4.0 ALTERNATIVES

This environmental statement considers the ways in which the plant will interact with the environment by reevaluating the environmental consequences considered earlier and by studying and adopting appropriate alternatives that would minimize any further adverse environmental consequences that would affect the overall balance of environmental costs and benefits. Analyses of alternative systems are described in sections 2.1 through 2.9. Alternative methods of generation and alternative plant sites are discussed in detail in sections 4.1 and 4.2, respectively.

4.1 Alternative Generation - Evaluations of alternative generating types and award of contracts were made prior to the enactment of the National Environmental Policy Act. This section discusses the alternatives considered.

1. Electric power purchases - The purchase of electric power in lieu of constructing the Sequoyah Nuclear Plant is not a feasible alternative. To supply equivalent amounts of power and energy on a year-round basis to TVA, another large electric utility with extensive transmission interconnections would have to install generating capacity in amounts slightly greater than that of the Sequoyah Nuclear Plant, build several high capacity transmission lines to the TVA area, and transmit the power to TVA. To construct such facilities on another power system would not avoid an impact on the environment, but would only create an environmental impact in another area. Even if the assumption is made that the plant locational factors and costs would be equal, the cost of transmission lines, the transmission line losses, the use of land for transmission line rights of way, and the exposure to transmission line outages would result in waste of natural resources, materials, and funds, and would provide a more costly and less reliable source of power for the TVA region than the Sequoyah plant.

2. Other generation alternatives - Planning for this capacity required that considerations be given to maintaining a practical mix of hydro, pumped-storage hydro, gas turbine, coal-fired, and nuclear generating units.

Hydroelectric units were eliminated as an alternative

because there are no hydroelectric sites in the TVA service area suitable for base-load hydroelectric generation in the amount required to serve the capacity and energy demands of this time period.

Studies of the system load characteristics and the characteristics of the existing generating facilities indicated that system power needs would best be met by base-load fossil-fired units or nuclear-fueled units.

Base-load plants with generating capacity of the magnitude of Sequoyah but fueled with natural gas or low-sulfur residual fuel oil were eliminated as feasible alternatives because of the unavailability of these fossil fuels for power plants of this size.

The remaining feasible alternative types of generation--coal-fired units and nuclear-fueled units--were evaluated considering such factors as the plant investment and fuel operating costs estimated for both alternatives.

The following table summarizes the results of this economic comparison made in 1968.

	Coal-Fired Plant	Nuclear-Fueled Plant
Plant Investment - $/kW	132.0	143.0
Levelized Fuel Cost - ¢/10^6 Btu	20.3	13.3
Net Plant Heat Rate - Btu/kWh	8,897	10,259
Estimated Annual Production Expense[a] - Mills/kWh		
Plant Investment	1.08	1.17
O&M Cost	2.00	1.56[b]
Total	3.08	2.73
Difference	0.35	Base

a. Based on 11-year present-worth evaluation at 5 percent interest.
b. Includes estimated cost of nuclear insurance.

The 0.35 mills/kWh advantage of the indicated nuclear alternative estimated in 1968 had an annual cost saving of about $6 million over the coal-fired alternative. Subsequent comparisons of nuclear and coal-fired alternatives have shown a significant economic and environmental advantage of nuclear power due principally to the rapid escalation of coal prices and increased plant investment that would be required to attempt to meet applicable air quality standards on coal-fired plants. Due to these factors and consideration of the current development and construction of the Sequoyah Nuclear Plant, it is not practicable to reassess and choose another type of alternative capacity.

4.2 Alternative Sites - Site preparation for construction of the Sequoyah Nuclear Plant was initiated prior to the enactment of the National Environmental Policy Act. TVA did, however, consider alternative sites, and the major considerations are described here.

Early in the development of the Sequoyah project analysis of the load and supply situation expected on the TVA system in the 1973 and 1974 time period indicated the need for locating generating capacity in the eastern portion of the system. Based on information available at that time three candidate sites in the eastern portion of TVA's system appeared to be suitable for the location of the nuclear plant scheduled for operation in this time period. These were:

Yellow Creek* - TRM 528 - Located on the right bank of the Tennessee River just below Watts Bar Dam.

Blythe Ferry - TRM 499 - Located on the left bank of the Tennessee River immediately downstream from the confluence of the Tennessee and Hiwassee Rivers.

Sequoyah - TRM 484.5 - Located on the right bank of the Tennessee River 13 miles upstream from Chickamauga Dam.

The pertinent features of each site entering into the site selection were:

1. Access -

   a. Yellow Creek - Since this site is located adjacent to the Watts Bar Steam Plant, only minimal extension of existing rail and highway access facilities was anticipated.

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*Subsequent to the site evaluation on Sequoyah this site became the location for the Watts Bar Nuclear Plant.

b. Sequoyah - Approximately 6 miles of railroad and 6 miles of highway construction were anticipated.

c. Blythe Ferry - Approximately 16 miles of railroad and 22 miles of highway would have to be provided at this site.

2. Land Requirements and Ownership -

a. Yellow Creek - About 300 acres of property not in TVA ownership would have to be acquired.

b. Blythe Ferry - About 250 acres of privately owned property would have been purchased.

c. Sequoyah - TVA owned all required property at this site.

3. Population (Based on 1960 census) -

a. Yellow Creek - Nearest town is Spring City, Tennessee, with a population of 1,800 and is located about 7 miles away. The population within a 5-mile radius is 1,600; 10-mile radius - 11,000.

b. Blythe Ferry - Nearest town is Dayton, Tennessee, with a population of 3,500 and is about 5 miles away. The population within a 5-mile radius is 3,800; 10-mile radius - 15,500.

c. Sequoyah - Nearest town is Soddy, Tennessee, with a population of 2,206 and is about 6 miles away. The population within a 5-mile radius is 8,000; 10-mile radius - 28,000.

4. Foundation Conditions -

   a. Yellow Creek - Core drilling conducted in 1950 showed that this site had rock suitable for foundations for the major structures.

   b. Blythe Ferry - Although the site had not been core drilled at the time, geologic indications showed that the rock present would not offer foundation conditions as favorable as those at the other sites.

   c. Sequoyah - Core drilling at the site indicated that rock was suitable for the major structures.

5. Cooling Water - At the time of the Sequoyah site evaluation, the thermal standards were not as restrictive as today's standards. Consequently, the major siting consideration relating to the availability of cooling water was the necessity of installing auxiliary cooling facilities. This consideration was reflected in the economic considerations associated with each site.

   a. Yellow Creek - Due to its close proximity to the Watts Bar Dam, the quantity of water flowing past the site would be primarily dependent on the operation of the hydraulic turbines at the Watts Bar Hydro Plant. After assessment of this operation, it was concluded that auxiliary cooling would be required.

   b. Blythe Ferry - Relatively large quantities of water are available at this site making it suitable for utilizing a diffuser pipe system.

c. Sequoyah - The available flow past Sequoyah is higher than at Blythe Ferry so the diffuser system was also applicable to this site.

6. Seismology - All three sites reside in the Southern Appalachian Tectonic Province and no significant difference in seismology was anticipated.

7. Meteorology - Meteorological conditions were judged to be generally similar at each of the sites as indicated by records at Chattanooga, Oak Ridge, Kingston, and Knoxville.

8. Transmission Interconnections - Due to the potential for the Sequoyah site as a substation, the Bull Run-Widows Creek 500-kV line had been routed through the Sequoyah site. The Widows Creek-Charleston 161-kV line also passed through this site. Because of the close proximity of these lines the required transmission interconnections for this site was expected to be minimal in comparison to Blythe Ferry and Yellow Creek where 500- and 161-kV transmission lines would have to be constructed.

9. Economic Considerations - An economic assessment of the alternative sites was made comparing plant investment, which included land requirements, access, site preparation, condenser cooling water facilities, and switchyard costs; transmission investments; and heat rate and capacity differences due to condenser water conditions. A summary of the principal cost differences are shown in the following table.

PRINCIPAL COST DIFFERENCES OF ALTERNATIVE SITES

	Sequoyah	Blythe Ferry	Yellow Creek
Plant Investment	Base	$6,700,000	$16,700,000
Transmission	Base	4,000,000	4,000,000
Heat Rate and Capacity Evaluation	Base	600,000	4,000,000
Total	Base	$11,300,000	$25,400,000

Since the Sequoyah site appeared to be suitable from the standpoint of physical and environmental site characteristics and offered substantial economic advantages over the other two candidate sites, it was chosen as the location for this capacity addition to the TVA system.

It is impractical to reassess alternative sites at this stage of development and construction of the Sequoyah Nuclear Plant.

5.0 SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

CEQ Guidelines call for a discussion of the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.

Construction and operation of the facility will result in short-term uses of the environment as described in the foregoing environmental considerations. The adverse effects of these short-term uses will be minimal and should have no long-term impacts on the environment. The cumulative effect of the plant will be the further localized shift of land usage to meet the demand for power.

Most of the short-term uses of the site itself will result in no significant effect on the long-term productivity of the land affected. Construction will be carried out in such a manner as to prevent significant land erosion and other effects which would have an impact on long-term productivity. After completion of construction, only that portion of the site occupied by the reactor system buildings will be affected for a period much longer than the useful life of the plant.

During the operation of the plant, local short-term uses will include the use of adjacent land for electrical transmission line rights of way and the use of Chickamauga Reservoir for the dissipation of waste heat and minor amounts of liquid radioactive effluents and chemical discharges. Transmission lines should not adversely affect long-term productivity. Thermal discharges will comply with thermal standards established by the State of Tennessee. These discharges should result in only a minimal short-term impact

on Chickamauga Reservoir and the long-term productivity of the reservoir should not be affected. The radioactive effluents will be small fractions of the limits established in 10 CFR 20. Chemical discharges will be negligible. Neither radioactive nor chemical discharges will hamper other short-term uses or alter the long-term productivity of the environment.

Environment monitoring programs will include the sampling and analysis of the air, water, aquatic life, and food web near the facility. This will provide a baseline inventory for detecting and evaluating any specific parameters of environmental impacts which might lead to long-term effects, in order that timely corrective action can be taken if required.

The construction and operation of the Sequoyah Nuclear Plant will be carried out in such a manner as to minimize adverse environmental impacts in order to pass on to future generations an environment with its potential productivity essentially unimpaired.

6.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The CEQ Guidelines call for a discussion of any irreversible and irretrievable commitments of resources which would be involved in the construction and operation of the facility. This requires identifying the extent to which this action irreversibly curtails the range of potential uses of the environment.

The construction and operation of the plant will involve the use of a certain amount of air, water, and land. Except for the site itself, the range of potential uses of the environment will not be curtailed, and while the site will continue to be dedicated to power production for the foreseeable future, this commitment is not irreversible. With the possible exception of the land occupied by the reactor system buildings, the site could be reclaimed and diverted to other uses.

The annual requirement for natural uranium for each reactor is approximately 200 tons of U_3O_8. About 700 kilograms per year of U^{235} and about an equal amount of U^{238} will be consumed by each unit. Some of the uranium can ultimately be recycled for other uses. A small quantity of fuel oil will be required for the operation of auxiliary boilers and testing diesel generators. To the extent that these fuels are consumed and not subject to being recycled to other uses, it will be an irreversible and irretrievable commitment of resources. In addition to these resources, some byproducts which result from the operation of the plant must also be considered irreversible and irretrievable commitments of resources. These include damaged components which are radioactive, solid radwaste materials, and

various chemicals which are used in the plant processes. Chemicals thus used will be widely dispersed to the environment, and reclamation of these chemicals after discharge from the plant is impractical.

Construction committed 48 areas of aquatic habitat for the life of the plant. The annual production of aquatic life lost during construction of the embayment and lost through the preemption of habitat is irretrievably committed. However, the biota lost represent a small portion of the available resource present in the reservoir.

Terrestrial communities have been displaced by permanent structures on and off the site. The final disposition of the decommissioned plant has not been determined; therefore, the habitat committed, as well as the annual production foregone, should be considered irretrievably committed.

The erection and maintenance of electrical transmission lines will preclude the production of certain forest products during the life of the transmission lines. Those products which could have been produced during the life of the lines must be considered to be irretrievably committed. However, the production of alternative products in these areas is possible and the land itself will not be irreversibly and irretrievably committed.

Since the ultimate disposition of the plant buildings and equipment has not been determined, it must be assumed that both land and construction materials will be irreversibly committed. It is unlikely, however, that more than the equipment and land directly in and beneath the reactor building will be ultimately irreversibly and irretrievably committed.

7.0 AGENCY REVIEW COMMENTS

Responses to agency review comments received on the draft environmental statement are included in the topical discussions of this final environmental statement. The numbers noted in the margins of the agency comments indicate the sections of this statement in which the questions are answered.

Comments were received from the following agencies:

Atomic Energy Commission
Environmental Protection Agency
Federal Power Commission
Department of Agriculture
Department of Commerce
Department of Defense
Department of Health, Education and Welfare
Department of the Interior
Department of Transportation
Office of Urban and Federal Affairs, State of Tennessee
  Tennessee Game and Fish Commission
  Tennessee Department of Public Health
  Tennessee Historical Commission
Chattanooga-Hamilton County Regional Planning Commission

In addition to agency review of the draft environmental statement, AEC has reviewed and commented on the proposed final environmental statement pursuant to the TVA-AEC lead agency agreement which provides for consultation between TVA and AEC in the preparation of this environmental statement. Their comments and TVA's responses are included in section 7.12.

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

JUL 3 1972

Docket Nos. 50-327
and 50-328

Dr. Francis Gartrell
Director of Environmental
Research and Development
Tennessee Valley Authority
720 Edney Building
Chattanooga, Tennessee 37401

Dear Dr. Gartrell:

This is in response to Mr. James E. Watson's letter transmitting the Draft Environmental Statement for Sequoyah Nuclear Plant, Units 1 and 2. We have reviewed the Draft Environmental Statement in accordance with the requirements placed on Federal agencies by the National Environmental Policy Act of 1969.

