae
- Keratella spp.
- Platy patulas
- Polyarthra spp.
- Notholca spp.
- Lecane spp.
- Filinia spp.
- Synchaeta spp.
- Trichocera spp.

Cladocera

- Bosmina longirostris
- Diaphanosoma spp.
- Daphnia galeata mendotae
- Daphnia parvula
- Daphnia retrocurva
- Daphnia spp. (immature)
- Leptodora kindtii

Copepoda

- Cyclops bicuspidatus
- Diaptomus pallidus
- Diaptomus reighardi
- Cyclops vernalis
- Macrocyclops ater
- Mesocyclops edax
- Calanoida (immature)
- Cyclopoida (immature)
- Nauplii

Phytoplankton

Diatoms

- Gyrosigma
- Tabellaria
- Cymbella
- Asterionella
- Cyclotella
- Dinobryon
- Eunotia
- Fragilaria
- Melosira
- Navicula
- Stephanodiscus
- Synedra
- Caloneis

Greens

- Staurastrum
- Cosmarium
- Rhizodenia
- Ulothrix
- Tetraspora
- Tetraedron
- Ankistrodesmus
- Chlorella
- Gleocystis
- Kirchneriella
- Mallamonas
- Pandorina
- Scenedesmus
- Tetradesmus
- Oocystis
- Protococcus
- Chlamydomonas
- Chlorococcum
- Pediastrum

Bluegreens

- Aphanizomenon
- Arthrospira
- Coelosphaerium
- Dactylococcopsis
- Oscillatoria
- Chroococcus
- Anabaena

Other

- Gymnodinium
- Euglena
- Phacus
- Ceratium

Table 1.1-18

SETTLED PARTICULATE DATA FROM VICINITY OF WATTS BAR SITE

TONS PER SQUARE MILE PER MONTH

	1969		1970		1971		1972	
	Sampler #1	Sampler #2	Sampler #1	Sampler #2	Sampler #1	Sampler #2	Sampler #1	Sampler #2
January			1.9	2.4	3.2	6.4	0.0	0.2
February			3.9	4.4	-	3.4	4.6	5.7
March			5.8	6.2	8.7	6.4	9.0	7.5
April	5.0	5.1	8.5	-	6.6	7.0	11.0	-
May	6.5	18.0	6.5	4.3	-	-	11.0	12.4
June	-	15.4	6.4	3.6	6.4	21.0		
July	-	8.4	6.6	10.1	19.3	6.7		
August	4.9	4.4	1.8	5.3	1.1	10.3		
September	1.9	2.2	3.3	7.1	2.8	2.0		
October	1.4	4.0	4.9	5.4	4.1	-		
November	0.9	1.5	3.9	1.9	2.8	3.1		
December	4.1	4.7	5.5	-	3.6	2.6		
Mean	3.5	7.1	4.9	5.1	5.9	6.9		
Minimum	0.9	1.5	1.8	1.9	1.1	2.0	0.0	0.2
Maximum	6.5	18.0	8.5	10.1	19.3	21.0	11.0	12.4

Table 1.1-17

COMMON AND SCIENTIFIC NAMES* OF FISHES IN ROTENONE SAMPLES

CHICKAMAUGA RESERVOIR, 1970

Game

White bass - Morone chrysops
Largemouth bass - Micropterus salmoides
Spotted Bass - Micropterus punctulatus
White crappie - Pomoxis annularis
Black crappie - Pomoxis nigromaculatus
Bluegill - Lepomis macrochirus
Warmouth - Lepomis gulosus
Longear sunfish - Lepomis megalotis
Green sunfish - Lepomis cyanellus
Redear sunfish - Lepomis microlophus
Rock bass - Ambloplites rupestris
Yellow perch - Perca flavescens
Sauger - Stizostedion canadense

Rough

Spotted gar - Lepisosteus oculatus
Longnose gar - Lepisosteus osseus
Skipjack herring - Alosa chrysochloris
Mooneye - Hiodon tergisus
Carp - Cyprinus carpio
Quillback - Carpiodes cyprinus
Smallmouth buffalo - Ictiobus bubalus
Bigmouth buffalo - Ictiobus cyprinellus
Black buffalo - Ictiobus niger
Spotted sucker - Minytrema melanops
Black redhorse - Moxostoma duquesnei
Golden redhorse - Moxostoma erythrurum
Blue catfish - Ictalurus furcatus
Channel catfish - Ictalurus punctatus
Flathead catfish - Pylodictis olivaris
Drum - Aplodinotus grunniens

Forage

Gizzard shad - Dorosoma cepedianum
Threadfin shad - Dorosoma petenense
Golden shiner - Notemigonus crysoleucas
Emerald shiner - Notropis atherinoides
Spotfin shiner - Notropis spilopterus
Bluntnose minnow - Pimephales notatus
Brook silversides - Labidesthes sicculus
Logperch - Percina caprodes

*From American Fisheries Society Publication Special Publication Number 6, Third Edition, 1970.

Table 1.1-19

SUMMARY OF WEEKLY OBSERVED DISSOLVED OXYGEN CONCENTRATIONS IN THE TAILRACE OF WATTS BAR DAM

1960-71

Year	Observed Dissolved Oxygen Concentrations mg/l		Number of Days Dissolved Oxygen Less than Stated Concentration			
	Minimum	Maximum	3.0 mg/l Days	4.0 mg/l Days	5.0 mg/l Days	6.0 mg/l Days
1960	3.3	10.5	0	6	47	101
1961	4.7	11.8	0	0	3	73
1962	2.9	10.5	4	30	77	144
1963	2.3	11.5	11	50	98	121
1964	3.2	11.2	0	25	39	116
1965	2.7	10.7	6	46	95	131
1966	2.1	12.6	32	43	82	120
1967	3.9	13.5	0	2	23	71
1968	3.3	12.4	0	25	78	133
1969	2.2	11.0	10	66	96	122
1970	2.9	11.6	2	66	116	148
1971	3.0	10.8	0	36	86	146

Table 1.1-20

WATER QUALITY AT TENNESSEE RIVER MILE 518.0

Date	Time	Location in Stream	Depth	Total Coliform	Temp.	D.O.	5-Day 20°C BOD	[illegible]	Turb.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Spec. Conductance	pH
1970			Ft.	[illegible]	°C.	mg/l	mg/l	[illegible]	[illegible]	[illegible]	mg/l	mg/l	mg/l		[illegible]	mg/l
7-13	[illegible] p.	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] a.	Middle	Surf.	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] p.	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]
[illegible]	[illegible] a.	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] a.	Middle	Surf.	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]
[illegible]	[illegible] a.	Middle	Surf.	-	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	[illegible]	[illegible]
[illegible]	[illegible] a.	Middle	Surf.	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1971																
[illegible]	[illegible] a.	Middle	Surf.	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] a.	Middle	Surf.	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] p.	Middle	Surf.	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] a.	Middle	Surf.	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] a.	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] p.	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Maximum Values					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Minimum Values					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 1.1-22

OBSERVED WATER TEMPERATURES - CHICKAMAUGA RESERVOIR *

Tennessee River Mile 487.7

July 1960 - June 1961

Date	Distance From Right Bank (% of Width)	Surface - depth 1 ft. Temperature	Bottom Temperature	Bottom depth, ft
July 12, 1960	50	81.9	75.6	38
August 5, 1960	50	81.7	77.9	35
August 23, 1960	50	79.0	76.5	37
September 22, 1960	50	76.9	74.1	40
October 18, 1960	50	73.6	72.1	36
November 22, 1960	50	55.6	55.0	36
January 18, 1961	50	41.7	41.5	35
February 21, 1961	50	46.6	46.6	40
March 21, 1961	50	52.5	52.5	40
April 18, 1961	50	57.9	56.5	44
May 16, 1961	50	65.8	63.9	42
June 14, 1961	50	78.3	72.0	48

*Data from Quality of Water in Chickamauga Reservoir, 1960-1961, Division of Health and Safety, TVA

1.1-49

Table 1.1-21

WATER QUALITY AT TENNESSEE RIVER MILE 529.9

Date	Time	Location in Stream	Depth ft.	Total Coliform MPN/100 ml	Temp. °C	D.O. mg/l	5-Day 20°C BOD mg/l	Color	Turb.	Threshold Odor	Alkalinity Phen. mg/l	Alkalinity Tot. mg/l	Hard. CaCO3 mg/l	pH	Spec. Conductance	Cl mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	Fe Total mg/l	Nitrite + Nitrate Nitrogen mg/l	SiO2 mg/l	SO4 mg/l	Solids Sus. mg/l	Solids Dis. mg/l	Solids Tot. mg/l
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]													[illegible]														
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	Middle	Surf.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Maximum Values					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Minimum Values					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

1.1-48

F-33

Table 1.1-23

OBSERVED MAXIMUM AND MINIMUM TEMPERATURES

Chickamauga Reservoir - Tennessee River Mile 487.5

Calendar Year	Surface Temperatures, °F. * Maximum	Minimum
1943	84.2	44.6
1944	82.4	41.0
1945	84.2	41.0
1946	84.2	42.8
1947	82.4	39.2
1948	80.4	42.8

* Data from Water Temperature of Streams and Reservoirs in the Tennessee River Basin, Hydraulic Data Branch, TVA

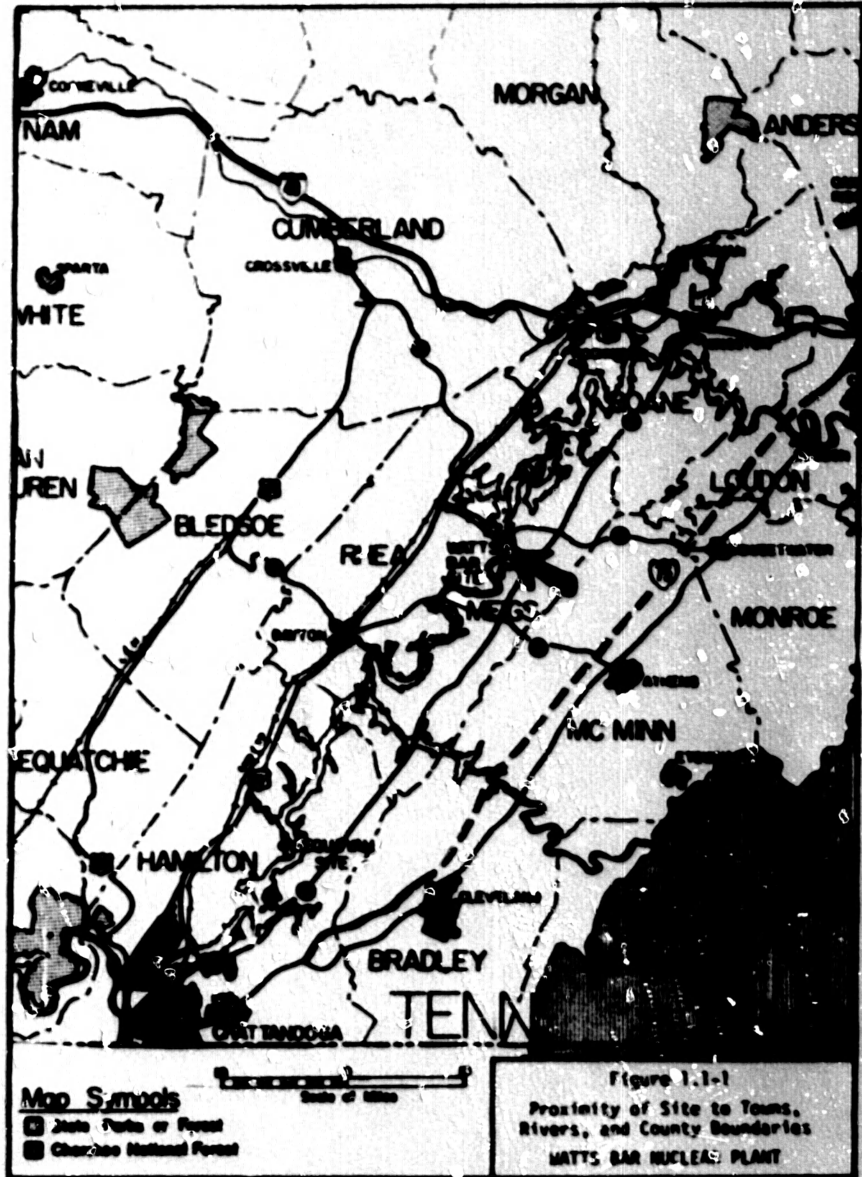

Figure 1.1-1

Proximity of Site to Towns, Rivers, and County Boundaries

WATTS BAR NUCLEAR PLANT

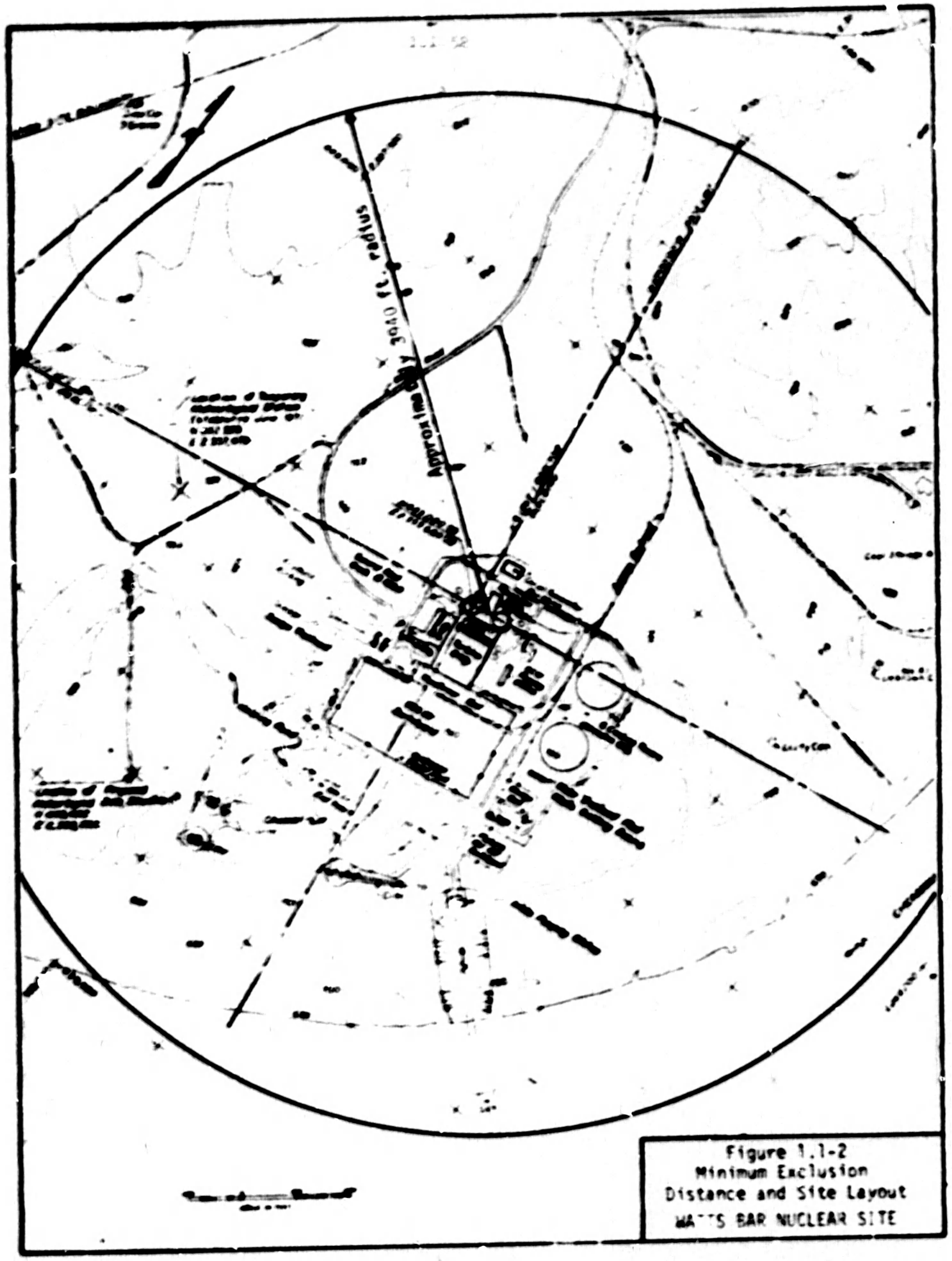

Figure 1.1-2
Minimum Exclusion
Distance and Site Layout
WATTS BAR NUCLEAR SITE

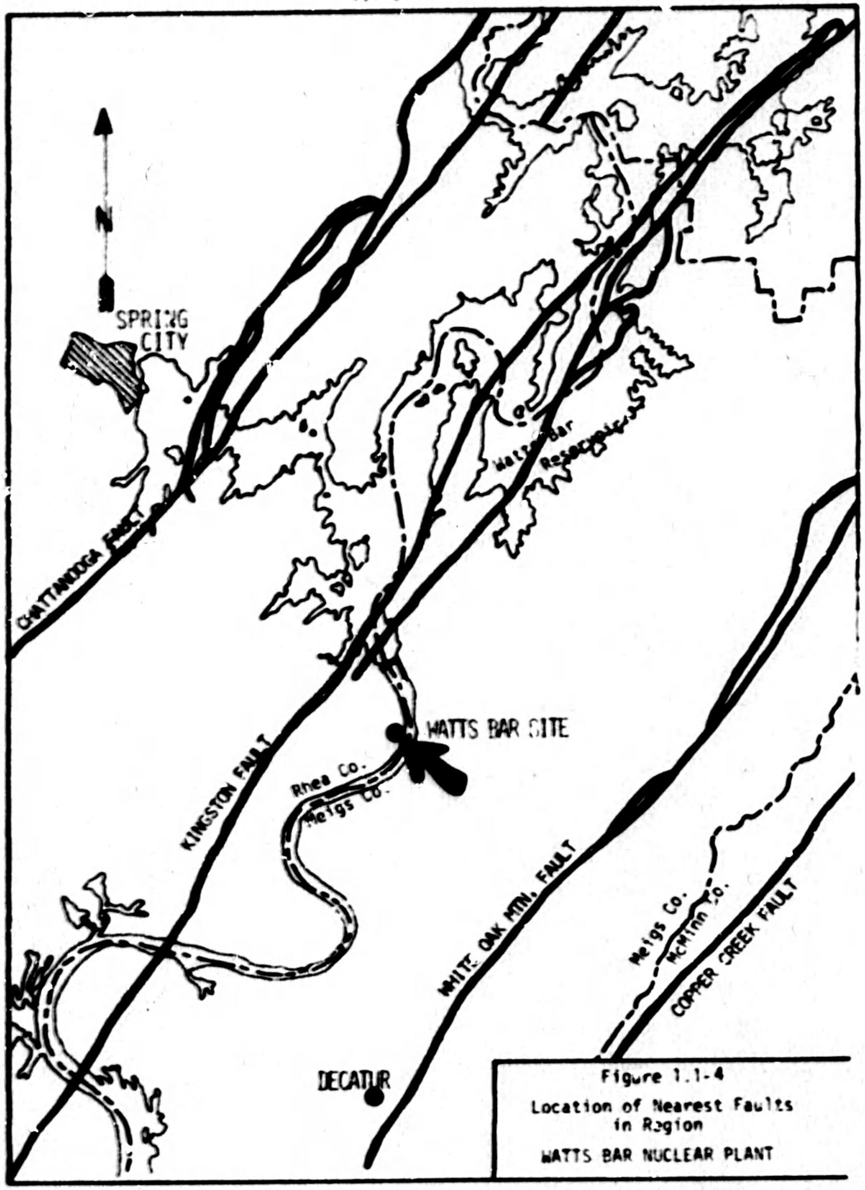

Figure 1.1-4
Location of Nearest Faults in Region
WATTS BAR NUCLEAR PLANT

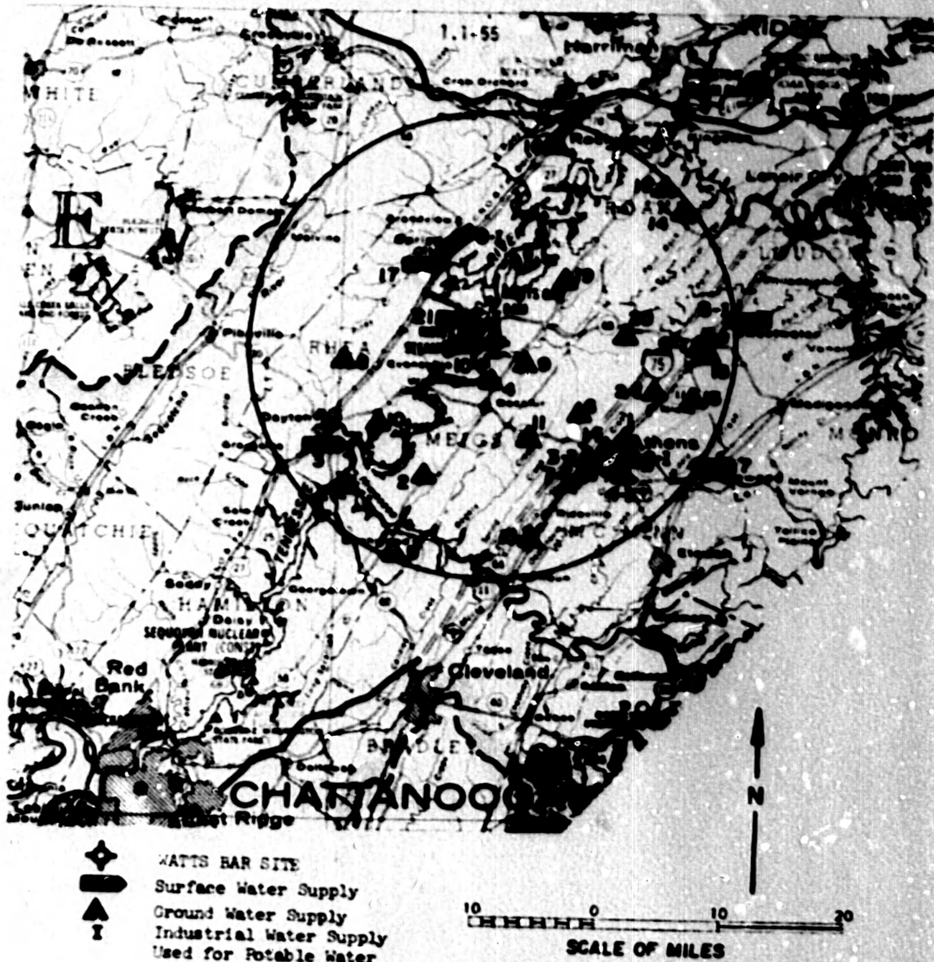

Figure 1.1-5
PUBLIC WATER SUPPLIES WITHIN TWENTY MILE RADIUS OF THE WATTS BAR NUCLEAR SITE

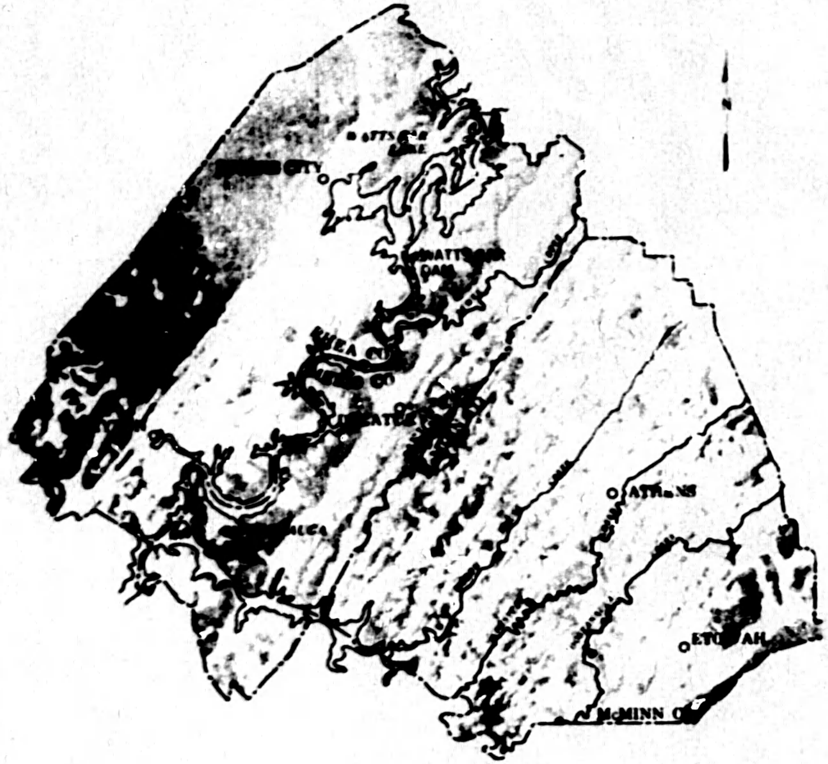

Figure 1.1-6

FOREST COVER

McMINN, MEIGS AND RHEA COUNTIES, TENNESSEE

APRIL 1970

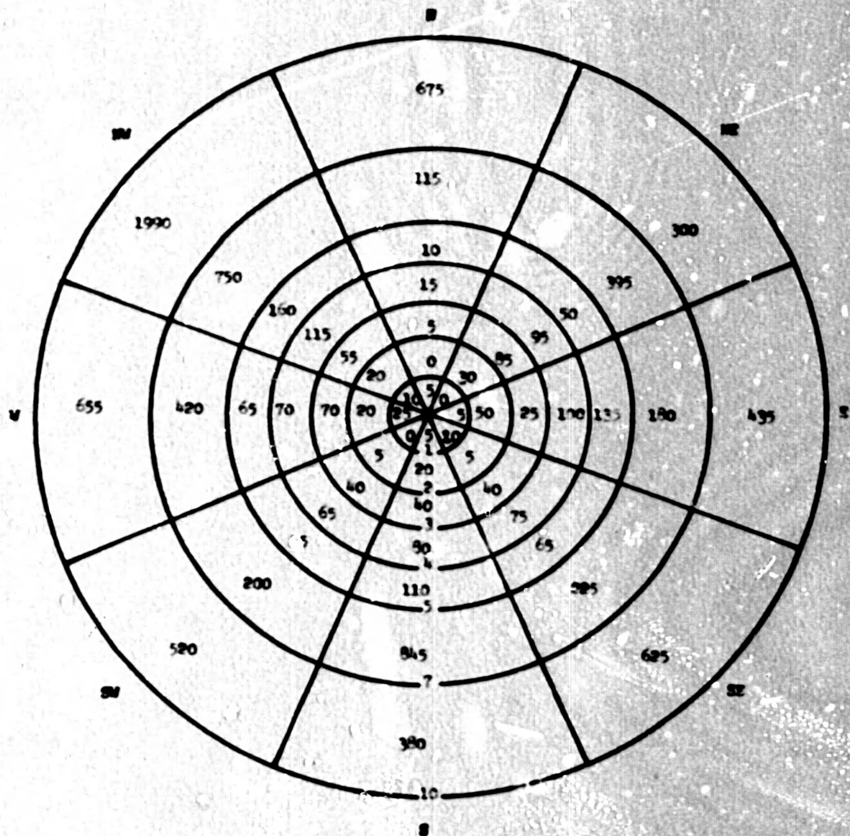

Figure 1.1-7

POPULATION DISTRIBUTION WITHIN 10 MILES

1970

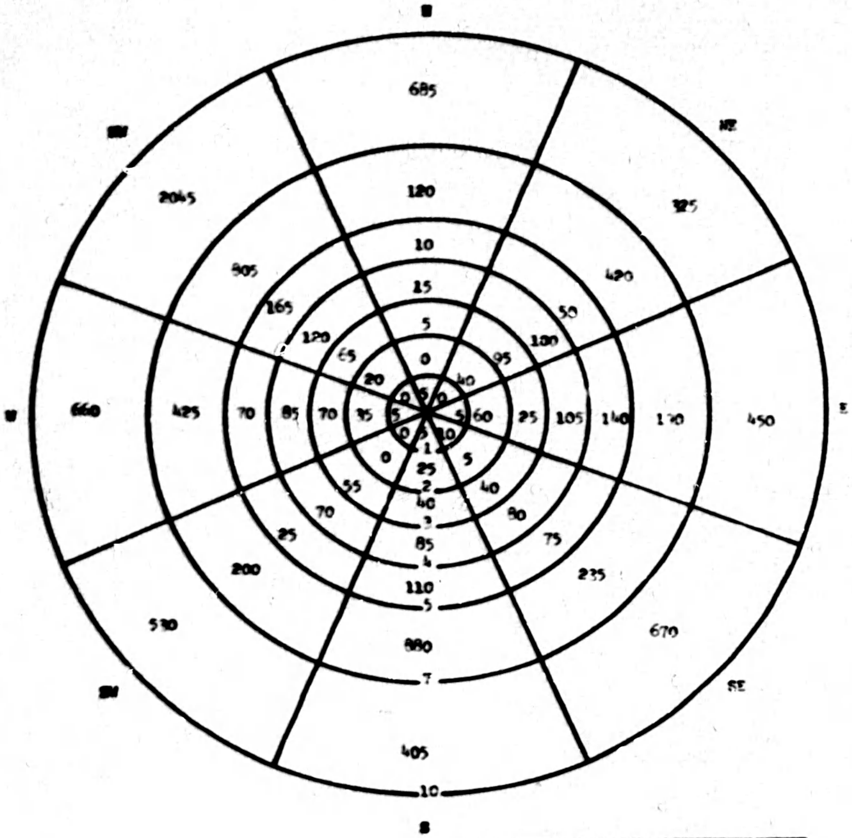

Figure 1.1-8

POPULATION DISTRIBUTION
WITHIN 10 MILES
1980

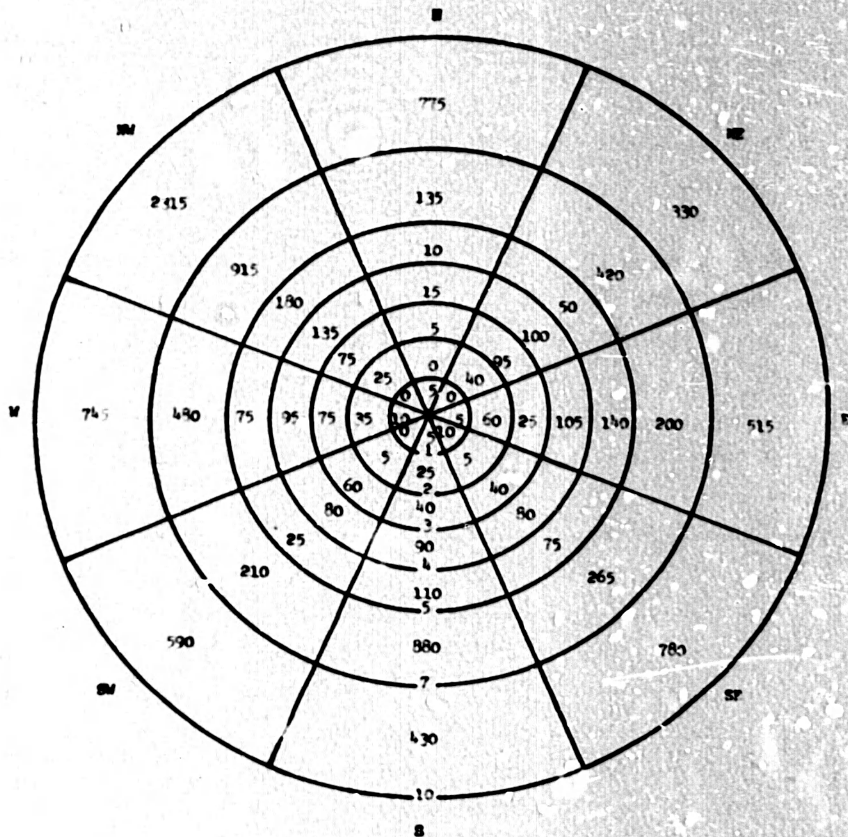

Figure 1.1-9

POPULATION DISTRIBUTION
WITHIN 10 MILES
2000

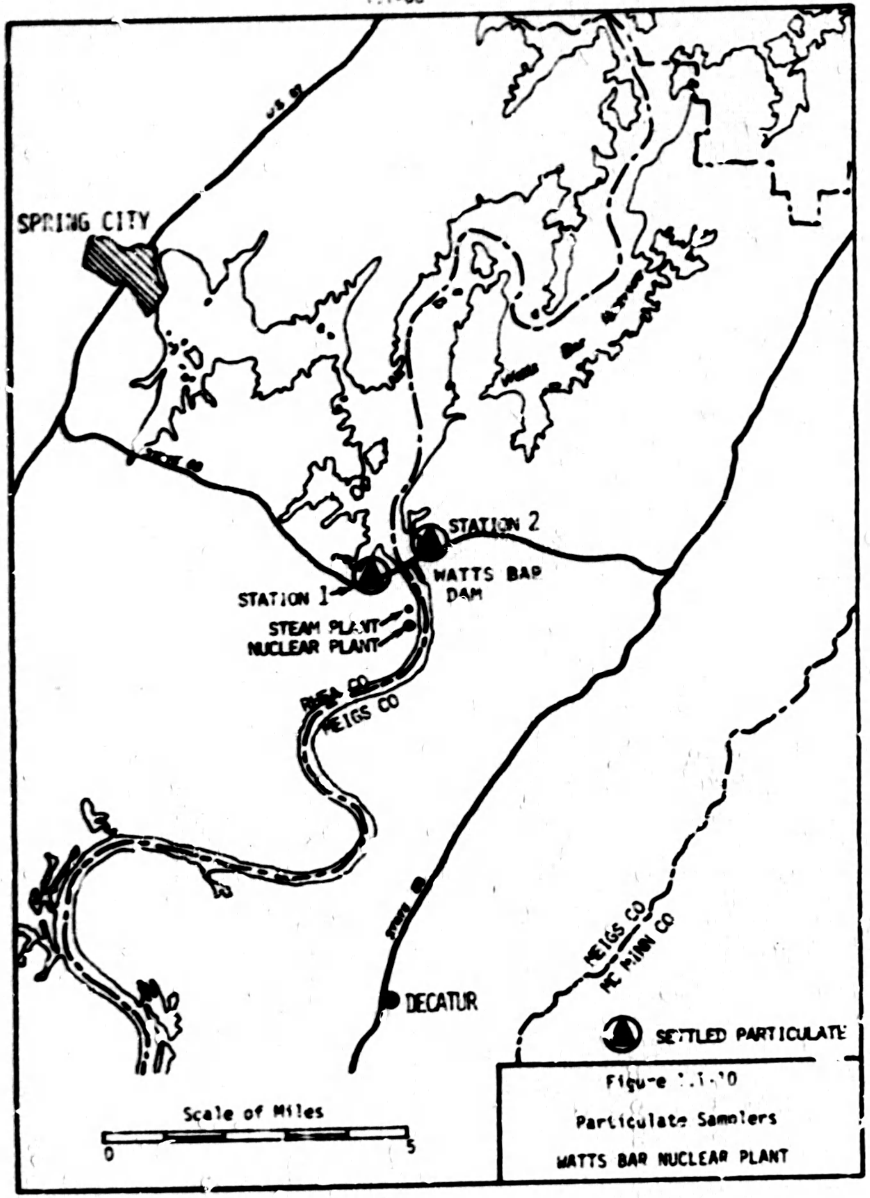

Figure 1.1-10
Particulate Samplers
WATTS BAR NUCLEAR PLANT

1.2 Electric Power Supply and Demand - TVA is the power supplier for an area of approximately 80,000 square miles containing about 6 million people. TVA generates, transmits, and sells power to 160 municipalities and rural electric cooperatives which in turn retail power to their own customers. The approximate areas served by these distributors are shown in figure 1.2-1. These distribution systems, which purchase their power requirements from TVA, serve more than 2 million electric customers, including homes, farms, businesses, and most of the region's industries. TVA also supplies power directly to 46 industries which have large or unusual power requirements and to 11 Federal installations, including the Atomic Energy Commission plants at Oak Ridge, Tennessee, and Paducah, Kentucky.

The importance of an adequate supply of power on the TVA system is by no means limited to electric consumers in the area which TVA supplies directly. This system, which with 19.8 million kilowatts of presently installed generating capacity is the Nation's largest, is interconnected at 26 points with neighboring systems with which TVA exchanges power. The TVA system is, in effect, part of a huge power network. In a time of power emergency, operation of the TVA power system could have a definite impact on power supply conditions from the Great Lakes to the Gulf of Mexico, and from New England to Oklahoma and Texas.