Enclosure 1 contains our comments on the radiological aspects of normal plant operation. While we agree with your conclusion that "...Sequoyah Nuclear Plant will operate within all applicable regulations and with a minimum of risk to the health and safety of the public...", we believe that many of the suggested changes will strengthen the environmental statement.

Enclosure 2 contains our analysis of the environmental impact of postulated accidents. This enclosure is based upon our calculational models and is consistent with the proposed amendment to Appendix D to 10 CFR Part 50, December 1, 1971.

Enclosure 3 contains our comments on other environmental impacts considered in the Draft Environmental Statement.

If you desire additional information, please contact Daniel R. Muller, Assistant Director for Environmental Projects (area code 301, 973-7261).

Sincerely,

A. Giambusso, Deputy Director
for Reactor Projects
Directorate of Licensing

Enclosures:
1. Comments on Radiological Impact of Plant Operation
2. Environ. Impact of Postulated Accidents
3. Comments on Other Environmental Impacts

SEQUOYAH DRAFT ENVIRONMENTAL STATEMENT
COMMENTS ON RADIOLOGICAL IMPACT OF PLANT OPERATION

A. Section 5.6.3, Monitoring Programs

1. Atmospheric monitoring (pp. 5-51 and 5-52): The bases for selecting the locations of the 12 monitoring stations should be given. 2.4.3

2. Terrestrial monitoring (p. 5-52): The bases (other than permitting a correlation between sample types) for selecting the locations of the terrestrial monitoring stations (apparently 8 stations within 10 miles - Figure 22) should also be given. Table 2.4-6 Some mention should be made of sampling techniques to be used (especially for soil samples). The term "vegetation" should be defined, e.g., does it include food crops? (A representative sampling of such crops should be included in the program.)

3. Water supplies (p. 5-59): The number of locations appears adequate; however, the sampling frequencies (monthly and quarterly) do not. A composite sample (especially at Chattanooga) would be more apt to respond to abnormal concentrations, which might be missed by the monthly or quarterly sample (assumed to be a "grab" or "spot" sample). 2.4.3

B. Section 5.7, Radioactive Discharges 2.4.1 (1)

1. P. 5-62: "Liquid wastes...will be discharged from the plant or packaged...." The criteria used to decide whether to discharge or ship offsite should be given.

2. P. 5-63: "If above the predetermined limits, the liquids will be processed before being released." The referenced limits should be defined. 2.4.1 (1)

3. P. 5-85 (Item B): Insufficient meteorological data have been supplied to permit a calculation of an individual's dose from gaseous effluents. 1.2.5

4. P. 5-85 (Item D): Insufficient meteorological and population data have been supplied to permit a calculation of population doses from gaseous effluents. Appendix I

5. P. 5-85 (General): It should be specified whether the calculated doses are for the total body or specific organs. Thyroid doses should be included in this table as soon as the iodine release rates (Table 21) have been estimated. Radiation doses to the offsite population due to direct gamma radiation from turbines, radwaste vessels, etc., should be included in this table (this pathway should perhaps be included in the discussion on p. 5-81). Table 2.4-10 Appendice I & K

C. Tables and Figures

1. Table 17: The charcoal filter should be analyzed weekly, rather than biweekly, for I-131. Rain water samples should also be analyzed for H-3 on a monthly basis. The distinction between semi-annual and monthly samples of vegetation is not clear. Milk samples should be analyzed weekly for I-131. In the footnote to this table, the term "biologically significant" should be defined. Table 2.4-6

2. Figures 8, 11, and 12: Population distributions should be given for a 50-mile radius, in addition to the data presented. 1.2.7(6)

3. Figure 22: The legend should be amended to show which stations are atmospheric, terrestrial, or both. Also, some indicator of direction (e.g., an arrow pointing north) would be helpful in this figure. Figure 2.4-9

SEQUOYAH DRAFT ENVIRONMENTAL STATEMENT
ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

2.3

A high degree of protection against the occurrence of postulated accidents in the Sequoyah Nuclear Plant is provided through correct design, manufacture, and operation, and the quality assurance program used to establish the necessary high integrity of the reactor system, as considered in the Commission's Safety Evaluation dated March 24, 1970. Deviations that may occur are handled by protective systems to place and hold the plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, in spite of the fact that they are extremely unlikely; and engineered safety features are installed to mitigate the consequences of these postulated events.

The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental effects standpoint have been analyzed using best estimates of probabilities and realistic fission product release and transport assumptions. For site evaluation in the Commission's safety review, extremely conservative assumptions were used for the purpose of comparing calculated doses resulting from a hypothetical release of fission products from the fuel against the 10 CFR Part 100 siting guidelines. The computed doses that would be received by the population and environment from actual accidents would be significantly less than those presented in the Safety Evaluation.

The Commission issued guidance to applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state of knowledge permits. The applicant's response was contained in the "Sequoyah Nuclear Plant Units 1 and 2 Environmental Statement - Draft," dated October 19, 1971.

The applicant's statement has been evaluated, using the standard accident assumptions and guidance issued as a proposed amendment to Appendix D of 10 CFR Part 50 by the Commission on December 1, 1971. Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious were identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a low occurrence rate, and those on the low potential consequence end have a higher occurrence rate. The examples selected by the applicant are presented in Table I and are reasonably homogeneous in terms of probability within each class. Certain assumptions made by the applicant do not exactly agree with those in the proposed Annex to Appendix D, but the

use of alternative assumptions does not significantly affect overall environmental risks.

Commission estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using the assumptions in the proposed Annex to Appendix D, are presented in Table II. Estimates of the integrated exposure that might be delivered to the population within 50 miles of the site are also presented in Table II. The man-rem estimate was based on the projected population around the site for the year 2000. (The projected population was based on 1960 census data.)

To rigorously establish a realistic annual risk, the calculated doses in Table II would have to be multiplied by estimated probabilities. The events in Classes 1 and 2 represent occurrences which are anticipated during plant operation and their consequences, which are very small, are considered within the framework of routine effluents from the plant. Except for a limited amount of fuel failures and some steam generator leakage, the events in Classes 3 through 5 are not anticipated during plant operation but events of this type could occur sometime during the 40-year plant lifetime. Accidents in Classes 6 and 7 and small accidents in Class 8 are of similar or lower probability than accidents in Classes 3 through 5 but are still possible. The probability of occurrence of large Class 8 accidents is very small. Therefore, when the consequences indicated in Table II are weighted by probabilities, the environmental risk is very low. The postulated occurrences in Class 9 involve sequences of successive failures more severe than those required to be considered in the design basis of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture, and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently small in probability that the environmental risk is extremely low.

Table II indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary to concentrations of radioactive materials within the Maximum Permissible Concentrations (MPC) of Table II of 10 CFR Part 20. The table also shows that the estimated integrated exposure of the population within 50 miles of the plant from each postulated accident would be orders of magnitude smaller than that from

naturally occurring radioactivity, which corresponds to approximately 165,000 man-rem/yr based on a natural background level of 140 mrem/yr. When considered with the probability of occurrence, the annual potential radiation exposure of the population from all postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the realistic analysis that the environmental risks due to postulated radiological accidents are exceedingly small.

TABLE I

CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

Classes	AEC Description	Applicant's Example(s)
1	Trivial incidents	Not considered
2	Miscellaneous small releases outside containment	Volume control tank leak, minor liquid leakage of primary coolant from CVCS
3	Radwaste system failures	Major leak in gas waste holdup tank
4	Events that release radioactivity into the primary system (BWR)	Anomalous fuel failures during normal plant operation
5	Events that release radioactivity into primary and secondary system (PWR)	Cladding failures and steam generator leak
6	Refueling accidents inside containment	Dropped spent fuel assembly in refueling canal
7	Accidents to spent fuel outside containment	Dropped spent fuel assembly to the storage pit floor
8	Accidents initiation events considered in design-basis evaluation in the Safety Analysis Report	Steamline rupture accident, steam generator tube rupture, loss-of-coolant accident, rod ejection accident, partial loss of flow
9	Hypothetical sequences of failures more severe than Class 8	Not considered

TABLE II

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS

Class	Event	Estimated Fraction of 10 CFR Part 20 at Site Boundary 1/	Estimated Dose to Population in 50-Mile Radius, man-rem
1.0	Trivial incidents	2/	2/
2.0	Small releases outside containment	2/	2/
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	0.077	4.5
3.2	Release of waste gas storage tank contents	0.31	18
3.3	Release of liquid waste storage tank contents	0.008	0.5
4.0	Fission products to primary system (BWR)	N.A.	N.A.
5.0	Fission products to primary and secondary system (PWR)		
5.1	Fuel cladding defects and steam generator leaks	2/	2/
5.2	Off-design transients that induce fuel failure above those expected and steam generator leak	0.002	0.10
5.3	Steam generator tube rupture	0.10	6.0
6.0	Refueling accidents		

Class	Event	Estimated Fraction of 10 CFR Part 20 at Site Boundary 1/	Estimated Dose to Population in 50-Mile Radius, man-rem
6.1	Fuel bundle drop	0.016	0.94
6.2	Heavy object drop onto fuel in core	0.28	16
7.0	Spent fuel handling accident		
7.1	Fuel assembly drop in fuel storage pool	0.01	0.60
7.2	Heavy object drop onto fuel rack	0.04	2.4
7.3	Fuel cask drop	N.A.	N.A.
8.0	Accident initiation events considered in design basis evaluation in the Safety Analysis Report		
8.1	Loss-of-coolant accidents		
	Small break	0.17	18
	Large break	0.19	41
8.1(a)	Break in instrument line from primary system that penetrates the containment	N.A.	N.A.
8.2(a)	Rod ejection accident (PWR)	0.019	4.1
8.2(b)	Rod drop accident (BWR)	N.A.	N.A.
8.3(a)	Steamline breaks (PWR's outside containment)		
	Small break	<0.001	<0.1
	Large break	<0.001	<0.1
8.3(b)	Steamline breaks (BWR)	N.A.	N.A.

1/ Represents the calculated fraction of a whole body dose of 500 mrem or the equivalent dose to an organ.

2/ These releases are expected to be in accord with proposed Appendix I for routine effluents (i.e., 5 mrem/yr to an individual from all sources).

SEQUOYAH DRAFT ENVIRONMENTAL STATEMENT

COMMENTS ON OTHER ENVIRONMENTAL IMPACTS

A. Section 5.3, Heat Dissipation

We note with concern the differences between the proposed temperature criteria of the State of Tennessee, and the criteria recommended by EPA and the Tennessee Game and Fish Commission at the July 27, 1971 hearing of the Tennessee Water Quality Board (pages 5-7 and 5-8). TVA has stated that it plans to operate the Sequoyah Plant in accordance with the proposed criteria of the State of Tennessee; that is, the main stream average water temperature shall not exceed 93°F, and the rise in temperature of the mixed stream shall not be more than 10°F above natural water temperature at any time. In contrast, EPA and the Tennessee Game and Fish Commission recommended that the maximum main stream temperature not exceed 86°F and the temperature rise not exceed 5°F. Because these criteria have a major bearing on alternative heat dissipation methods, such as cooling towers, it is suggested that this matter be resolved in the final environmental statement. This is an especially important aspect of plant design, because TVA concludes that cooling towers require a construction schedule between 19 and 42 months, depending on the type selected. 2.6.1

B. Section 5.4, Chemical Discharges (or other appropriate section of the final statement)

We suggest that the means that will be used to clean the cooling water condenser tubes be described (mechanical means such as rubber balls; chemical means such as chlorine or another biocide, etc.). We recommend that the description include how these solutions will be treated and/or discharged to the reservoir. 2.5.1

C. Section 5.8, Radiological Effects of Accidents (page 5-114 and Table 30)

We suggest that the projected population (and the year of the projection) within fifty miles of the plant site be provided. Appendix G

D. References

We suggest that a list of references (or footnoting) be provided for each section of the environmental statement.

ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC 21 1971

OFFICE OF THE ADMINISTRATOR

Mr. Lynn Seeber
General Manager
Tennessee Valley Authority
Knoxville, Tennessee 37802

Dear Mr. Seeber:

We have reviewed the Draft Environmental Statement for the Sequoyah Nuclear Plant, Units 1 and 2, and are pleased to provide you with the enclosed report which contains our comments. Our review was performed in accordance with the requirements placed on Federal agencies by the National Environmental Policy Act of 1969.

Our review of the impact statement revealed several deficiencies which made it impossible to verify the conclusions reached in the draft. These deficiencies are listed in the conclusions and are described fully in our enclosed review. Before a final review can be completed, we must have access to the additional information required.

On the basis of the information presented in the Draft Environmental Statement, we believe that the major potential environmental impact of the proposed operation of the Sequoyah plant involves the release of significant quantities of waste heat to the Chickamauga Reservoir. We understand that TVA intends to comply with the applicable water temperature standards: however, we question the ability of the plant, as presently designed, to comply with existing and/or anticipated standards. We also question the effectiveness and feasibility of the special control measures proposed; namely, stream-flow regulation and/or reducing power level. In this respect, presentation of the expected power level throughout varying periods of the year would be useful in better understanding the potential environmental effects associated with normal operation, especially thermal effects.

In order to insure that alternative cooling systems are fully considered and evaluated, we request that TVA provide us with additional information on the thermal pollution issue before the final environmental impact statement is filed with the Council on Environmental Quality. This information should describe fully alternative cooling systems that will permit the plant to operate within existing and proposed State and Federal water quality standards.

Additional information required to answer these questions and other comments are contained in the enclosed report. We would be pleased to discuss any of these comments. If we can assist you further in this matter, please let us know.

Sincerely yours,

Robert W. Fri
Deputy Administrator

Enclosure

EPA-D-TVA-06008-23

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Sequoyah Nuclear Plant Units 1 and 2

ENVIRONMENTAL PROTECTION AGENCY
Washington, D.C. 20460

December 1971

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INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency has reviewed the draft environmental impact statement for the Sequoyah Nuclear Plant, Units 1 and 2, prepared by the Tennessee Valley Authority and issued on October 19, 1971.

The following are our major conclusions:

1. On the basis of the information provided in the draft environmental statement, it is not possible to verify the conclusions. Additional information is needed on accident analyses, thermal effects, air quality, and solid waste disposal (during construction and plant operation), site characteristics (such as on-site meteorological data, relocation of the Savannah Utility District water intake, and stream flow data), effects of the disposal of chemical wastes and toxic material used during plant operation, unavoidable environmental impact and reasons why the unavoidable environmental impact cannot be decreased.

2. The plant cooling water system will not allow present and proposed water temperature standards to be met without additional control measures. The statement does not present adequate information to evaluate the feasibility and effectiveness of the proposed control methods.

3. We suggest that TVA follow AEC guidance in areas such as accident and cost/benefit analysis. Such guidance is being prepared by the AEC and is in the proposed rule making stage or in final draft form.

4. For cost/benefit analyses, we recognize that some costs and benefits are difficult to quantify; however, the analyses presented in the statement were considered too qualitative. Methods for quantifying cost/benefit analyses are provided in the AEC draft guide. We suggest

that the analyses include a balance of savings in environmental damage on costs (i.e., the benefit), to the environment that would otherwise occur against the cost of candidate alternative plant sub-system designs. Where the savings to the environment can be evaluated in detail, a determination should be made of the level at which the cost for this benefit would be preferred. For example, cost/benefit analyses should include: a) effects of heat rejection to Chickamauga Reservoir, b) effects of discharges of chemicals and liquid and gaseous radioactive wastes, c) accident consequences and costs of mitigation, d) cooling systems-diffuser and alternatives, e) waste management systems and f) an evaluation of the current status of construction as it relates to cost/benefit considerations. These evaluations, where possible, should include the ultimate cost to the consumer and the bases for the economic evaluation (e.g., discount rates and periods).

5. Entrainment and the rapid heating of aquatic organisms in the plant cooling system will result in biological damage. The present design criteria for the Sequoyah intake structure (velocity of 2.2 ft/sec) and temperature rise across the condenser (29.5°F) are greater than normally employed on other plants of similar design. We recognize, however, that the condenser design allows TVA to adopt alternate cooling systems should this prove necessary.

6. The radioactive effluent control systems were reviewed in detail, and several commendable system improvements or additions were noted: a) the off-gas holdup capacity was extended from 45 to 60 days, b) the steam generator blowdown treatment system was added, and c) a charcoal filter was added to the mechanical vacuum pump exhaust. A commitment to fully utilize the design capability of these systems to minimize effluent releases should also be made.

SITE CHARACTERISTICS

In considering site characteristics, EPA evaluated the impact of the proposed plant on air, water, radiological, solid waste, and noise pollution. Alternative sites were considered by TVA and it was concluded that the Sequoyah site "was the most advantageous for this project at this time." 4.2 The discussion in the statement does not fully support this conclusion. Those important environmental parameters which led to the choice of the Sequoyah site should be presented in the final statement for the chosen site and the alternative sites. Particular emphasis should be given to population distributions, cooling systems, seismology, meteorology, geology, hydrology, and the radiological impact of the plant on the surrounding area and the period of time during which these studies were conducted. These site parameters are listed as having been evaluated in the process of selecting the Sequoyah site; however, details as to the various degrees of importance of each are lacking.

It is stated (p. 7-3) that an analysis of a spray irrigation canal 4.2 system and a cooling lake would require extensive investigation of the site, location, soil conditions, and economic feasibility. 2.6.9 The site selection study should have included these factors in sufficient detail to justify the selection of a cooling system using a diffuser versus possible alternative cooling methods.

The water intake of the Savannah Utility District is currently 1.2.6(3) located 2,000 feet downstream from the proposed Sequoyah diffuser location and near the surface of the reservoir. TVA has indicated an intention to relocate the Savannah Utility District water intake upstream from the discharge diffusers; however, the plans to move this intake are not mentioned in Table 8. Because of the importance of reducing

population doses whenever possible, it is strongly recommended that either the diffuser design or the Savannah Utility District water intake location be modified so that this critical pathway of population dose from radioactive liquid effluents will be eliminated. TVA should make a commitment to remedy this situation before the operation of Unit 1, and this commitment should be confirmed with the Savannah Utility District or with the AEC as a license requirement which should be included in the final environmental statement.

TVA should also include dose estimates for both the present and newly chosen water intake location. The water diffusion calculations should be presented with emphasis on slug and routine liquid discharges under low flow and average flow conditions. The population using the water intake along with the average water consumption per day should also be presented. If there is any possibility that a slug release may reach the intake, the Savannah Utility District should have sufficient storage capacity to allow temporary shut down of the intake until the slug has passed. Appendix H

The Sequoyah Nuclear Plant is located within the Chattanooga Air Quality Control Region. Prolonged periods of poor dispersion occur in this area because of a light average wind speed, topographically confined flow and frequent inversion conditions. The climatological appraisal for the site has been developed from meteorological data collected at stations within approximately 75 miles; however, it is not apparent from the statement that an on-site meteorological program has been put into operation by TVA to verify that conditions at the site are not significantly different from those in the general area. 1.2.5 Appendix H

Since hydraulics and flow patterns of the Chickamauga Reservoir are presently controlled by peaking operations of the Watts Bar Dam (upstream) and Chickamauga Dam (downstream), it appears that steady state conditions are seldom achieved and that periods of low or no flow probably exist frequently and are of varying duration. The information on the frequency and duration of these low or no flow occurrences should be presented so the thermal conditions and biological effects of Sequoyah discharges under these anticipated operational conditions can be assessed. The low flow rates for the Tennessee River at the Sequoyah site should also be presented for both a 10-year and 20-year average.

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2.6.3

1.2.6(2)

CONSTRUCTION ASPECTS

Extensive grading of the site will occur during construction. These operations, in conjunction with the heavy rainfalls of the area, could cause a number of environmental problems. Large quantities of soil particles would be disturbed and if allowed to reach the reservoir, could adversely affect water quality and/or damage aquatic organisms. The effects of silt can be far-reaching since this material might be resuspended by river traffic. 2.7.4

In addition to the normal on-land plant construction, significant construction adjacent to or in the Tennessee River will be required or is underway for 1) the intake skimmer wall and dikes, 2) the intake channel, 3) the discharge canal and pond, 4) the yard drainage pond, 5) the submerged dam, 6) the fill section and diffuser pipes, 7) the relocation of the water supply intake for the Savannah Utility District, and 8) the grading adjacent to the river. Particular attention is necessary in construction areas near shore or adjacent to streams on transmission line rights-of-way where adequate safeguards to protect aquatic organisms and substrates and water quality should be instituted. Items 1,3,4,5,6, and 7 above will be accomplished primarily within the reservoir where suspended and dissolved solids could cause adverse effects and where existing substrate damage would be maximum. Numerous construction techniques are available, and the best practicable methods should be utilized to reduce siltation and other adverse effects to the absolute minimum. Construction of items 2 and 3 is presently being accomplished by dragline operations behind a plugs which will be removed later. During removal of these plugs, measures to minimize siltation effects should be instituted. Although TVA has indicated a commitment to use construction procedures that will minimize environmental damage, reference to these procedures should be made. 2.7.4 2.2.4 2.7.4

The potential for damage to aquatic organisms and substrates by permanent removal or siltation and for producing undesirable effects on water quality such as turbidity and dissolved solids increases is of great concern. However, inadequate information is presented in the statement on measures proposed for minimizing these effects. Additional details on construction techniques and protective measures proposed (seeding, sprigging, sodding, diapers, etc.) 2.7.4 and possible alteration in procedures both during and after construction, to minimize or mitigate possible environmental damage, should be presented. Furthermore, there is no explanation of where and how dredging spoils will be disposed. This could constitute a severe short-term pollution problem if not properly performed. Again, a brief summary of protection measures planned for use during the construction phase should be included.

TVA proposed to place two diffuser sections on a 12-foot fill which will 2.6.2 cover an area of approximately 130 feet wide by 700 feet long in the existing 900-foot river channel. In addition, an underwater dam to within 21 feet of the normal minimum pool elevation is proposed about 250 feet upstream from the diffusers. This dam will cover an area approximately 150 feet wide by 900 feet long across the channel (p. 5-126). Figure 13, however, notes that sideslopes are only 1.75 to 1 which would require a width of less than 120 feet. This discrepancy should be clarified since slopes on the order of 3 to 1 are normally considered necessary, depending on the materials involved. Informa- 2.7.3 tion on fill material, proposed construction techniques, and possible alternative construction methods which could be used to reduce environmental damage should be included. The reason for use of the 12-foot fill for the diffuser 2.6.2 pipes as well as alternative methods for supporting the diffusers should be discussed and evaluated. Possible adverse effects resulting from siltation of organic matter behind these barriers should be discussed. 2.9.4

Plans for disposing of the solid waste generated by land clearance 2.7.5
and construction as well as the refuse from about 2,000 construction 2.7.6
employees should be presented including the arrangements for the collection
and disposal of non-radioactive solid wastes. This plan should comply with
existing or proposed air pollution and solid waste rules and regulations. 2.9.4
If any construction and clearing wastes are to be deposited at any city
or county disposal site, then deposition should be in accordance with
the State solid waste program through established procedures. If disposal 2.7.5
is not in accordance with these procedures, adverse environmental effects
can be expected to result.

Since some portions of the Chattanooga Air Quality Control Region do
not meet national ambient air standards for particulates and oxides of
nitrogen, it is essential that adequate control methods be implemented
during construction and during operation of the facility. The means of 2.7.9
controlling and minimizing emissions from combustion, the concrete mixing
plant, and the construction equipment should be discussed relative to
maintenance of air quality standards. Emissions from the site concrete
mixing plant should be kept to a minimum by utilization of available control
techniques and equipment, and an alternative method for disposal of land 2.2.3
cleared and construction debris should be developed for both the plant and
transmission line constructions. For example, vegetation, which might be 2.7.5
incinerated, could be mulched and where appropriate, returned to the site.
In order to minimize environmental problems caused by soil erosion, final
landscaping activities should be undertaken as soon as practicable rather 2.7.4
than after all construction is completed.

Although we recognize that the proposed plant is located in a sparsely populated area, the final environmental statement should contain specific information concerning noise abatement procedures to be used 2.7.8 during land clearing and during construction phases including noise generation of construction equipment

NORMAL OPERATIONS

Transportation of Fuel and Solid Wastes

Transportation of fuel to and from a reactor facility will be evaluated in the environmental statement prepared by the AEC. It is suggested that TVA follow the same practice. The statement notes that about 173 truck shipments per year may be required to deliver fuel assemblies and remove spent fuel and radioactive solid wastes from the Sequoyah Nuclear Plant. The potential for spilling or dumping of these products in transit between the fuel fabrication plant and Sequoyah and the fuel reprocessing plant, were not sufficiently discussed in the draft environmental statement. The probabilities of accidents and the consequences of these accidents should be evaluated in terms of the effects on the environment. Specifically, the provisions for safeguarding the fuel in transit, the routes that will be used in transporting these fuels to avoid populated areas, and the back-up methods for reclaiming and recapturing accidental radioactive spills should be detailed.

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2.1.2(2)
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2.1.2(1)
2.1.3(1)
2.1.4(3)

Waste Treatment and Effluent Discharge

Radioactive Gaseous Waste Treatment

In order to reduce gaseous discharges to the lowest practicable level, the gaseous holdup time for the decay of radioactive gases has been increased from 45 days to 60 days. The data presented indicate that this additional 15 day gaseous holdup will reduce ^{133}Xe discharges by about 90 percent and ^{131}Xe discharges by about 60 percent and that the gaseous effluent will be reduced to essentially ^{85}Kr. This equipment, which is estimated to cost $100,000, is expected to be in service at the start up of Unit 1. We commend TVA for extending the gaseous holdup capacity and are hopeful that they will fully utilize it and commit to do so in the operating specifications to be prepared for the facility. The commitment to use the full capacity should be included in the final environmental statement. Another reasonable commitment to reduce population doses would be to correlate periodic, controlled releases with good meteorological dispersion conditions. 2.4.1(4)

Charcoal filters are to be installed in the condenser off-gas line which will provide a significant improvement in the effluent control system for the plant by removing iodine. A commitment should be made to utilize this filter on a routine basis whenever there is a primary to secondary leak. This should also be reflected in the final environmental statement. An estimate of the DF (decontamination factor) for the estimated temperature and moisture conditions at the charcoal filter location would be helpful. 2.4.1(4)

The auxiliary building gas treatment system (ABGTS) will provide for charcoal adsorption and filtration of the effluents from the auxiliary building. The levels of radioactivity which determine when this system

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is utilized should be specified since it is indicated that this treatment system is normally bypassed. The possibilities of connecting the containment purge exhaust into the ABGTS, which could be a further positive improvement by making better use of the existing system, should be considered. Also, effluent releases due to containment purging should be evaluated and a commitment should be made to utilize the planned containment auxiliary charcoal and HEPA filters to minimize releases of iodines and particulates to the environment. 2.3 2.4.1(4)

Radioactive Liquid Waste Treatment

The radioactive liquid waste treatment system will be used to treat miscellaneous tritium-containing waste by evaporation. Miscellaneous waste by filtration, detergent-containing waste, spent fuel shipping cask decontamination waste, and other miscellaneous wastes will be treated by filtration. 2.4.1(1)

Consideration should be given to providing organic waste treatment in addition to filtration of detergent (equipment cleaning and decontaminating, laundery, shower, handwash, etc.) and ammonia wastes in the septic tank system or by providing equivalent secondary treatment. 2.4.1(2)

All tritiated water (defined as having ^{3}H concentrations at least 50% that of primary coolant) will be recycled to storage tanks for reuse in the plant. If it is necessary to bleed tritiated water from the primary coolant, the tritiated coolant will be "drummed" and, as necessary, shipped offsite as low specific activity liquid waste for disposal at an AEC-approved disposal site. It is difficult to justify the indicated definition of tritiated water. A cost/benefit analysis should be presented relative to providing evaporation of the "non-tritiated" waste volumes expected. 2.4.1(1)

A detailed discussion of the waste processing equipment was not presented in the draft environmental statement. The statement should 2.4.1
present the potential environmental impact of the facility and the degree that such waste treatment systems will reduce this impact. Details regarding the waste treatment system (components, capacities, component characteristics) should be presented with emphasis on equipment decon- Table 2.4-4
tamination factors (DFs) for individual radionuclides. This detailed information is extremely important since it is required to determine the estimated radioactivity discharges in the liquid waste from the facility. For example, an evaporator DF of 10^6 is stated in the PSAR; however, EPA field measurements show that this DF may be over estimated by several orders of magnitude. The evaporator DF should be justified by reference to available operating experience, especially since an overestimated DF will result in an underestimated liquid discharge level. The liquid 2.4.1(2)
radwaste activity estimates differed between the PSAR and the draft environmental statement. These discrepancies should be resolved. When the estimated liquid radwaste levels are presented in the final environmental statement, consideration should be given to the possible consequences of recycling tritiated waste.