During the past 20 years, loads on the TVA power system have increased approximately 7 percent per year. This rate of growth in power requirements has meant that the capacity of the generating and transmission system has been doubled every 10 years. Until the end of World War II, most of TVA's generating capacity was hydroelectric. By that time, however, most of the suitable hydroelectric sites had been developed, and beginning in 1949 substantially all of the capacity increases were met by the construction of fossil-fueled plants. In the middle 1960's large-scale nuclear plants had become feasible, and TVA began to take steps to add nuclear capacity to its system. TVA has also begun providing pumped-storage and gas turbine capacity to meet system peak loads. Table 1.2-1 shows major TVA system capacity additions since 1949.

The amount of electricity generated in 1965 to meet customer requirements for power exceeded 74.4 billion kilowatthours. By 1970 annual electric generation for customer needs had reached 92.7 billion kilowatthours. Generating needs are expected to reach 135 billion kilowatthours by 1975. TVA presently must add an average of 1,000 megawatts or more of new generating capacity each year to keep up with the rapid increase in electric power usage in this region.

Estimates of future TVA loads are prepared by extending trends of the past while taking into account changes in factors affecting use. Loads are forecast by a number of geographic and class of service categories. Redundant methods are used, where possible, to increase forecast accuracy. Forecasting is preceded by analysis and adjustment of historical data and background preparation including a review of industry conditions, a review of current appliance sales and housing trends, study of possible new loads, and other factors such as the outlook for the national and regional economy.