PRIMARY TO SECONDARY LEAKAGE

The statement indicates an awareness of the problem of primary to secondary leakage in PWR generating plants and the original plant design was modified to minimize these problems. An auxiliary evaporator will be provided to treat contaminated liquid waste. Blowdown monitors will be provided to detect leakage; however, the amount of radioactivity which may escape before the blowdown line closes is not indicated. TVA should evaluate the operational cost of using the blowdown treatment system anytime there is primary to secondary leakage versus the environmental benefit that would be obtained in effluent level and population dose reductions. This evaluation should include consideration of a condenser which could be employed in the blowdown line to avoid the flashing of liquid blowdown to steam with ultimate release to the atmosphere via the flash tank vent. 2.4.1(6) Table 2.4-4 2.4.1(6)

The criteria for utilization of the charcoal filters which have been installed in the condenser off-gas line should be provided whenever there is primary to secondary leakage. Presentation of TVA's analyses of the operational cost versus the population dose benefit of such procedures would also be helpful. 2.4.1(4)

The statement indicates that during periods of operation with steam generator leaks it will be necessary to discharge some secondary system water which will contain tritium and that it is not practical to recycle the water for primary system makeup because a prohibitive amount of storage capacity would be needed. The analysis which led to this conclusion should be presented, including dose estimates for the discharged blowdown. The need for such an evaluation is made especially important for 2.4.1(6)

the tritium concentrations that will result from the recycling of tritiated water.

CHEMICALS AND HAZARDOUS MATERIALS

Caution must be observed in the handling of all industrial waste and to avoid spills, not only into a water body such as the Chickamauga Reservoir, but also a direct spill into the terrestrial environment where there is the possibility of percolation into the ground water which moves toward the reservoir.

Fuel oil, lube oil, chromium, hydrazine, acids, bases, and other solid and liquid hazardous materials will be stored on site during construction and/or operation of the plant. Little information on methods of transport and storage or measures to assure compliance with Section 11 of the Federal Water Pollution Control Act, as amended, are provided. A yard drainage pond is proposed with a low level discharge pipe to assure that any oil that is accidentally spilled and enters the yard drainage system will not be discharged to the river. It is stated that "safeguards against accidental release of all chemicals will be provided" (p. 5-27). Details regarding these "safeguards" should be presented in the final statement. The possibility of oil or fuel loss from barges during normal operations is noted in the statement and such losses "will settle along the shoreline or on the bottom materials and organisms in the dock area or downstream" (p. 5-125); however, the magnitude of this possibility is not presented. 2.5.3 2.7.9

Storage and control methods and proposed procedures to prevent the contents of a ruptured tank, accidental leakage or spillage of oil or hazardous materials from reaching surface water courses should be presented. Discussions should include an analysis of the possibility and 2.5.3

probable quantities of materials which could be discharged under earthquake, flood, tornado, plant malfunction, human error, or other abnormal 2.5.3
occurrences and the resultant effects on aquatic and terrestrial organisms.

The exact type and degree of treatment for chemical wastes has not yet been determined by TVA; however, the statement notes "all chemical wastes will receive the highest degree of treatment that is technically feasible within reasonable economic limits." A description of the treatment given to chemical wastes is important for a complete evaluation
of the environmental impact of this facility. The procedures should 2.5.1
include sedimentation of suspended solids from the filtration unit and other waste streams. The use of chemicals for cleaning the condenser, information on the essential service water system cooling tower blowdown discharge, with emphasis on potential chemical additives and the treatment of blowdown prior to discharge, should also be discussed.

CONSIDERATION OF INTERRELATING FACILITIES 2.6

While the statement considers the interaction of both Sequoyah units, it fails to address possible thermal interrelationships between Sequoyah and other TVA electric stations. Presenting such interrelationships is important to adequately assess the impact and cumulative effects of Sequoyah and other plants on the environment.

POPULATION DOSE ASSESSMENT

It would appear that the most significant radiological effect of the operation of the station will be the population dose that results. For 1% failed fuel, the statement indicates that the total annual dose Appendix I to any individual will be 2.2 mrem and the total estimated population dose within a 50 mile radius (1970 census) will be 9.1 man-rems. The preparation of such a population dose estimate is commendable. The value of the estimate would be improved, however, if the data and assumptions used in these calculations were presented; thus, an analysis of the dose estimates could be made. For example, an annual average dilution factor (X/Q) is not appropriate for estimating the gaseous dose rate if the gaseous discharge occurs over a short time period. In this case a short term X/Q would be more applicable. From the information presented, it could not be determined where an annual average or a short term X/Q was Table 2.4-2 employed. For gaseous discharges, radionuclide activity estimates should include secondary sources such as containment purging and the ventilation building exhaust.

With respect to water pathways, the ability of plankton and benthic 2.4.4 organisms to concentrate certain radioisotopes and pass them further up the food chain should be discussed. This would also apply to considerations Appendix H of heavy metal toxicity evaluations.

AIR QUALITY EFFECTS

If the plant will not interfere with attainment of Federal air quality standards, the statement should so state. If there is any possibility of creating a violation of these standards or any other applicable air pollution law or regulation, including the "Imminent and Substantial Endangerment" clause of the Clean Air Act, the air pollution control methods that will be used should be described. 2.5.5

The transmission connections to the Sequoyah Nuclear Plant switchyard will initially consist of three 500 kV and seven 161 kV transmission lines. A total of 1,360 acres of land are required for rights-of-way for new lines. Numerous environmental effects and proposed procedures to minimize them are presented (pages 3-118 through 3-122); however, no mention is made of the potential environmental hazards associated with the production of ozone. An estimate of ozone concentrations in the vicinity of high voltage power lines and power plants should be made along with an evaluation of the impact on humans and wildlife. 2.2.5

The technical literature since the late 1950's contains much information on the effects of ozone on animal and human tissue. Recent work at the University of Florida substantiates and reinforces the similarity of ozone damage to that of ionizing radiation in producing chromosome aberrations. Direct extension (considerable possible error) of this animal study to the human case indicates that presently permitted industrial ozone exposure limits (up to 0.1 ppm or 4 ppm hr/week in a 40 hr. week) would be expected to result in break frequences that are orders of magnitude greater than those resulting from permitted radiation exposure.

Analysis of the potential for cooling tower induced fog or icing is based on extensive observations of the plume from the towers at TVA's Paradise Plant. While only a qualitative assessment of the potential for ground fog is given data are presented showing predicted plume lengths for 16 compass point directions for various percentages of time. It should be noted, however, that a plume must reach the ground for a fog to occur, as discussed on pages 7-9 to 7-11 for mechanical draft towers and pages 7-16 to 7-17 for natural draft towers. We concur that, if cooling devices are required, natural draft towers would be preferable from the standpoint of lower potential for tower induced fog and icing. It is also noted that natural draft towers could be operated on a closed cycle system or in conjunction with the proposed diffuser.

MONITORING AND SURVEILLANCE

Surveillance sample types were specified in Table 17, however, food crops were not identified. Since food crops may be a critical pathway for exposure from radionuclides discharged from the Sequoyah facility, this pathway should be monitored. These food crops may be included within the vegetation classification, but this is not clear. A separate category for food crops should be added to Table 17 along with the sample frequency and method of analysis. 2.4.3 Table 2.4-6

Because the expected low discharge levels will not be detected by the environmental surveillance program, accurate dose estimations will depend on measured discharge levels and on-site meteorological and water dispersion data. All gases and liquids will be analyzed before being discharged and will be monitored during discharge. The reported discharges should be based on sensitive measurements and should be on a radionuclide basis so that dose estimations can be made. 2.4.1(4)

The sensitivity of the monitoring instrumentation is also extremely important in determining the magnitude of inadvertent releases. The final environmental statement should evaluate the amounts of liquid and gaseous radioactivity that could be released undetected, e.g., auxiliary building exhaust, liquid waste monitoring, shield building vent gas monitor, and steam generator blowdown. The evaluation of the undetected activity releases should consider discharges under slow leak conditions which may not actuate alarms. 2.4.1(6)

Whether or not biological changes can be detected by monitoring programs is highly questionable. Experience has shown that drastic changes in the population structure, in the order of 25 to 50 percent, are required before current census techniques can detect population

changes in reservoirs of this size. It is unlikely that monitoring programs that are instituted will detect other than gross changes in the reservoir populations. Also, it is likely that monitoring programs 2.5.6 will not be able to measure the biological effects of this plant in relation to detrimental effects due to other intakes of municipalities, power plants, and other industries.

In order to provide documentation that thermal criteria of the 2.6.1 Tennessee Water Quality Standards are not violated, it will be necessary to provide continuous monitoring of water temperature downstream of the diffuser mixing zone at one or more stations in Chickamauga Reservoir. Use of a multidepth buoy system incorporating telemetry for transmission to a shore based receiving station is recommended.

1.2.6(2)(c)

It is possible that there may be synergistic effects between thermal 1.2.8(1) discharges and heavy metals present in the Tennessee River or discharged to the river as the result of plant operations. Information on existing concentrations of heavy metals in the Tennessee River water and aquatic life were not presented in the statement. Due to the high background 2.5.1 levels present in some reaches of the Tennessee River, it is recommended that such information be presented with an analysis of environmental impacts.

COOLING METHODS

The present design of the condenser cooling system may impart significant ecological effects on Chickamauga Reservoir at the intake, in the condenser, in the discharge pond, and in the lake proper. The skimmer wall located in the intake should substantially reduce the number of organisms entering the intake channel. The long retention time provided by the 32-acre discharge pond will result in all entrained organisms being killed before they are discharged back to the reservoir. Furthermore, the velocities in the intake reservoir and even under the skimmer wall are such that most plankton organisms, as well as the young fish fry, will not be able to overcome the current and escape from the intake. In addition, the high water velocity through the vertical moving intake screen will probably result in unnecessary killing of small fishes. Apparently, studies have not been undertaken to determine the magnitude of these effects on the lake biota, but a gradual decrease in the population of some species is anticipated.

The environmental effects of the proposed circulating water intake system (moving screen and 2.2 ft/sec velocity) should be considered and an evaluation of the alternate design possibilities relative to minimizing 2.6.5(2) environmental impact should be made. For example, 1) the technical literature indicates that horizontal screens cause less damage to fish than vertically moving screens; 2) the quantities of material removed from either screen system should be documented and means of disposal other than return to the reservoir (land fill, etc.) should be discussed;

3) the cost/benefit of reducing the water velocity through the screen should be evaluated in view of the relatively high design flow of 2.2 ft/sec.

Information on the expected frequency of various flows passing the plant ("flow duration curves") is noticeably absent. This affects both engineering and biological analyses. The statement estimates that with both units operating, the cooling water intake/discharge will be about 8% of mean annual flow. However, the periods of interest are spawning times (spring) and summer low flow periods. From the limited information contained in the statement on this subject, it appears that with both units in operation the Sequoyah Plant may use 25% or more of the flow in the reservoir for several days during the late summer.

A questionable assumption is used throughout most of the report, namely that there will be complete mixing with the river flow. But, it is stated in several places that some substantial part of the flow, approximately 2/9ths of the cross-sectional area over the channel, will not mix rapidly with the effluent and in many cases will occur underneath the heated effluent in a stratified situation. It is anticipated that the hypolimnion in this weakly stratified reservoir will be substantially reduced at periods of low flow. 2.6.3

Mention is made that operation of this plant will have to be curtailed or additional water will have to be released from upstream reservoirs at certain periods in order to avoid severe effects from the thermal discharge. It is important that missing information be provided on the duration and frequency when flows through the reservoir will be

greatly diminished due to controlled releases of upstream and downstream 1.2.6(2)(b)
dams for hydrogeneration. The full effect of thermal discharges cannot be evaluated until this information is available.

The alternative cooling methods, such as cooling towers versus the plant discharge using diffuser pipes are well presented. However, the discussion is deficient relative to other alternate means of controlling or minimizing the effects of waste heat on the lake. Cost/ 2.6.9
benefit analyses should be presented for: 1) use of spray modules in the discharge pond combined with the proposed diffuser system or cooling towers, 2) a direct pipeline to the diffuser pipes eliminating the 2.6.9(7)
discharge pond, 3) operation of diffusers and the cooling towers for the essential service water system in the combined mode, and 4) modification of the intake and condenser cooling system to provide a small increase in temperature across the condenser. Details of the increased cost to the consumer of the proposed systems for all the alternatives should be included in the final statement. Also, the discussion should be expanded relative to the following environmental considerations: 2.6.5(5)
1) elimination of the biologically productive area included in the discharge pond, and 2) the environmental and operational considerations associated with various concentrations of cooling tower blowdown (e.g., higher volume, lower concentration, more frequent blowdown 2.5.1
as opposed to smaller volume, higher concentration, less frequent blowdown).

The environmental statement does address some water quality effects of the heated water discharged to the reservoir; however, due to the effect of heat on the aquatic biota, there will be synergistic effects

which should be evaluated and discussed. For example, the increased temperature will reduce the water's capacity for absorbing oxygen. The biological law of Q_{10}, which states that biological activity approximately doubles for each 10°F temperature rise, will apply for heat tolerant organisms. The combined effects of lower dissolved oxygen capacity and increased respiration will be most severe in the early morning just before sunrise when the diurnal D.O. sag is critical. Plant design features further compound these problems. 2.6.5(2)

High intake velocities sweep in plankton and then expose them to a thermal shock of 29.5°F. Most of the plankton will be killed and will add to the organic load downstream. With critical D.O. sag in mind, facultative aerobic and, possible, anaerobic conditions could result. Therefore, the statement should be expanded to include discussions and implications of withdrawal and return of cooling water and should also include or expand discussion of such topics as temperature effects on: 1) reaeration rate, 2) increased metabolism and respiration rates, 3) increase in ultimate BOD, 4) increased evaporation, 5) shifts in populations and diversities, 6) predation, 7) feeding and growth rates, 8) reproduction, 9) parasitism and disease, and 10) synergism with toxic substances. 2.6.5(2) 2.6.5(3)

There appear to be anomalies in the stated naturally occurring lake temperatures. In the paragraph on temperature, the temperatures range from 41.7°F to 81.9°F. In the chapter on Biological Impact, the statement indicates that surface temperatures of 85°F are commonly reached. There is no clear indication just what temperature rise would be expected during operation of the proposed plant. Figure 16 shows that the heat wedge moves upstream above the plant intake area during low flow conditions 1.2.6(2)(c) Appendix M

(Q_R=30,000 cfs). Stream flow data for 1951-1965 indicates an average flow of about 27,000 cfs during summer months (May-October). This means that heat may be recycled through the plant which will result in a heat build up in the reservoir between the plant intake and discharge. This should increase the number of days that the temperature criteria would be equaled or exceeded for this portion of the reservoir.

On the basis of the above, the statement should more thoroughly discuss thermal effects and should delineate between direct thermal effects and the physical conditions that are influenced by temperature and can result in biological damage. Also, temperature patterns in the upper reaches of Nickajack Reservoir resulting from the discharges of heated water at Sequoyah should be quantified so that effects on the downstream fishery can be adequately assessed. 2.6.4 2.6.7 Appendix M 2.6.4

Temperature data for the period 1943 through 1948 have been summarized in Table 14. However, similar treatment of the 1966 through 1970 temperature data from Chickamauga Dam would provide data on the more recent thermal conditions in the reservoir. 1.2.6(2)(c)

The diffuser design and thermal mixing patterns are analyzed on the basis of excellent modeling studies conducted for the Browns Ferry site. However, the Sequoyah statement does not indicate the manner in which the data for the Browns Ferry model has been extrapolated to the Sequoyah site. Discussions of thermal patterns, reservoir thermal behavior, and associated environmental effects presented in the statement are generally based on steady-state physical modeling developed for the Browns Ferry Plant. In addition to the problems associated with transient and low or no flow conditions, differences in physical arrangement Appendix M

of facilities (including the upstream submerged dam and placing of the diffuser on a fill section at Sequoyah) will cause discrepencies in predictions. Some mention is made of qualitative variation in temperatures predicted, but little information on quantitative differences is presented. Additional physical modeling would be desirable using proposed structures in the river to more accurately predict temperature patterns and mixing zones which will exist at Sequoyah.

Our independent analysis predicts that with sufficient flow to move the heated water away from the diffuser complete mixing will take place in a short distance (less than 100 feet) from the diffuser. At stagnant or low flows, this will not be accomplished. With the average summer flows of 27,000 cfs, the mixed temperature would be 4-5°F above ambient; with lower flows the mixed temperature will be higher. Furthermore, it is important to note that when the mixed temperature is close to the equilibrium temperature, heat dissipation from the plume to the atmosphere between the site and Chickamauga Dam (about 12 miles) will be minimal, and the heated wedge will extend to the dam.

The statement contains two additional items of data that are of 2.6.4
concern from the standpoint of environmental impact. First, on the basis of historic flows and water temperature, a 5°F rise would be exceeded a significant percentage of the time, even if the heated discharge were completely mixed with the total flow of the reservoir. Second, the 2.6.1
statement postulates that no more than 75 percent of the cross-sectional area would be affected; this seems excessive when viewed against the National Technical Advisory Committee to the Secretary of the Interior on Water Quality (NTAC) recommendation of 25 percent.

At the present time, federally approved thermal criteria for the Tennessee River in Tennessee have not been established. The design thermal criteria for the Sequoyah facilities are based on the original Tennessee standards of 93°F maximum and a temperature rise of 10°F over natural temperatures which were excepted from approval by EPA predecessor agencies. Accordingly, no cooling is provided, and the heated condenser water is to be discharged directly to Chickamauga Reservoir through the proposed diffuser system, which is designed to provide rapid mixing of heated condenser water in the reservoir.

It is anticipated that Tennessee will propose thermal criteria of 30.5°C (86.9°F) and 3°C(5.4°F) maximum rise above naturally occurring temperatures which are expected to be acceptable by EPA. Based on data presented in the statement (pages 5-22 through 5-24, Table 15 and Figures 20 and 21), significant periods of violation of these criteria will exist without supplemental means of cooling even when complete mixing with the total river flow is assumed (an unlikely situation during part of the year). A major provision of the Tennessee Water Quality Standards is that the standards must be met at "instantaneous minimum flow" on regulated streams; therefore, violations undoubtedly would occur in a significantly large number of days when instantaneous flow at the site is low. If complete mixing does not occur, the frequency of violation of the above criteria as well as the 93°F maximum and 10°F rise criteria would be greater than estimated. If the criteria of 86.9°F maximum and 5.4°F rise is approved, the facility is expected to have considerable difficulty complying without auxiliary cooling. 2.6.4

In reference to EPA's recommendation for thermal limits applicable to the reach of the Tennessee River within the State of Alabama, TVA states "...it has been reported informally that EPA is now (September 1971) reconsidering the 86°F maximum recommended at the April 1971 Conference..." (page 5-8). EPA Region IV is not aware of any such reconsideration and anticipates that an 86°F maximum temperature will be adopted.

It is stated that "thermal limits will be met by either: 1) regulating streamflows at the Sequoyah site, 2) decreasing power level, or 3) a combination of both." If streamflow regulation is used, virtually continuous discharges from the Watts Bar and Chickamauga hydroelectric plants will be required because temperature criteria would have to be 2.6.4
met at all instantaneous flows. This would, in effect, require the operation of these plants to be changed basically from a peaking to a base-load type operation which is undesirable from an economic standpoint. 2.6.7
Power level reduction is also undesirable during periods of high demand which are likely to occur during periods of low natural streamflow. Both of these techniques appear unlikely for application in a real situation since peak power demands from air conditioning usually coincide with low flow periods and low reservoir volume periods. Since Sequoyah would be a base-load station and peak power demands throughout the TVA connected power pool are likely to coincide, power system operators would 2.6.1
probably be reluctant to cutback the Sequoyah operation. This assumption is reinforced by the current concern over power "blackouts" or "brownouts" which are arguments against flow augmentation

or power reduction as means to meet thermal discharge criteria. It 2.6.6
appears, therefore, that some type of auxiliary cooling facilities will probably be necessary at least for critical periods when both units are in operation.

Although we recognize that other agencies will provide specific comments on the effects of Sequoyah on important aquatic species, EPA reviewers identified general areas of concern. The statement indicates that only the lower half of the Chickamauga Reservoir has significant spawning areas for important organisms, especially fishes, because the upper half of the reservoir lacks the shallow water areas necessary for spawning habitat. Approximately two-thirds of the cross-sectional area in the lower half of the reservoir is in shallow water, and much of this contains important spawning areas. 2.6.5(2)

Careful scrutiny of Figure 21 showing the annual temperature patterns for 1966 through 1970 in the reservoir and the temperatures that would have occurred had two units been operating through those years, reveals that summer temperatures would not be very hazardous to the organisms of importance in this reservoir. However, a very critical period from March through May occurs when many important species in this reservoir will be spawning. During this period, extreme temperature fluctuations are to be expected. For example, if the two units had been operating in 1967, ambient temperatures would have been raised in April and May from 55°F to 60°F up to approximately 95°F. Such rises in temperature will be devastating to any species of fish that spawns during that period. Experience shows that only minor temperature rises can be tolerated in waters in this latitude during the period when eggs are being incubated.

These temperature peaks are probably the result of flow regulation from upstream reservoirs; but, there is no reason to expect that these will be drastically altered in the future. The exact period in which eggs are being incubated in any given year will be unknown and, therefore, there would be no way to control the flows to protect spawning as is implied in the statement. It is clear that the biological impact of this dis- 2.6.5(2)
charge will be greater during the period of late March, April, and May than during other times of the year. Fluctuations in temperature, such as will occur, will damage desirable species, particularly considering the large percentage of the area that will be affected in the lower half of the reservoir where spawning and reproduction principally occur. Regardless of what temperature standards are finally approved for this body of water, they will not be protective unless temperatures are carefully and critically controlled during the spring months of reproduction.

The statement concludes that an increase in water temperature outside the mixing zone to an average of 93°F in the cross section and a rise over natural temperature of 10°F would not have significant adverse effect on aquatic life. It is indicated that this position is based on "TVA studies at its own fossil-fueled power plants and the experience of others." The statement documents this with:

1. A list of fish species present in Chickamauga, and a discussion of the importance of the extensive overbank areas below the facility as nursery areas for fish and fish food organisms.

2. TVA experience with heated water at two existing facilities--Widows Creek on Guntersville Reservoir and Paradise Steam Plant on the Green River.

No adverse effects were noted at Guntersville, where the temperature of the discharge water was 84-86°F in August and September of 1967; this is not necessarily comparable with the Sequoyah situation. At the Paradise Steam Plant, adverse effects were demonstrated, and TVA installed cooling towers. However, "experience of others" is not discussed nor is any published material quoted.

Roughly six miles of the Chickamauga Reservoir will be affected by the hot-water discharge and will experience elevated temperatures from the floating warm water. The report specifically points out that these temperatures will stimulate metabolism and food consumption by organisms, a detrimental effect; however, they are not expected to die. The report indicated that thermally intolerant species will avoid the area of heated temperatures over a distance of three miles up and down-stream from the diffuser, or an area of three and one-half square miles. This constitutes a loss of 6 to 7 percent of the surface area of the total reservoir or 12 to 14 percent of the surface area in the lower half of the reservoir, the half where most of the spawning habitat occurs. Furthermore, there are thermal discharges upstream from this plant, and they could add to the effects of the proposed discharge. Some of the more heat sensitive species have already failed to reproduce successfully in some years; the frequency of years during which unsuccessful reproduction occurs could be increased in the area of this discharge.

Sauger, white bass, and shad (gizzard and threadfin), three important species of fish in Chickamauga lake, move upstream into headwater areas and tributaries to spawn. The capability of these species to migrate through a thermal barrier up to 10°F warmer than ambient river temperatures without undergoing thermal shock should be evaluated. This may be particularly important to the two species of shad both of which 2.6.5(2) are particularly susceptible to temperature fluctuations. In addition, both shad and white bass move upstream to spawn in April at a time when, according to Figure 21, maximum elevations in temperatures will occur. The statement estimates that about 75% of the reservoir cross-section would be affected by the thermal plume. It appears that although an absolute barrier may not form, the proposed maximum effect plume could cause a severe hindrance to fish migration. The TVA statement addresses itself to this problem as follows: "The probability of formation of a thermal barrier is judged to be insignificant; therefore, no impact on movement is predicted... Passage through the heated water could be either beneficial or adverse but will not be lethal." However, no data are presented, and these statements are inadequate to evaluate potential effects of the heated water on spawning movements.

On page 45, it is noted that: "...within two miles of the diffusers, the heated water will have spread over the full width of the reservoir. This may result in some warming of spawning areas in shallow embayments and overbank areas, and this may accelerate spawning times and egg development." Spawning, egg development, and egg hatching under undisturbed conditions is synchronized with the availability of food for the developing fry and fingerlings. Early hatching as a result of elevated

temperatures will possibly result in starvation and high mortality of fry, particularly of nest-building species such as large-mouth and small-mouth bass, crappie, and sunfish that spawn in the shallow overbank areas. This is true since the development of phytoplankton is more dependent on light increments than on temperature increments, and fish fry of the above species are dependent on the plankton community as a source of food. The TVA statement does not adequately address itself to this problem. There are no studies aimed specifically at determining reproductive success and survival of sauger, white bass, and shad whose movements, gonadal development, and egg hatching may be affected by the heated water. As to nest-building species, such as large-mouth and small-mouth bass and crappie, there should be studies aimed at determining the affect of heated water on the timing of the appearance of fish fry and their food in the form of zooplankton and aquatic insects. 2.6.5

The plant's discharge of heat will increase the reservoir's temperature and give a competitive edge to the more heat tolerant species. Rough fish, blue-green algae, and other less desirable aquatic life will be favored. Other significant species in the reservoir such as large mouth bass, white bass, and channel catfish may well benefit somewhat from the heated discharge. They are likely to congregate in the area of the discharge and feed on the killed organisms in the condenser water as well as feed on organisms that may be stimulated to grow in the heated discharge area. However, no analyses are presented to delineate the effect of plant shutdown (planned or unanticipated) on these species.