Residential uses are forecast by utilizing published forecasts of national household trends and historical trends for regional share of national households and number of customers per household. Average use is forecast by estimating the regional saturation of appliances and annual uses of appliances.

Peak load energy forecasts of large commercial and industrial loads served by municipalities and cooperatives are individually prepared on the basis of past history, stated plans for operating levels, type of product, contract demand, etc.

Large industrial and Federal loads which are directly served by TVA are also forecast on an individual basis. Industrial loads are grouped according to industry type, and known expansion and allowance for growth are considered.

1. Power needs - The Watts Bar Nuclear Plant is being constructed to supply 2,340 MW of dependable capacity to the TVA system for the period 1977-2012. A review of the load and supply situations of neighboring utilities as given in reliability council reports and environmental reports indicates that the required capacity could not be supplied by neighboring utilities with their existing and planned system capacity additions. Surplus capacity is, however, available on a seasonal basis from these utilities. TVA makes maximum use of this surplus seasonal capacity through seasonal exchanges of generating capacity. At the present time TVA has agreements in which a total of 2,060,000 MW of firm power is made available to TVA during the winter and returned by TVA to these utilities in the summer. The agreements include: 1,500,000 MW with Mississippi

Power & Light Company; 300,000 MW with Southern Services, Inc.; and 260,000 MW with the Illinois-Missouri group. The TVA power system is a winter and summer peaking system with the highest annual peak loads in the TVA service area usually occurring between November and March. Due to these seasonal exchange arrangements, the loads which TVA generating capacity must actually serve during the remainder of this decade will be greater in the summer than in the preceding winter; therefore, it is not feasible for TVA to further increase its interchange capacity during this period.

TVA believes that the construction of generating capacity to serve its own needs in conjunction with maximum use of surplus seasonal capacity through interchange agreements serves to optimize the capacity additions both on the TVA and the interconnected systems.

The following tabulation indicates TVA's expected power supply outlook during the 1977-79 peak load seasons based on the current capacity installation schedules:

Period	Estimated Peak Demand TVA System-MW	Interchange Delivered or Received-MW	Load Served by TVA-MW	Dependable Capacity-MW	Margin MW	Margin %
Winter 1976-77	26,050	-2,060	23,990	28,595	4,605	19.2
Summer 1977	22,700	+2,060	24,760	29,936	5,176	20.9
Winter 1977-78	27,400	-2,060	25,340	29,765	4,425	17.5
Summer 1978	23,830	+2,060	25,890	31,106	5,216	20.1
Winter 1978-79	28,800	-2,060	26,740	30,935	4,195	15.7

[illegible] above power supply projection is based on commercial operating da[illegible] [illegible] the Watts Ba[illegible] nuclear units of May 1977 and February 1978. Both units have been rescheduled to nine months later than shown in the draft enviro[illegible] [illegible] statement.

2. <u>Consequences of delays</u> - T[illegible]'s desired reserve margins are determined by utilization of the loss of load probability method which has been adapted to the characteristics of the TVA system. The planning criteria are to maintain a desired reserve margin within a reliability risk level of one day in 10 years, and any reduction below these margins increases the risk of not serving firm load. Even if the projected sche[illegible] for capacity are achieved, the margins shown in the above tabulation are deficient in each of the winter periods indicated, as shown in the following tabulation:

Period	Margins Desired MW	Margins Desired %	Margins Available MW	Margins Available %	Deficiency MW
Winter 1976-77	5,137	21.4	4,605	19.2	532
Winter 1977-78	5,290	20.9	4,425	17.5	865
Winter 1978-79	5,476	20.5	4,195	15.7	1,281

Any further delays in operation of the Watts Bar units could result in the inability of the TVA system to meet adequately its obligations under the peak load conditions during 1977-78 with presently scheduled generating capacity. The total consequences of such delays of the Watts Bar Nuclear Plant would be determined by the extent of these delays and the date when such delays were identified. The following tabulation indicates the amounts by which reserves on the TVA system will be inadequate during various peak load seasons of 1977-78, postulating a further delay of twelve months for each of the Watts Bar units from their current schedule. (A delay of unit 1 results in an equal delay in unit 2.) The deficiencies shown are based on the assumption that the winter peak occurs in January and the summer peak occurs in August since these are the months having the higher probability of the peaks occurring. The winter peak has occurred as early as November and the summer peak as early as June.

	TVA System Reserve Deficiencies Due to Watts Bar Unit Delays of 12 Months
Summer 1977	654[a]
Winter 1977-78	2,035
Summer 1978	656[a]
Winter 1978-79	2,451

a. Any Watts Bar unit delays would result in a serious deficiency of margins available for scheduled maintenance for all TVA generating units during the period of delay.

Deficiencies of the magnitude caused by an additional twelve months' delay of the Watts Bar units must be replaced either by the installation of alternative capacity on the TVA system or by the import of power from other utility systems; otherwise, the reliability of power supply to TVA's customers will be drastically reduced. By the time that additional delays in the Watts Bar nuclear units would be confirmed, it is unlikely that additional fossil-fired capacity could be installed to meet these deficiencies since the

period from decision until commercial operation for fossil units is about 5 to 6 years. Therefore, the only feasible means of obtaining additional reliable generation on the TVA system during the time period being considered is the installation of either combustion turbine or combined-cycle units since power in the magnitude being considered would most likely not be available from other utilities when it is needed on the TVA system.

The economic costs of any Watts Bar delays (which must ultimately be borne by the consumer) would consist of two parts: (1) cost of replacement capacity, and (2) increased production expense during the delay period because of unavailability of low-cost nuclear energy.

The estimated investment cost of 1,000 MW of replacement capacity which could be installed for the 1977-78 period is approximately $130 million. Annual fixed charges of about $13 million on such an investment must be borne by consumers in the form of higher rates until the effect of these additions can be absorbed in later years by system growth. The present value of these fixed charges (assuming an 8 percent discount rate and a discount period of 4 years) would be about $43 million.

Fuel, operating, and maintenance expense for the Watts Bar nuclear units is estimated to cost about 2.1 to 2.2 mills per kWh during the 1977-78 period, while replacement energy which would be used in lieu of this nuclear energy in the event of further delays would cost from 3.5 to 10 mills per kWh, depending on the source of this replacement energy. Studies of the effects of Watts Bar unit delays indicate that each month's delay on these units would result in increased production expenses on the TVA system of approximately $3.5 million.

In addition to these economic costs, each month's delay on the two Watts Bar nuclear units could require that approximately 560,000 tons of additional coal and 6.1 million gallons of oil be burned in plants on the TVA system or other systems to replace the lost nuclear energy. This could have an adverse environmental impact in terms of increased emissions of particulates, sulfur dioxide, and other materials to the atmosphere.

In summary, delays of the Watts Bar Nuclear Plant will have a twofold effect on the TVA power system.

1. Costs to TVA's customers could be increased by at least $3.5 million for each month of delay, assuming the delay did not require the installation of combustion turbines or combined-cycle units. If additional generating capacity were required to offset deficiencies due to Watts Bar delays, costs to TVA's consumers over and above those shown above could be increased by $43 million. These costs could total nearly $85 million for a 12-month delay.
2. Increased operation of TVA's older, less efficient fossil-fired units would be required during the period of further Watts Bar delays. Such operation would result in the increased emission of particulates, sulfur dioxide, and other materials into the atmosphere.

The analysis shown on page 1.2-5 shows that TVA cannot carry out its statutory obligation of providing an ample supply of electricity for the TVA region without the Watts Bar Nuclear Plant. Even with the Watts Bar plant, the reliability risk level will be below that which TVA considers desirable. Without the plant, the reliability risk level would be increased to a loss of load probability of nearly four days per year, which is clearly unacceptable.

Table 1.2-1
(Continued)

MAJOR TVA SYSTEM CAPACITY ADDITIONS

SINCE CALENDAR YEAR 1949

Plant	Number of Units	Nameplate Capacity-kW Unit	Nameplate Capacity-kW Total	Commercial Operating Date First Unit	Commercial Operating Date Last Unit
TVA Hydro					
Boone	3	25,000	75,000	3-16-53	9-03-53
Chatuge	1	10,000	10,000	12-09-54	12-09-54
Cherokee*	2	30,000	60,000	1-29-53	10-07-53
Chickamauga*	1	27,000	27,000	3-07-52	3-07-52
Douglas*	1	26,000	26,000	8-03-54	8-03-54
Fontana*	1	67,500	67,500	2-04-54	2-04-54
Ft. Patrick Henry	2	18,000	36,000	12-05-53	2-22-54
Guntersville*	1	24,300	24,300	3-24-52	3-24-52
Hiwassee*	1	59,500	59,500	5-24-56	5-24-56
Melton Hill	2	36,000	72,000	7-03-64	11-11-64
Nickajack	4	24,300	97,200	2-20-68	4-30-68
Nottely	1	15,000	15,000	1-10-56	1-10-56
Pickwick*	2	36,000	72,000	10-31-52	12-31-52
South Holston	1	35,000	35,000	2-13-51	2-13-51
Wheeler*	5	32,400	162,000	3-04-50	12-18-63
Wilbur*	1	7,000	7,000	7-19-50	7-19-50
Wilson*	6	3 @ 25,200 3 @ 54,000	237,600	1-06-50	4-12-62

*Other units in this plant installed in period prior to 1950.

Table 1.2-1

MAJOR TVA SYSTEM CAPACITY ADDITIONS

SINCE CALENDAR YEAR 1949

Plant	Number of Units	Nameplate Capacity-kW Units	Nameplate Capacity-kW Total	Commercial Operating Date First Unit	Commercial Operating Date Last Unit
TVA Thermal					
Thomas H. Allen	3	330,000	990,000	9-22-59	10-25-59
Thomas H. Allen (Gas Turbines)	16	23,900	382,400	6-05-71	6-05-71
Bull Run	1	950,000	950,000	6-12-67	6-12-67
Colbert	5	2 @ 200,000 2 @ 223,250 1 @ 550,000	1,396,500	1-18-55	11-07-65
Gallatin	4	2 @ 300,000 2 @ 327,600	1,255,200	11-08-56	8-09-59
John Sevier	4	1 @ 223,250 3 @ 200,000	823,250	7-12-55	10-31-57
Johnsonville	10	4 @ 125,000 2 @ 147,000 4 @ 172,800	1,485,200	10-27-51	8-20-59
Kingston	9	4 @ 175,000 5 @ 200,000	1,700,000	2-08-54	12-02-55
Paradise	3	2 @ 704,000 1 @ 1,150,200	2,558,200	5-19-63	2-27-70
Shawnee	10	175,000	1,750,000	4-09-53	6-17-57
Widows Creek	8	5 @ 140,625 1 @ 149,850 1 @ 575,010 1 @ 550,000	1,977,985	7-01-52	2-07-65

Leased January 1, 1965, from Memphis, Tennessee, Light, Gas and Water Division.