It is relevant to emphasize the probable thermal effects on aquatic biota following a rapid termination of heated water discharge to 2.6.5(2) Chickamauga Reservoir. This effect would be most dramatic during the colder months. Whether the shutdown is rapid, due to an abnormal occurence, or planned and routine, there is likely to be a minor to moderate fish kill as a result of the disappearance of the heated plume. Although this would be a reversible effect and should not drastically alter the population structure of the biota in the reservoir, it is likely to be one that is visible to the public.

Because detailed data are lacking it is not possible to adequately assess biological changes as a result of entrainment of the plankton population. The reservoir is highly productive, and it is conceivable that the kill of zooplankton and phytoplankton through entrainment in the plant cooling water might have a beneficial effect in reducing the productivity of the reservoir and, thereby, the algal blooms.

Abnormal Situations - Radioactivity Releases

Appendix G

There is insufficient information in the statement to allow formulation of an independent judgement as to the validity and appropriateness of accident probabilities and consequences. While the statement does quantify the radiological effects of accidents on individuals (dose in rems) and on the population as a whole (man-rems), the information (source terms, fission product removal mechanisms and clean-up credit, meteorological parameters and time intervals) and assumptions upon which they were based are not adequately presented. We strongly recommend that the assumptions used in the accident dose analyses be detailed and referenced.

Postulated accidents have been divided into nine (9) classes in guidelines prepared by the AEC[5] for preparation of Environmental Reports; this guidance dismisses accident Classes 1 and 9 as trivial and incredible, respectively. On this basis, the AEC guidelines indicate that environmental reports need not address either Class 1 or Class 9 accidents. However, it is not clear that this guidance was intended to apply to environmental statements, and it would seem that these accident classes should be evaluated in balancing the total risk/benefit of nuclear power. In the case of Class 1 accidents, for example, the release of small quantities of radioactive materials within the containment vessel (such as small routine reactor coolant leaks when there is leaking fuel cladding) will result in release of substantial quantities of radioiodines (relative to the yearly total releases from the plant) to the environment when the containment is purged. It is possible to control this release by providing a containment purge exhaust ventilation flow path through the auxiliary building gas treatment system (ABGTS). The cost/benefit

2.3

2.3

of such control should be considered. This appears to be a reasonable alternative since 1) the purge exhaust and ABGTS are at the same elevation in the auxiliary building and 2) the flow capacity of the ABGTS is probably sufficient to handle the purge exhaust.

Similarly, Class 9 accidents should be evaluated in order to place the entire question of potential nuclear accidents in perspective relative to the risk/benefit of nuclear power. In addressing Class 9 accidents, it should be clearly indicated what additional failure or failures would be required to progress from a Class 8 accident into a Class 9 accident. Furthermore, it is possible that the probability of these accidents may increase as the plant ages. 2.3

In Class 2 accidents it is assumed that in the event of a primary coolant leak in the auxiliary building, the leak will occur downstream of the purification demineralizers. Thus, the iodine concentration released will be "negligible". After reviewing the schematic diagrams of the chemical and volume control system, it is not obvious that the leakage necessarily will occur after demineralization. In any event, it is not clear what type of resin is used in the demineralizer and what iodine decontamination factor (DF) was assumed. 2.3

It is stated that there are two charcoal filters in series in the ABGTS; however, the PSAR does not indicate the presence of two filters in series. The DF assumed for each filter or the combination of filters should be indicated. While the filtration capability provided by the 2.4.1(4)

ABGTS is an addition which should provide "as low as practicable" releases from the auxiliary building, the assumed DF should be based on the iodine concentrations which will enter the filter system. (See Health Physics: Vol. 19, No. 2, pp. 223-244, August, 1970).

A potential to contaminate ground water supplies may exist due to the possible rupture of or a leak from an outside contaminated liquid storage tank, e.g., primary water makeup tank. Additional protection against such events should be evaluated on a cost/benefit basis. 2.9.2 Appendix G

It appears from operational experience that Class 3 accidents, unintended accidental releases of liquid or gaseous wastes, have occurred due to human error and/or equipment failures. Therefore, there should be operational data by which a realistic probability for Class 3 accidents may be determined. Also, a cost/benefit analysis should be presented for primary safeguards against releases such as inclusion of a single or multiple lock and key system on discharge valves. 2.3 2.4.1(1)

In evaluating Class 5 accidents, TVA assumed that most of the iodines will be removed by the charcoal filter system on the condenser vacuum pump exhaust. The addition of this filter, which, incidentally, is not documented in the PSAR, is a positive addition to the Sequoyah nuclear units and should result in releases which are as low as practicable consistent with present technology. It would be helpful to state the efficiency of this charcoal filter as well as the iodine partition factor in the condenser and/or through relief valves. 2.4.1(4)

For Class 6 and Class 7 accidents, the technical bases should be presented for assuming the failure of only 15 fuel rods. In addition, justification should be provided for the assumed "times to isolation" of the containment purge system. If the containment purge exhaust were to be directed through the ABGTS, this time interval would not be so critical relative to evaluation of radiological dose consequences. In order to assure that radiogases released as a consequence of these accidents are filtered, the appropriate charcoal filter systems should be in use whenever irradiated fuel is handled in the containment and/or in the spent fuel pit area. This condition would significantly reduce the potential environmental effects of radioactivity releases in case of fuel handling accidents. In addition, there should be substantial data available to calculate the probabilities of accidents involving fuel handling based on operational experience. This information should be utilized to determine accident probabilities for the final environmental statement.

2.3 Appendix G 2.3 2.3

The Class 8 control rod ejection accident has been analyzed by TVA assuming a 0.2% failed fuel source term with a release to the environment occurring via containment leakage. However, the statement (p. 5-107) indicates that "failures could occur as a result of this transient," and the PSAR indicates that 40% of the fuel might undergo cladding failure (p. 14.2-26). Thus, the radiological effects of this accident should be reevaluated including the additional source term resulting from the damaged fuel. Also, the bases for the source terms should be presented. Furthermore, this type of accident should be evaluated assuming a primary to secondary side steam generator tube leak.

Similarily, a main steam line rupture accident should be evaluated including a primary to secondary side steam generator tube leak which is not necessarily in the "failed steam generator". The final environmental statement should clearly indicate the release paths and sources of releases, e.g., failed steamline, intact contaminated steam generators, relief valves, condenser vacuum pump. 2.3

The statement indicates that the release of radioactive material due to a steam generator tube rupture is "less than" for the main steam line rupture accident. This is inconsistent with the data presented. Appendix G In addition, it is not clear if the calculated accident consequences as evaluated include dose contributions due to 1) existing secondary side fission product activity released during plant cool-down and 2) primary coolant leakage through the intact steam generators during the cool-down period. For the latter, it does not seem justified to assume that all the existing leakage is in the "failed steam generator."

Emergency Plans

The draft environmental statement notes that a Radiological Emergency Plan (REP) is being prepared for the Sequoyah facility. The TVA plan shows a clear value of adequate planning, and it is indicated that the plan will be coordinated with off site support groups which will include Federal, state, and local agencies. We are basically in agreement with this approach. On page 5-115, the statement implies that site boundary whole body doses during the course of the loss-of-coolant accident would be limited to less than 8.6 mrem through the implementation of site radiological emergency plans. It is not clear if this means 1.5

that the emergency evacuation plan will be in effect for dose levels less than 8.6 mrem. Significant parts of the emergency plan which should be included are: 1) the various levels of response, 2) the criteria for implementing the actions, and 3) the sources of responsibility among the local, state, and Federal agencies as well as within TVA. The plan should be developed to balance the risk/benefit of various response levels. 1.5

November 12, 1973

Mr. Jack E. Ravan
Region IV Administrator
Environmental Protection Agency
1421 Peachtree Street, NE.
Atlanta, Georgia 30309

Dear Mr. Ravan:

On December 21, 1971, in a letter from Mr. Robert W. Fri to Mr. Lynn Seeber, TVA General Manager, EPA provided comments on our draft environmental statement for the Sequoyah Nuclear Plant, Units 1 and 2. In that letter and enclosures it was requested that TVA provide additional information concerning alternative cooling systems before filing the final environmental statement with the Council on Environmental Quality.

TVA has conducted a detailed reevaluation of the proposed cooling facilities for Sequoyah. Based on this reevaluation, it is proposed that natural draft cooling towers be designed and installed to supplement the cooling capability of the once-through diffuser system. It is our intention to operate the composite cooling system in the open, helper, and closed modes as needed in order to comply with the revised thermal criteria.

Forty months will be required for design and construction of the cooling towers. During eight to nine months of the latter eleven months of that period, only one of the two nuclear units is to be operational. During this interim period, TVA expects to be able to meet applicable standards with the diffuser system and with minor regulation of streamflow.

Filing of the Sequoyah final environmental impact statement with CEQ is planned for early December. We should be pleased to meet with you prior to that time to resolve any remaining questions concerning the alternative cooling systems for Sequoyah.

Sincerely yours,

F. E. Gartrell, Dr. P. H.
Director of Environmental Planning

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
1421 PEACHTREE ST., N. E.
ATLANTA, GEORGIA 30309

4AEP:CHK

Dr. F. E. Gartrell
Director of Environmental Planning
Tennessee Valley Authority
Chattanooga, Tennessee 37401

Dear Dr. Gartrell:

Reference is made to your letter of November 12, 1973, relative to the Sequoyah Nuclear Plant. Due to the imminence of issuance of the Final Environmental Statement and the difficulty of scheduling a meeting in December, a meeting prior to issuance of the Statement appears impossible.

Therefore, we will review the Statement when received and subsequently schedule a meeting should any issues remain unresolved.

Sincerely yours,

Paul Traina

Paul J. Traina
Director,
Enforcement Division

Enclosure: Letter dated
November 12, 1973

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

December 30, 1971

Dr. F. E. Gartrell
Director of Environmental
Research and Development
Tennessee Valley Authority
Chattanooga, Tennessee 37401

Dear Dr. Gartrell:

This is in response to your letter of October 19, 1971, requesting comments of the Federal Power Commission on the Tennessee Valley Authority's Draft Environmental Statement for the Sequoyah Nuclear Plant, Units 1 and 2.

These comments are in accordance with the National Environmental Policy Act of 1969 and the Guidelines of the President's Council on Environmental Quality dated April 23, 1971. We understand that possible effects of the proposed facilities on the natural environment are being analyzed by others. These comments are directed to a review of the need for the facilities as concerns the adequacy and reliability of the bulk power electric system, and are based on the Tennessee Valley Authority's Draft Environmental Statement, the April 1, 1971 submission of the Southeastern Electric Reliability Council (SERC) made in accordance with FPC Order No. 383-2, Statement of Policy on Adequacy and Reliability of Electric Service, and the Federal Power Commission staff's independent analyses of these documents together with related information from other Federal Power Commission reports.

The project is located on a 525-acre site on the west shore of Chickamauga Lake on the Tennessee River in Hamilton County about 18 miles northeast of the City of Chattanooga, Tennessee. The 2,250-megawatt plant will contain two 1,125-megawatt steam-turbine-electric generators with pressurized-water nuclear reactors. Unit No. 1 is scheduled for commercial service in April 1974 and Unit No. 2 in December 1974. This new capacity will be wholly-owned by the TVA and will augment existing system generating capacity and that of the Southeastern Region.

Dr. F. E. Gartrell

The TVA's system is the Nation's largest electric power system, currently with 19,800 megawatts of installed generating capacity. This public power generation and transmission system sells power to 160 municipal and rural electric cooperatives, 46 industries, and 11 Federal customers located in a supply area of 80,000 square miles and with a population of six million people. The TVA's system is interconnected at 26 points with adjacent systems with which it has power exchange agreements.

The Applicant states that the Sequoyah Units No. 1 and 2 will be required to meet the anticipated system loads during the 1974 summer peak and the 1974-75 winter peak periods.

The Need for Power

The need for the new capacity of the proposed units will be evaluated in relation to the 1974 summer peak and the 1974-75 winter peak periods which immediately follow the commercial service dates of April 1974 for Unit No. 1 and December 1974 for Unit No. 2.

The data tabulated below show the loads served by the Tennessee Valley Authority and the Southeastern Region and the relationship of the Sequoyah Units No. 1 and 2 to their available reserve capacities at the 1974 summer peak and 1974-75 winter peak periods. These are the anticipated initial service periods of the new units, but the life of these units is expected to be some 35 years and they are expected to constitute a proportionate part of the system's total capacity throughout that period. Therefore, they will be depended upon to supply power to meet future demands over a period of many years beyond the initial service needs discussed in this report.

TVA System Reserve Margin

	1974 Summer Peak	1974-75 Winter Peak
Without Sequoyah Units		
Net Capability - Megawatts	25,319	25,458
Load Responsibility - Megawatts 1/	21,690	21,640
Reserve Margin - Megawatts	3,629	3,818
Percent of Peak Load	16.7	17.6

1/ System load plus net of firm receipts and deliveries.