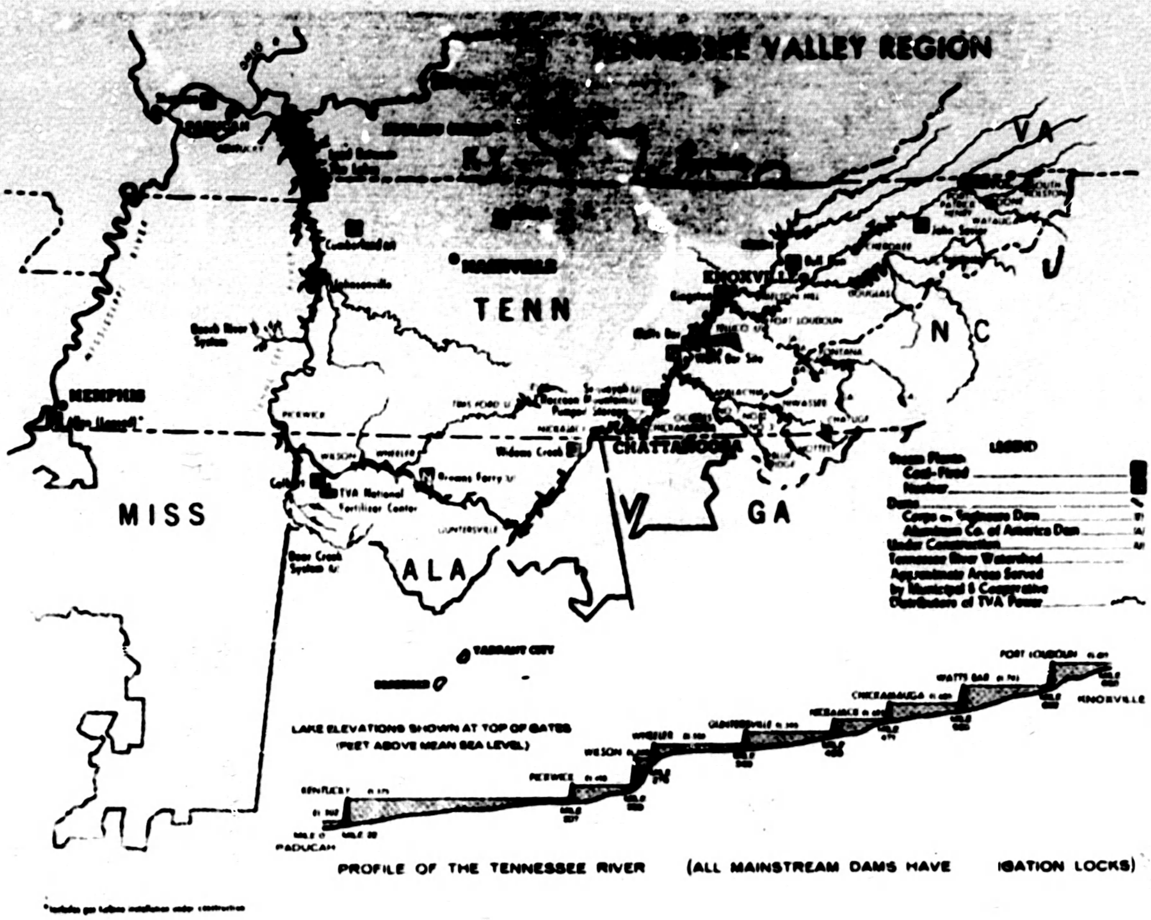

Table 1.2-1
(Continued)

MAJOR TVA SYSTEM CAPACITY ADDITIONS

SINCE CALENDAR YEAR 1949

Plant	Number of Units	Nameplate Capacity-KW Unit	Nameplate Capacity-KW Total	Commercial Operating Date First Unit	Commercial Operating Date Last Unit
Alcoa Hydro					
Bear Creek	1	9,000	9,000	4-14-54	4-14-54
Cedar Cliff	1	6,375	6,375	8-22-52	8-22-52
Chilhowee	3	16,667	50,000	8-28-57	10-18-57
Tennessee Creek	1	10,800	10,800	5-19-55	5-19-55
Corps of Engineers Hydro					
Barkley	4	32,500	130,000	1-20-66	3-30-66
Center Hill	3	45,000	135,000	12-11-50	4-11-51
Cheatham	3	12,000	36,000	11-21-59	11-09-60
Dale Hollow*	1	18,000	18,000	11-17-53	11-17-53
Old Hickory	4	25,000	100,000	4-09-57	12-23-57
J. Percy Priest	1	28,000	28,000	2-03-70	2-03-70
Wolf Creek	6	45,000	270,000	10-06-51	8-22-52

*Other units in this plant installed in period prior to 1950.

1.3 Environmental Approvals and Consultations - AEC is responsible for the issuance of a construction permit and operating license for Watts Bar Nuclear Plant, following a complete review of environmental and licensing considerations. There are also numerous other requirements to insure protection of environmental values in the construction and operation of the plant. In the planning, design, and construction of its generating facilities TVA uses a broad interdisciplinary approach to insure that environmental values are given consideration at appropriate stages, and has adopted procedures and standards which will insure protection of the environment. In addition to its own standards, as a Federal agency TVA is subject to comprehensive and broad-scale environmental procedures and Federal and state consultation and coordination requirements of the National Environmental Policy Act of 1969, 42 U.S.C. § 4321 (1970) (as implemented by Executive Order 11514 (35 Fed. Reg. 4247) and guidelines issued by the Council on Environmental Quality (36 Fed. Reg. 7724)). In addition, TVA is subject to Executive Order 11507 (35 Fed. Reg. 2573) relating to the prevention, control, and abatement of air and water pollution in Federal facilities, as well as the Clean Air Act, 42 U.S.C. § 1857 (1963), the Federal Water Pollution Control Act, 33 U.S.C. § 446 (1965) (as amended by the Federal Water Quality Improvement Act of 1970, 33 U.S.C. § 1152 (1970)), and Office of Management and Budget Circulars A-78 and A-81, all of which require compliance with applicable state or Federal air and water quality standards. In addition, TVA is subject to the intergovernmental coordination requirements of Office of Management and Budget Circular A-95 which insures that major generating and transmission

projects are coordinated from the point of view of community impact and land use planning with state and local agencies.

By statute, TVA is not subject to the provisions of Section 10 and 13 of the River and Harbors Act of March 3, 1899, 33 U.S.C. Sections 403, 407(1970). TVA has consulted with the Corps of Engineers concerning the Corps' implementation of the Refuse Act Permit Program under Section 13. To assist the Corps in administering the Permit Program, TVA has agreed to provide information concerning the quantity and content of TVA's discharges identical to that which the program is designed to secure from private permit applicants.

The state and regional A-95 clearinghouses have been advised of the Watts Bar Nuclear Plant, and the draft environmental statement and supplements and additions to the draft statement have been submitted for their review.

On August 31, 1970, the project manager for the Watts Bar Nuclear Plant met with the county chairmen of Rhea and Meigs Counties, the mayors of Dayton and Decatur, and the city manager of Dayton to discuss the proposed plant.

In October 1970, one of TVA's regional planners met with the Rhea County Planning Commission in Dayton to discuss the impact of the plant construction on schools and education. He also met with the Spring City Chamber of Commerce to discuss water and sewer problems with the Chamber and with members of the Tennessee Planning Commission, the Rhea County Planning Commission, and the Southeast Development District.

Also in October 1970, TVA education and manpower officials began a continuing discussion of the impact of the proposed plant on education with the superintendents of the Rhea, Roane, and Meigs County school systems, the Dean of Harriman Community College, and a representative of the Tennessee Department of Education.

On November 20, 1970, the project manager and TVA's Board Chairman addressed a meeting of the Spring City Chamber of Commerce which drew 250 persons. On December 21, 1970, the project manager and representatives from TVA's Divisions of Reservoir Properties and Navigation Development and Regional Studies met with city officials of Spring City and Decatur to coordinate water supply needs for the plant.

Throughout the first three months of 1971, meetings were held between local leaders in the area and TVA's Office of Tributary Area Development to identify and help solve community problems.

In February of 1971, staff from the Office of Health and Environmental Science consulted with officials of the Tennessee Department of Public Health concerning TVA's plans for environmental protection at the proposed Watts Bar Nuclear Plant.

On March 2, 1971, the project manager for the plant site discussed the economi and social impact of the plant on the region at a meeting of the Dayton Chamber of Commerce.

TVA's Education and Manpower Development Staff has provided technical assistance and information to the Rhea County Board of Education since March of 1971. Part of this effort involved assisting the Board in preparing an application for a grant to construct a consolidated high school. The application was filed in June 1971, and the notice of funding for $900,000 was received in June 1972.

Another activity of the staff was to work with local education boards, local labor leaders, and state manpower officials to develop a training program for local citizens to qualify them for construction jobs on the project. The state included this program in its State Manpower Plan submitted to the Department of Labor in June 1972.

In October 1971 TVA's Regional Planning Staff arranged for a meeting between the Tennessee State Planning Commission and the Rhea County Quarterly Court to discuss the planning assistance available from TSPC. The plant's imminent construction and accompanying effects provided the catalyst for stimulating local interest in such a program. The Rhea County Planning Commission has been meeting regularly since then and, as a first step in fostering orderly development, has adopted subdivision regulations.

TVA will continue to work with local officials and organizations to minimize impacts on local schools, housing, etc. These expected impacts are discussed in detail in section 2.9.

There is no zoning which would affect the plant site.

1.4 Emergency Planning - TVA has developed a Radiological Emergency Plan (REP) which sets forth the policies, purposes, delegations, standards, guidelines, and, where feasible, specific instructions necessary for TVA to discharge its responsibilities during a radiological emerg[illegible] in order to comply with pertinent directives applicable to the protection of the health and safety of the public and TVA personnel, plants, and properties.

The REP consists of the basic document and annexes. The basic document contains program delegations and broad guides, which apply generally to all TVA nuclear operations. Annexes to the basic document will include detailed radiological emergency plans for each TVA nuclear plant. In addition, the annexes will contain a Radiological Emergency Medical Assistance Plan for dealing with employees who might be injured during an accident. A site radiological emergency plan will be prepared for the Watts Bar Nuclear Plant.