Dr. F. E. Gartrell

TVA System Reserve Margin
(continued)

	1974 Summer Peak	1974-75 Winter Peak
With Sequoyah Units		
Net Capacity - Megawatts	26,444	27,708
Load Responsibility - Megawatts 1/	21,690	21,640
Reserve Margin - Megawatts	4,754	6,068
Percent of Peak Load	21.9	28.0
Percent of Reserve Represented by these Units	24.2	37.1

Southeast Regional Reserve Margin

	1974 Summer Peak	1974-75 Winter Peak
Without Sequoyah Units		
Net Capability - Megawatts	96,358	101,118
Load Responsibility - Megawatts 1/	80,353	77,106
Reserve Margin - Megawatts	16,005	24,012
Percent of Peak Load	19.9	31.1
With Sequoyah Units		
Net Capability - Megawatts	97,483	103,368
Load Responsbility - Megawatts 1/	80,353	77,106
Reserve Margin - Megawatts	17,130	26,262
Percent of Peak Load	21.3	34.1
Percent of Reserve Represented by these Units	6.6	8.6

1/ System load plus net of firm receipts and deliveries.

The Tennessee Valley Authority's system is a winter peaking system and it participates in seasonal diversity interchanges of firm power with the summer peaking companies in the SERC region and adjoining regions. A particular interchange arrangement of note is the 1,500-megawatt seasonal exchange between TVA and the South Central Electric Companies. At the time of 1974 summer peak with Sequoyah Unit No. 1 in service, TVA's system reserves are estimated to be 4,754 megawatts or 21.9 percent of peak load. At the 1974-75 winter peak with both

Dr. F. E. Gartrell

Sequoyah Unit No. 1 and No. 2 in service, system reserves are estimated to be 6,068 megawatts or 28.0 percent of peak load. If these units are not available to meet these peaks, reserves will be reduced to 3,629 megawatts or 16.7 percent of peak load and 3,818 megawatts or 17.6 percent of these peaks, respectively.

Southeast Regional reserves at the time of the 1974 summer peak are estimated at 17,130 megawatts or 21.3 percent of peak with Sequoyah Unit No. 1 in service. At the time of the 1974-75 winter peak with both Sequoyah Units in service, the reserves are estimated at 26,262 megawatts or 34.1 percent of peak load. If the Sequoyah Units are delayed and not available to meet these peak periods, the reserves will be reduced to 16,005 megawatts or 19.9 percent of peak and 24,012 megawatts or 31.1 percent of peak load, respectively.

In the fast-growing Southeast Region, the reserve margins for both TVA and the SERC region during the 1974 summer and 1974-75 winter peak periods are considered satisfactory with the capacity of the Sequoyah Units 1 and 2 included. Without these units, the reserve margins of 16.7 percent for 1974 summer and 17.6 percent for the following winter for the TVA's system are less than what the Applicant considers to be of minimal order of magnitude to provide the needed adequacy and reliability of bulk power supply. A major impact upon the other region systems, if these two units are not timely installed, particularly those with summer peaks, would be the loss of flexibility in scheduling diversity interchanges to permit the necessary scheduled maintenance programs to continue.

The Southeastern Electric Reliability Council in its April 1, 1971 response to FPC Order 383-2, listed 38,853 megawatts of capacity to be added and in commercial operation by the 1974-75 winter peak, including the two Sequoyah Units. This included 3,161 megawatts of combustion turbines, 1,207 megawatts of hydroelectric capacity, 19,076 megawatts of fossil-fired steam capacity, and 15,409 megawatts of nuclear capacity. The 38,853 megawatts of capacity to be added is 38.3 percent of the total regionally-owned capacity of 101,508 megawatts shown to be in service for the 1974-75 winter peak. The two Sequoyah Units represents 5.8 percent of the total regional additions in this time period, and 14.6 percent of the nuclear additions. Since the submission of the report, delays have already been experienced with some of this capacity and a probability exists for further delays, particularly with the nuclear units. Any such delays could rapidly erode the reserve margins analyzed above.

Dr. F. E. Gartrell

Alternates to the Proposed Units

Any reliance upon the purchase of firm power, in addition to that already scheduled, from other systems located in the Southeast Region or adjoining regions is not practical, since these systems currently have no better reserve margins that those on the TVA's system. The systems within the region recognize the only solution to the problem of low reserve margin is the acquisition of additional generating capacity within their respective systems which is evidenced by the large construction program scheduled.

A review of the potential undeveloped hydroelectric capacity indicates that the capacity of the area has been almost fully developed and comparatively little additional hydroelectric development is foreseen on the TVA's system in this time frame and economic situation. Large amounts of gas-turbine peaking capacity have been installed recently in the TVA's system and other regional systems, but such peaking capacity does not adequately fill the base-load needs of the systems involved since gas-turbine installations are not usually suited to high load-factor operation because of the resulting heavy maintenance requirements and the high-unit cost of power produced by such units.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

December 8, 1971

Mr. F. E. Gartrell
Tennessee Valley Authority
Chattanooga, Tennessee 37401

Dear Mr. Gartrell:

We have had the draft environmental statement for TVA's Sequoyah Nuclear Plant Units 1 and 2 reviewed in the relevant agencies of the Department of Agriculture, and the only comment we have to make is that clearing, site development and construction of this project will disturb the soil and vegetation on several hundred acres of land in a relatively high rainfall area. Assistance in minimizing runoff is available from the Soil Conservation Service through the local soil and water conservation district.

Two copies of the statement are returned herewith.

Sincerely,

T. C. Byerly

T. C. BYERLY
Coordinator, Environmental
Quality Activities

Attachments

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

January 5, 1972

Dr. F. E. Gartrell
Director of Environmental Research and Development
Tennessee Valley Authority
Chattanooga, Tennessee 37401

Dear Dr. Gartrell:

This is in response to your memorandum of December 10, 1971. We have reviewed the draft environmental statement covering the Rehabilitation of the Nolichucky Project and have no comment.

I am enclosing an information copy of the Department's comments on the TVA Sequoyah Nuclear Power Plant Units 1 and 2.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosure

December 27, 1971

Mr. Lester Rogers, Director
Division of Radiological and
Environmental Protection
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

We have reviewed the draft environmental impact statement for the TVA Sequoyah Nuclear Power Plant Units 1 and 2 and offer the following comments.

First, the environmental statement itself does not contain sufficient information on meteorological calculations to enable us to verify, for instance, the data presented in Table 30. However, because we had opportunity (in 1968 and 1969) to review the Sequoyah Plant's Safety Analysis Reports, we have independent knowledge of the validity of the applicant's meteorological treatment.

Second, the statement did not discuss the question of increased frequency and intensity of steam fog downstream of the plant that may arise from discharge of waste heat into the Tennessee River. This may be a noteworthy omission since the disadvantages of such fog generation were discussed with reference to alternative (cooling tower, pond) means of wast heat disposal.

Third, there was no discussion of the synergistic warming effects of the Sequoyah and the other nuclear plants in operation or under construction on the River, with regard to fog. Any increased fog from a general warming of the River could have an adverse impact on the safety of river and nearby road traffic.

We hope this information will be helpful.

Sincerely,

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1070
NASHVILLE, TENNESSEE 37202

IN REPLY REFER TO ORNED-P

1 December 1971

Dr. F. E. Gartrell
Director of Environmental Research
and Development
Tennessee Valley Authority
Chattanooga, Tennessee 37401

Dear Dr. Gartrell:

Your letter of 19 October 1971 forwarding a copy of the draft environmental statement for the Sequoyah Nuclear Plant, Units 1 and 2, to Dr. Louis M. Rousselot, Assistant Secretary for Defense (Health and Environment), was referred to this office for reply.

The environmental effects of the proposed project, with regard to those areas in which the Corps of Engineers has jurisdiction or special expertise, seem to have been adequately covered. We have no further comments to offer at this time.

The proposed project will not conflict with any present or projected programs of the Corps of Engineers. The opportunity to review the draft statement is appreciated.

Sincerely yours,

WM. F. BRANDES
Colonel, Corps of Engineers
District Engineer

CF:
Director
Div of Radiological and
Environmental Protection
AEC, Washington, D. C. 20545

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
WASHINGTON, D.C. 20201

OFFICE OF THE SECRETARY

JAN 21 1972

F. E. Gartrell, Dr. P. H.
Director of Environmental Research
and Development
Tennessee Valley Authority
Chattanooga, Tennessee 37401

Dear Dr. Gartrell:

Your draft detailed statement for the proposed Sequoyah Nuclear Plant, Units 1 and 2, transmitted with your memorandum of October 19, 1971, has been reviewed within this Department. Based on information contained in this statement, it does not appear that there will be unacceptable radiation exposures to the public nor other environmental health hazards resulting from construction and operation of this proposed nuclear generating station.

In part 3.4 of the report, Electric Power Supply and Demand, you may wish to include a discussion in subpart 2, Consequences of any delays, a statement concerning health effects which could result from such delays. This might include both an estimate of the health impact of utilizing alternate sources of power as well as that which could result from power shortages due to a reduction in the reliability of the region's power supply.

Sincerely yours,

Merlin K. DuVal, M.D.
Assistant Secretary for
Health and Scientific Affairs

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

MAR 7 1972

Dear Dr. Gartrell:

Your letter of October 19, 1971, requested the Department's comments on the draft environmental statement for the proposed Sequoyah Nuclear Plant, Units 1 and 2, Hamilton County, Tennessee (AEC Docket Nos. 50-327 and 328), furnished in accordance with Section 102(2)(C) of the National Environmental Policy Act of 1969.

Generally, the statement presents a good discussion of most of the environmental impacts of the proposed nuclear plant; however, we have the following comments for your consideration.

Impacts of the Proposed Action

This section should be expanded to include more detailed description of the project's effects on the environment, including both fish and wildlife and their habitats. Specific suggestions are given in the following paragraphs.

The impacts of transmission line right-of-way clearing on the wildlife and their habitats are not adequately evaluated. We suggest that changes in types and amounts of various wildlife habitats be evaluated along with the associated wildlife. Although the statement indicates that the transmission line routes were selected to minimize land-use conflicts including the use of existing rights-of-way and concern for esthetics, it does not fully assess the methods to be used to accomplish this and the expected environmental impacts. 2.2.2 2.2.1 2.2.5(3) 2.2.5(4)

The discussion, given on page 5-47, of dissolved oxygen changes as a result of the plant's operation should be expanded. The statement indicates that, since the condenser cooling water has DO concentrations below saturation levels during the summer months and that the 29.5°F increase of temperature is not apt to cause supersaturation, no significant reduction in oxygen concentration will occur

due to hydraulic or temperature changes caused by the plant's operation. While this may be true when these intake and discharge measurements are taken near the plant the increased need for oxygen by aquatic life due to this raised temperature and the BOD cause by killed plankton may significantly lower the quality of the fish habitat in the downstream waters. 2.6.5(3)

The described radiological monitoring study is generally comprehensive, although it is believed that several items should be added. Aquatic vegetation should be sampled since vegetation provides food and cover for fishes and aquatic animals. Waterfowl, especially resident species, also should be sampled. A waterfowl management area is only 3 miles from the plant site and these birds would travel to feed in the area. A collecting permit from the Bureau of Sport Fisheries and Wildlife is required when sampling waterfowl. In addition to the fish being sampled in the study, piscivorous species such as largemouth bass or white bass also should be sampled. 2.4.3 **Table 2.4-7**

The cumulative radiological and thermal impact upon the environment which will result from this plant and the Watts Bar nuclear and steam plants should be described so that interested persons may have or make a comprehensive evaluation of the impact on Chickamauga Reservoir. In this connection, TVA has asserted that the waste heat load contributed to the stream by Sequoyah proceeds downstream in practically undiminished amount. Since this is so, it becomes imperative to judge the total thermal pollution in relation to the tolerance of the organisms dwelling in the stream and in the reservoirs. It may well be that no additional facilities could be added on this stream in the effort to provide 1,500 MW of generating capacity per annum without very serious results, even to the extent of eliminating some very important game species. Appendix L 2.6.8

Likewise, regarding entrainment, the applicant indicates the amount of entrained plankton will be relatively small, since at average flow, only eight percent of the volume of available water will be passed through the plant. Again, the cumulative effect of this plant plus existing plants upon net loss to the river ecosystem should be quantified and--even if not considered a seriously depleting factor now--should be weighed carefully in considering what might happen if additional plants were added.

The statement discusses the packaging and transportation of high level radioactive wastes for offsite disposal but does not give the locations and method of disposal. We suggest that the location of the disposal site and method of disposal be included in the final statement. 2.1.3(1)

The statement does not adequately present the impacts of postulated accidents for other than air borne emission. Many of the accidents described on page 5-87 and Table 30 could result in releases to the water and should be evaluated in detail. 2.3

Appendix G

We also think that Class 9 accidents resulting in both water and air releases should be described and the impact on human life and the remaining environment discussed as long as there is any possibility of occurrence. The consequences of an accident of this severity could have far-reaching effects on land and all water courses downstream of the plant.

Though the proposed project would not have adverse impact on any existing or known potential unit in the National Park System or on any properties eligible or under study for registration as National Historic Landmarks, National Natural Landmarks, or National Environmental Educational Landmarks, the statement should show evidence of consolidation with the State Liaison Officer of Tennessee (Executive Secretary, Tennessee Historic Commission, State Library and Archives Building, Nashville, Tennessee 37219) for information regarding properties being considered for National Landmark Register nomination. It is recommended that the environmental statement indicate the action taken or proposed to determine whether archaeological resources that have not been disturbed by plant construction and clearing for transmission line rights-of-way are present in the project area. These recommendations and proposals should be included in consideration of impacts on cultural environmental values. 1.4 2.9.4

A complete assessment of the existing and proposed site recreation facilities and the with-the-project recreation potential should be included in the statement. For instance, the thermal impacts of the project on the recreation facilities existing and proposed have not been described. 1.2.7(4)

A timetable showing construction and completion of recreation facilities, as well as arrangements for financing and the responsibility of facility operation and maintenance, should be included. In addition, the combined impacts of the three electric generating plants on Chickamauga Reservoir recreation development should be described so that adequate evaluation of the impacts can be made. 2.9.4

Adverse Environmental Effects of the Action that Cannot be Avoided

This section should restate the adverse impacts of the project on the environment found in the impacts section. In addition, this section should describe in detail the means and measures that will be or are proposed to be taken to eliminate or minimize these effects. 3.0

Alternatives to the Proposed Action

This section does not provide sufficient description of the impacts of the various alternatives on fish and wildlife resources to permit an evaluation. Though detailed consideration of the coal-fired generating plant alternative was given, the criteria for discarding this alternative are not described in sufficient detail that an evaluation can be made. 2.5 4.1.2

Page 7-24 states, "Until thermal standards have been established or other indications of the need for different temperature limits are observed, TVA cannot determine what, if any, additional cooling facilities will be required." In the absence of adequate State thermal standards, we suggest that those given in the Report of the National Technical Advisory Committee on Water Quality Criteria should be used. 2.6.1

Relationship Between the Short-Term Uses and the Long-Term Productivity

This section should compare the environment, including fish and wildlife resources, under "without-the-project conditions" to that under "with-the-project conditions." The short-term effects of the project on the uses and the long-term productivity should be listed and compared. 5.0

Though the monitoring studies will provide an inventory of the area and evidence of the plant's impacts upon the environment as the applicant states, these studies will not describe the relationship between the short-term uses and the long-term productivity.

Irreversible and Irretrievable Commitment of Resources 6.0

In addition to the committed mineral, land, and water resources which are considered irretrievable, the fish and wildlife habitat and the annual production that will be lost also are irretrievable and should be described. Though these resources are renewable, the annual production foregone is irretrievable; thus, the annual production of fish and wildlife due to habitat displacement and loss and any reduction in habitat quality will produce an irretrievable commitment of resources.

We appreciate this opportunity of commenting on the environmental statement for this project.

Sincerely yours,

Deputy Assistant Secretary of the Interior

Dr. F. E. Gartrell
Director of Environmental
Research and Development
Tennessee Valley Authority
Chattanooga, Tennessee 37401

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (WS/83)
400 SEVENTH STREET SW.
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

15 DEC 1971

Dr. F. E. Gartrell
Director of Environmental
Research and Development
Tennessee Valley Authority
Chattanooga, Tennessee 37401

Dear Dr. Gartrell:

This is in response to your recent letter addressed to Mr. Herbert F. DeSimone, Assistant Secretary for Environment and Urban Systems, concerning the draft environmental impact statement on the Sequoyah Nuclear Plant, Units 1 and 2, Hamilton County, Tennessee.

The concerned operating administrations and staff of the Department of Transportation have reviewed the draft statement for this project. It is the determination of this Department that the impact of this project upon transportation is fairly minimal. Noted however in the Federal Railroad Administration review of the draft statement is the following:

> "We are pleased to see the environmental impact of new transmission lines discussed in such detail. However, the question of inductive coupling or direct faulting with the signal and communication lines of railroads is not addressed. We would suggest that the statement reflect that there are neither railroads involved or that satisfactory protection has been mutually agreed upon with any railroad company involved." 2.2.5(2)

In its review of the draft statement, the Department's Office of Hazardous Materials noted the following:

> "We have no specific comment to make on the statement since it is difficult to evaluate the content of the statement relative to transport in other than a general fashion. Noted, however, in the statement is the significantly greater depth in which the transport of nuclear materials are discussed. The statement is not inconsistent with existing AEC and DOT regulatory requirements.

"TVA may be aware that the AEC regulatory staff has recently been working very intensely on the development of a document which will be entitled "Detailed Statement - Environmental Considerations by the Division of Radiological and Environmental Protection, USAEC, Related to the Transportation of Nuclear Fuel from the Fabrication Plant to the Nuclear Power Plant, Irradiated Fuel from the Nuclear Power Plant to the Fuel Recovery Plant, and Solid Waste from the Nuclear Power Plant to the Waste Burial Site". Although this statement has not yet been relased by the USAEC, it will generally be a generic statement which the AEC will easily be able to fit into their own environmental impact statements prepared in compliance with NEPA, 1969 for nuclear facilities and projects.

"It is noted that the Sequoyah statement transportation discussion is directed to the three typical phases of transportation that future AEC statements will deal with. This office also understands that the AEC statement will also include a "Risk Analysis of Transportation Accidents" including a discussion on alternatives to the transportation methods analyzed."

The Department of Transportation is pleased to review draft statements such as this one on Sequoyah which has addressed itself to those aspects of transportation which may be of concern to us and which have been informally discussed with members of your staff.

The Department concurs in the Sequoyah Nuclear Plant Project and recommends early implementation.

The opportunity for us to review and comment on the draft environmental impact statement for the Sequoyah Project is appreciated.

Sincerely,

J. M. AUSTIN
Captain, U. S. Coast Guard
Deputy Chief, Office of Marine
Environment and Systems
By direction of the Commandant

STATE OF TENNESSEE
OFFICE OF URBAN AND FEDERAL AFFAIRS
SUITE 1025
ANDREW JACKSON STATE OFFICE BUILDING
NASHVILLE 37219

ARD K. BRADLEY
DIRECTOR

741-2714

December 29, 1971

Mr. A. J. Gray
Division of Planning
Tennessee Valley Authority
Knoxville, Tennessee 37902

Dear Mr. Gray:

Enclosed are copies of the initial review responses we received from our Public Health Department and the Game and Fish Commission on TVA's Environmental Impact Statement for the Sequoyah Nuclear Plant Units 1 and 2. They are so technical that I considered it unwise to paraphrase them.

Both agencies want to meet with your personnel to discuss specific questions raised in the letters. I assume that your personnel, like ours, will be getting back to routine in early January. When they have had time to digest these comments, I'll look for a telephone call from you to arrange some conferences.

Have a good New Year!

Sincerely,

John Wellborn

JW:ks

Enclosures

Tennessee Game and Fish Commission

Ellington Agricultural Center • P. O. Box 40747 • Nashville, Tennessee 37220

DAVID M. GOODRICH, DIRECTOR
HAROLD E. WARVEL, ASS'T DIR.

November 30, 1971

Mr. John Wellborn
Division of Urban and Federal Affairs
1025 Andrew Jackson State Office Building
Nashville, Tennessee 37219

Dear Mr. Wellborn:

There are two general areas for concern about the proposed design of the Sequoyah Nuclear Plants. Most important are the temperature considerations with reference to criteria to be used and methods of meeting the criteria. TVA precludes many questions by stating that, whatever standard is adopted, the plant will be designed to comply. They further state that, considering three possible criteria, any could be met without the use of cooling towers and employing a diffuser system instead. None of the three hypothetical criteria considered include one consistent with the needs for coolwater fish species. Although the new temperature standard adopted by the Tennessee Water Quality Control Board has not included a section specifically protecting these species, the Game and Fish Commission is still working toward the adoption of such a section which would not allow waters where these species exist to be elevated in temperature above 83°F. Although Chickamauga Lake is a borderline situation, it is notable that its fishery includes many coolwater fishes. These include rock bass, sauger, walleye, yellow perch, several species of redhorse, hogsucker, logperch, and the fantail darter. The Hiwassee River and this area of Chickamauga Lake comprise the only region in the state that the introduced yellow perch exists. In addition to these, other species are intermediate between warm and coolwater in their temperature requirements. These include spotted bass, and the longear and redbreast sunfish. The new temperature standard adopted by the Tennessee Water Quality Control Board is set at a maximum 87°F at a 10-foot depth. Previous records show that this area and depth of the lake normally do not exceed 79°F to 83°F; this is consistent with the needs of the coolwater species which are normally not found in waters over 83°F. Surface temperatures reach over 84°F but, at such times, the coolwater species seek lower, cooler levels of water assuming these levels still contain oxygen. Thus, we have a situation in Chickamauga Lake where the water is presently at a temperature barely acceptable to the coolwater species for which a limited fishery now exists. To elevate these temperatures at all would jeopardize their existence. 2.6.1

MEMBERS OF COMMISSION

DR. W. H. BLACKBURN, Camden
G. L. LOWE, Chattanooga
SMITH HOWARD, Pulaski
JAMES J. BEASLEY, Milan
RHEA R. BROWDER, Harriman
EDGAR W. EVINS, Alexandria
DR. WILLIAM C. BURRUS, Hendersonville
DR. PERCY A. CLAYTON, Memphis
BEN SCHARFSTEIN, Johnson City
WILLIAM JENKINS, Rogersville

Mr. John Wellborn
Page 2
November 30, 1971

Other factors point out the need for consideration of a more strict temperature standard. Presently, temperatures in overbank and spawning areas of the lake exceed the 84°F maximum temperature mentioned above. 2.6.4
Do TVA's calculated temperature elevations consider that the natural temperatures in these areas are higher? Will temperatures in these areas still be within criteria limits while the plant is in operation? How was it determined that no significant adverse effects would occur to reproducing organisms from this phenomenon (page 5-45 - 5-46)? TVA states that "... the impact of the warm water on spawning habitats cannot be assessed at this time." (P. 5-45) This entire discussion appears unclear as to what TVA has determined and predicts.

Page 5-9 begins a discussion of expected water temperatures assuming a 93°F maximum, 10°F maximum rise standard. In this discussion it is stated that the average temperature outside the mixing zone would not exceed 93°F and 95°F would not be exceeded at any point at any time. It is our impression that a 93°F maximum temperature standard would not mean an average but instead a temperature not to be exceeded at any point at any time. This discussion also identifies the mixing zone not to exceed 75% of the reservoir cross section which appears contradictory to the caption of Figure 21. 2.6.4
Some aspects of the mixing zone appear unclear. The proposed diffuser line would span 75% of the breadth of the lake. Complete mixing is to be attained within 50 to 200 feet downstream. Would temperature criteria be met at this point of 200 feet from the diffuser or at a point much farther downstream where the water spanned by the diffuser mixes with that bypassing same? It is noted that reference figures presented in Figure 21 assume complete mixing of discharge water with the entire flow of the river. Figure 21 presents hypothetical figures assuming full, continuous operation of both units. Would this not produce a much smoother graph line than would be shown if normal fluctuations in unit use were reflected? Using the least strict temperature standard (93°F maximum, 10°F rise maximum), standards are equalled or exceeded often in the years covered by the graphs. TVA states that these instances will be eliminated by manipulation of stream flows from upstream dam releases. However, the estimates given assume a uniform daily streamflow which does not reflect reality. If they could have been shown, would streamflow fluctuations within a day's time have 2.6.4
altered the peaks of these graphs? Knowledge of instantaneous temperature readings is of vital importance in considering the well-being of aquatic organisms.

It appears that, even though stratification is weak, the method by Appendix
which underlying levels of water in the summer would be heated most might sharply increase the summer temperatures of the Chickamauga tailwater even though a given temperature criteria would be met. The tailwater temperatures are determined by the temperatures of waters from varying depths of the lake making up the total discharge. The composite discharge in the summer would therefore normally include water from the cooler lower levels in the lake. The effect of this could have an effect on the tailwater

fishery even if none was felt in the lake fishery where lower levels of water are most significantly temperature elevated. In addition to the warmwater fishes, smallmouth bass, spotted bass, rock bass, longear sunfish, sauger, walleye, yellow perch, redhorse, and an occasional trout (from stocked North Chickamauga Creek) are caught representing a wide variety of cool and even coldwater species. Temperature increases in the tailwater would almost certainly affect this fishery.

TVA concludes that, although cooling towers are feasible if standards required them, present proposed temperature standards deem them unnecessary. They state that "It is concluded that operating the plant in compliance with a 10°F rise and a 93°F maximum would not result in any significant adverse effect on the reservoir ecology except for possible effects resulting from death of entrained organisms." (P. 5-46). The fact that EPA has rejected this temperature standard and is insisting on a more strict one seriously questions the validity of the above quote. The above discussion questions how the standard will be met, and raises specific questions as to the possible effects on the aquatic environment. Heated water acts synergistically with other pollutants in their impact on aquatic organisms. Generally the presence of a given pollutant would have a more detrimental impact on fish in warmer water than the same level of that pollutant in cooler water. In the case of oxygen, the above is 2.6.1
true in addition to the fact that warmer water normally cannot hold as much oxygen, all other factors remaining equal. The headwaters of Nickajack Lake (Chattanooga, below Chickamauga Dam) are among the most polluted waters of the state. Tremendous quantities of industrial and municipal wastes are received by the Tennessee River at Chattanooga. We question the effect of even slight elevations of water temperature in 2.6.5(
relation to the pollutional impact of these wastes.

In light of the above, we urge the consideration of additional cooling of the discharge water via cooling towers or some other practical method. Below is a copy of the Tennessee Antidegradation Statement of 2.6.9
the General Water Quality Criteria for the Definition and Control of Pollution in the Waters of Tennessee.

1. The Standards and Plan adopted are designed to provide for the protection of existing water quality and/or the upgrading or "enhancement" of water quality in every interstate stream within Tennessee. It is recognized that some waters may have existing quality better than established standards.

2. The Criteria and Standards shall not be construed as permitting the degradation of these higher quality waters when such can be prevented by reasonable pollution control measures. In this regard, existing high quality water will be maintained unless and until it is affirmatively demonstrated to the Tennessee Stream Pollution Control Board that a change is justifiable as a result of necessary social and economic development.

3. All discharges of sewage, industrial waste, or other waste shall receive the best practicable treatment (secondary or the equivalent) or control according to the policy and procedure of the Tennessee Stream Pollution Control Board. A degree of treatment greater than secondary when necessary to protect the water uses will be required for selected sewage and waste discharges.

4. In implementing the provisions of the