TVA is coordinating all aspects of the REP with the appropriate state agencies, such as the Departments of Public Health and Public Safety. The TVA Radiological Emergency Plan defines the details of authority and responsibility of all offsite agencies involved in an emergency situation. Responsibilities such as evacuation, housing, and feeding evacuees are defined so that the responsible agencies may take the initiative in expeditiously executing their phases of the plan. The standards and procedures used are consistent with regulatory programs of state and other Federal agencies. To ensure that their latest recommendations are considered, TVA maintains liaison with these agencies.

In developing the Radiological Emergency Plan, meetings have been held with the State Health Departments of Alabama, Georgia, South Carolina, and Tennessee to ensure workability of the plan and delegation of responsibility, authority, and emergency assignments. In addition, the State Health Department of Kentucky has been contacted and arrangements made for participation in the event of a transportation accident.

Each state through which radioactive material from a TVA plant is transported either has or will have a radiological assistance plan for use in the event of a transportation accident within its jurisdiction. These plans have been or will be obtained and incorporated in the REP as they are available. The plans will be completed prior to shipment of radioactive material from the facility.

Contacts have also been made with the appropriate Atomic Energy Commission Operations Offices to ensure that assistance can be obtained through the Interagency Radiological Assistance Plan, if necessary.

The Eastern Environmental Radiation Laboratory, EPA, has agreed to provide additional analytical laboratory services in the event of an accident if these services are not available within TVA.

Written agreement among participating state and Federal agencies and TVA will be obtained outlining each agency's responsibilities. The individual states' health department radiological assistance plan will be incorporated as an annex to the TVA Radiological Emergency Plan.

1. __Meetings with outside agencies__ - Representatives of TVA have met or will meet with representatives of the following states and agencies to discuss and plan for radiological emergencies which might result as a consequence of the operation of the Watts Bar Nuclear Plant.

(1) __State of Georgia__* - Department of Public Health.

(2) __State of South Carolina__* - Department of Public Health.

(3) __State of Tennessee__* Department of Public Health - October 12, 1971.

(4) __State of Kentucky__* - Department of Public Health.

(5) __State of Illinois__* - Department of Public Health.

(6) __Environmental Protection Agency__* - Eastern Environmental Radiation Laboratory - October 22, 1970, and June 9, 1971.

2. __Responsible agencies to be notified in case of accident__ - Appropriate TVA personnel receiving notice of a transportation accident shall notify the TVA load dispatcher who notifies the Central Emergency Control Center director who shall notify as appropriate key persons in the states involved, as well as the EPA and the AEC.

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* Previously consulted on radioactive material shipments from Browns Ferry Nuclear Plant.

2.0 __ENVIRONMENTAL [illegible] OF THE PROPOSED FACILITY__

The following discussion assesses the probable impact of the construction and operation of the facility on the environment.

Impacts have been evaluated considering the environment of the area as described in Section 1.1, __General Information__.

The sources of impacts discussed in sections 2.1 through 2.10 have been examined for their potential effects on land, water, and air uses, including industrial operations, transportation, farming, forestry, recreation, wildlife preserves, waterways, government reservations, and water supplies. No adverse impacts on these uses other than those identified in the following sections are anticipated, and no other loss of use of land, water, and air is expected to occur.

2.1 Transportation of Nuclear Fuel and Radioactive Wastes - About 100 tons of nuclear fuel will be shipped annually to and from the plant, and packaged radioactive waste totaling about 25 tons annually will be shipped from the plant to AEC-licensed disposal areas. These two types of radioactive materials will be shipped in accordance with applicable Federal and state regulations. Packaging and transport of radioactive materials are regulated at the Federal level by both the Atomic Energy Commission (AEC) and the Department of Transportation (DOT). In addition, certain aspects, such as limitations on gross weight of trucks, are regulated by the states.

The protection of the public from radiation during the shipment of nuclear fuel and radioactive waste depends upon the limitations on the contents, the package design, and the external radiation levels as well as the method, routing and safeguards to be followed in transport. These factors are discussed below in regard to the shipment of new fuel, spent fuel, and radioactive waste.

1. New fuel shipment - Fuel elements for the plant require an annual commitment of about 200 tons of natural uranium in the form of U_3O_8 for each reactor. However, some of this uranium may come from reprocessed spent fuel.

New fuel for the plant is made of slightly enriched uranium dioxide pellets which have been sintered and compacted to form very dense pellets having high strength and high melting points. The pellets are 0.3659 inch in diameter by 0.6 inch long and are stacked inside zircaloy tubing with a space left at the end of the tubing to provide for collection of gas generated during the fission

process. These tubes are welded shut at both ends, forming a fuel rod, and are subjected to rigorous quality control to ensure their integrity. Two hundred and four of these rods are included in a 15 x 15 array to form a fuel assembly. A more detailed description of the fuel assemblies is given in the safety analysis report which was filed in support of the construction permit application.[1]

TVA will apply for a special nuclear material license to provide for receipt, possession, and storage only of fuel elements before the initial core of the reactor is shipped to the plant. In addition, all fuel assemblies will be delivered to the TVA plant site in accordance with shipping procedures and arrangements authorized for use by the fuel fabricator under special nuclear material license in accordance with AEC regulations.[2] Fuel will be shipped in shipping containers which will have been demonstrated to assure criticality safety under both normal and accident conditions.

(1) Method and frequency of shipment - Westinghouse is the fabricator of the unit 1 initial core fuel assemblies and is responsible for shipment of these fuel assemblies to the reactor site. Westinghouse presently has fuel fabrication plants at Cheswick, Pennsylvania, and Columbia, South Carolina. Although this fuel can be shipped by either truck, barge, or rail, it will most likely be shipped by truck trailers from the Columbia, South Carolina, fabrication plant in quantities up to seven shipping containers per load, each containing two fuel assemblies, thereby providing a maximum of 14 fuel assemblies per truck shipment. About 10 such shipments by truck will be received at the plant annually (about 14 shipments in the initial core for each unit).

(a) Shipping routes - It is assumed that Westinghouse Electric Corporation will ship the initial core fuel assemblies by truck from its fabrication plant in Columbia, South Carolina, to the plant. The major population centers encountered over an assumed 32[illegible]-mile route include the following:

City	1970 Population	Density Persons/mile²
1. Columbia, SC--by way of I-26 to	113,542	6,343
2. Spartanburg, SC--by way of I-26 to	44,546	2,837
3. Asheville, NC--by way of I-40 to	57,681	2,658
4. Knoxville, TN--by way of I-40 to	174,587	2,267
5. Harriman, TN--by way of U.S. 27 and State 68 to	8,734	4,159
6. Watts Bar Plant Site	---	---

As indicated, interstate highways along with primary roads are assumed to be used to the maximum extent possible for the shipment of nuclear fuel and radioactive wastes. Alternate parallel routes will be used whenever necessary because of temporary construction or closure of highway segments.

(b) Shipment activity - Relatively low levels of radiation are emitted from unirradiated new fuel assemblies. Because the type of radiation emitted by uranium is reduced by thin layers of metal and self-shielding reduces the cumulative effect, no additional gamma or beta shielding is required in shipping packages for new fuel. The new fuel properties are given below:

- No radioactive fission products.
- No radioactive gases.
- High melting point.
- Insoluble solid.
- Zircaloy clad.
- In the clad form, the fuel assemblies will not disruptively react or decompose under expected or postulated thermal conditions.

(2) Environmental effects - The population exposure resulting from the normal shipment of radioactive material has been evaluated for the people who reside on either side of the transport route as shown on figure A-1 of Appendix A of this document. The radiation dose as a function of distance from a stationary shipping container is shown in figure A-2 of Appendix A. In order to assess the environmental effects of radioactive material shipments, it is assumed that they are made at the regulatory radiation level limit of 10 mrem/h at 6 feet from the nearest surface. The actual dose rate will be below the indicated values. As shown, the radiation exposure rate drops off quite rapidly, and at 240 feet from the container the exposure rate to a resident living at this point is approximately equal to natural background. Because the container will be normally moving, the total exposure from the containers to such an individual will be an insignificant fraction of the exposure from natural background radiation.

(a) Normal shipments - The only exposure to people from the routine shipment of new fuel is for the brief period such a shipment is in direct view and to the individual truck drivers so assigned, because of the estimated low dose rates at the time of shipment (<0.1 mrem/h at 6 feet from the cluster of containers). For example, a member of the general public who spends 3 minutes at an average distance of 6 feet from the container would receive a dose not exceeding 0.005 mrem. If 10 persons were so exposed per shipment, the total annual dose for the 10 shipments of new fuel would be about 0.0005 man-rem.

Based on an estimated radiation level in the cab of the truck of <0.1 mrem/h, exposure to transportation personnel is estimated to be less than 1 mrem per shipment. A total dose to all drivers for a given year, assuming two drivers per vehicle, would not exceed 0.02 man-rem.

It is concluded that there are no environmental risks from radiation associated with the normal shipment of new fuel.

(b) Accident occurrences - The damage which might result from a transportation accident equivalent to that specified in 10 CFR Part 71 would consist of the physical damage of the impact and the interference associated with having to send the fuel back to the fabricator for inspection and a determination of whether there had been damage of such significance that it would affect the subsequent operation of the fuel in the reactor. There would be no release of radioactive materials and no increase in radiation dose

rates over those from normal shipment. Thus, it is concluded that there would be no significant environmental risks from radiation resulting from an accident involving a shipment of new fuel.

2. Spent fuel shipment - The spent fuel removed from the two reactors during the annual refuelings contains on a weight basis in excess of 99.99 percent of the fission products formed inside the fuel and is temporarily stored in the spent fuel pool at the plant. The water in the pool serves as a radiation shield and coolant while the short-lived fission products decay. At the end of this storage period of about 3 to 4 months, the spent fuel is loaded into ruggedly built shielded containers for shipments to a fuel reprocessing plant where the spent fuel is chemically reprocessed to recover its unused fuel content, uranium and plutonium, for future use. It is possible to ship spent fuel by rail, truck, or barge.

(1) Method and frequency of shipment - All the equipment and services for spent fuel transportation and reprocessings are to be provided to TVA by contract. This includes transport vehicles, special shielded containers, services associated with container loading, and all transport arrangements. Even though TVA contracts these services, it will specify the scope, terms, scheduling, transportation, and reporting of shipments as appropriate and in accordance with AEC and Department of Transportation regulations. Presently, there are fuel reprocessing plants in operation or under construction in Morris, Illinois; West Valley, New York; and Barnwell, South Carolina.

There is a considerable diversity of shipping methods possible for irradiated fuel. These range from truck shipments with cask capacities from 0.4 to 1.2 metric tons of uranium to rail shipments with cask capacities from 3.2 to 5.0 metric tons of uranium at a time. Water transportation also has the potential to move 5 metric tons of uranium at a time and in special cases may be used as a link to the nearest available railroad.

Truck shipment of spent fuel from Watts Bar would involve about 130 legal weight shipments (73,280 pounds) over a period of about 4 to 6 months each year, or about 65 shipments if a 90,000-pound limit is permitted.

Rail shipments originating from the plant would require about 13 shipments annually. The shipments would be in a special rail cask holding ten fuel assemblies. Fuel assemblies which have identified clad perforations will be placed in a special container as necessary before being loaded into the spent fuel cask.

Since it will not be necessary to ship spent fuel from Watts Bar to a reprocessing plant until approximately 1978, TVA has not entered at this time into a contract for shipment of spent fuel from this plant. Even though the exact mode of transportation and other details related to spent fuel shipments have not yet been defined, rail shipments are assumed for purposes of routing and estimating the environmental effects.

(a) Shipping routes - It is assumed that the spent fuel from Watts Bar would be shipped about 325

miles by rail to the closest fuel reprocessing plant which is at Barnwell, South Carolina. The major population centers encountered over an assumed route are:

City	1970 Population	Density Persons/mile^2
1. Watts Bar Site--by way of CNO&TP and Sou to	---	---
2. Knoxville, TN--by way of Sou to	174,587	2,267
3. Asheville, NC--by way of Sou to	57,681	2,658
4. Spartanburg, SC--by way of SCL to	44,546	2,837
5. Greenwood, SC--by way of GA and FL and Sou to	21,069	2,926
6. Barnwell, SC (AGNS site)	4,439	562

(b) Shipment activity - Fuel elements which are removed from the reactor will be essentially unchanged in appearance. However, they contain a fraction of the original useful uranium fuel and plutonium which are recoverable and an accumulation of fission products. This irradiated spent fuel is subsequently shipped to a reprocessing plant for recovery of its unused fuel content for future use.

The inventory of fission product activity and decay heat of spent fuel at the time of shipment is given in Table 2.1-1. However, it should be noted that effectively all of this contained radioactivity, except for about 30 percent of the noble gases and about 3 percent of the iodines, is tightly bound within the insoluble, high-melting-point uranium dioxide pellets. Therefore, even if the shipping cask should be breached in an accident and the clad fuel were to be breached, there is still no ready mechanism for dispersing any substantial fraction of the total contained radioactivity.

(2) Environmental effects - Prior to shipment, the fuel will be allowed to decay a minimum of about 3 to 4 months with the result that essentially all noble gases with the exception of krypton-85 will be virtually gone and the iodine-131 will have decayed to very low levels. Further, the decay heat which has been generated by the fuel during reactor irradiation will have decreased. Of the iodine isotopes, only iodine-131 is present in significant amounts. Fission products other than noble gases and iodine are strongly held within the uranium dioxide fuel pellets. Hence, only noble gases and iodine would escape through a penetration in fuel clad to the shipping cask cavity. Fuel rods known to have ruptured cladding prior to shipment will be sealed in a container for ruptured fuel rods.

(a) Normal shipment - The principal normal environmental factor from spent fuel shipments would be the direct radiation dose as they move from the reactor to the reprocessing plant. The population exposure resulting from normal shipments of radioactive materials has been evaluated on the basis that there would be about 32,500 people living in an area between 100 feet and 1/2 mile on both sides of the transport route along the estimated 325-mile route. It has also been assumed that the shipments are made at the maximum permitted level of 10 mrem/h at 6 feet from the nearest accessible surface. Figure A-1 of Appendix A shows the location of the shipping container relative to people living adjacent to the

transport route that was used to calculate the radiation exposures. The calculation does not include reductions of exposures due to shielding from structures, topographic features, or other radiation-attenuating materials.

For the estimated 13 shipments per year, each moving at only 20 mi/h, the maximum exposure received by any individual along the route would be about 0.0038 mrem per year. The average exposure for these 13 shipments to an individual living along the transport route would be about 0.0002 mrem per year. On the basis that there would be a total of about 32,500 people living within 1/2 mile on either side of the transport route between Watts Bar and the fuel reprocessing plant at Barnwell, South Carolina, these people would receive an annual dose of about 0.007 man-rem per year. Train brakemen or a member of the general public might spend a few minutes in the vicinity of the car, at an average distance of 6 feet, for an average exposure of about 0.5 mrem per shipment. With 10 different brakemen and 10 members of the general public so involved along the route, the total dose for 13 shipments during the year is estimated to be about 0.13 man-rem.

Since the exposure to the 32,500 people who reside along the route and to a person who might come within 6 feet of the railcar for a short period is only 0.0001 and 0.4 percent respectively of the exposure these same people receive from natural background radiation it is concluded that no adverse environmental effects will result from the normal transportation of spent fuel from Watts Bar to the fuel reprocessing plant.

(b) Accident occurrences - The principal potential environmental effects from an accident are those from direct radiation resulting from increased radiation levels, from gaseous release of noble gases and iodine, and from release of contaminated coolant.

Evaluation of exposure from direct radiation assumes that the radiation exposure rate is the maximum permitted by regulations, 1,000 mrem/h at 3 feet from the surface of the container, and that people have surrounded the container beginning at about 50 feet from the container. Figure A-3 of Appendix A shows the exposure rate for accident conditions as a function of distance from the container. The exposure rate at 50 feet would be about 17 mrem/h. Assuming a tightly packed crowd, there would be 154 people and these people would provide shielding such that people in subsequent rows would receive greatly reduced radiation exposure. If a person remained in the front row for 2 hours, his exposure would be about 34 mrem. Further, the increased radiation level would most likely be from only a localized area on the container, and thus only a small number of people in the front row of a crowd would be exposed to these low radiation levels.

Calculations for a probable shipping container indicate that there would be no gaseous releases without a substantial quantity of decay heat in the shipping container plus the addition of external heat such as from a fire. Thus, it is assumed that the thermal currents surrounding the container fission gases carry any released fission gases to a height of 10 meters before they

are dispersed in the environment. Assuming a person stands in the plume during the entire accident, the resulting whole body dose would be about 2 mrem, the skin dose would be about 86 mrem, and the thyroid dose would be about 5 rem. For the noble gas release, assuming an average population density of 100 people per square mile, the total whole-body population dose from the accident would be 0.07 man-rem. TVA considers the average population to be a realistic number for analyzing transportation accidents because of the small fraction of the total distance travelled in high population density areas and because accidents in such areas generally occur at lower speeds and therefore would be less severe.

The contaminated coolant is basically low specific activity material. In the event the coolant were drained from the container in an accident, the emergency plans restricting access to the localized area of the accident and preventing a radiation hazard to the public and the environment would be initiated.

The principal environmental risk resulting from an accident would be the potential whole-body radiation exposure due to the release of noble gases and from direct radiation and potential thyroid dose due to the release of iodine. Because of the dose reduction with distance and the mitigating effect of proposed emergency actions, it can be concluded that the whole-body radiation exposure to the public will be negligible. Because of the unlikely combination of circumstances which must be present to result in a significant dose due to the release of iodine, the probability of significant doses due to this occurrence is considered extremely small.

2. Radioactive waste shipment - The radioactive wastes to be shipped for disposal can be classified as concentrates from the waste evaporators, spent demineralizer resins, miscellaneous dry solid wastes, irradiated or contaminated equipment components, and tritiated water.

The radwaste packaging facility at Watts Bar is equipped to use standard DOT17H[3] drums. The waste evaporator bottoms and spent demineralizer resins will be solidified by a cement-vermiculite process before shipment to a disposal site regulated by AEC and the state.

(1) Method and frequency of shipment - Waste evaporator concentrates and spent demineralizer resins are collected in the plant and may be stored for decay of short-lived isotopes. After about 60 to 120 days' decay, the only significant radioactive isotopes present are long-lived corrosion products such as cobalt-60.

Based on the estimated quantities and activities, there will be about 15 shipments of the waste evaporator concentrates and 10 shipments of the spent demineralizer resins each year in approved containers. Waste evaporator concentrates are drummed and placed in an approved all-steel container for shipment to an AEC-licensed

disposal areas. The resins may be shipped in specially constructed lead-steel containers similar to the LL-60-150 cask to be used for shipping the higher activity radioactive material from the Browns Ferry Nuclear Plant. Special high strength trailers will be used to transport the LL-60-150 cask and the all-steel container to offsite burial grounds. The casks will be decontaminated if necessary at the disposal area and returned to the plant.

Appropriately packaged compressible wastes will probably be shipped to the disposal area on flatbed trucks. Packages exceeding the regulatory limits permitted will be placed inside containers which will provide shielding. There will be approximately five to ten shipments per year from the plant.

Radioactive equipment components will have a low volume and no shipments are expected during the first years of operation. They will be stored in the spent fuel pit until a sufficient amount is accumulated for a shipment.

Tritiated water will be shipped in tank trucks licensed for low specific activity liquids. Beginning between 7 to 12 years after initial operation, about 50,000 gallons of tritiated water may have to be disposed of annually which would require use of about 13 tank trucks with each containing about 35 Ci of tritium.

(a) Shipping routes - It is assumed that radwaste shipments from Watts Bar would be by truck about 300 miles to the closest AEC-approved disposal area at Morehead, Kentucky. The nearest major population centers encountered along an assumed route are: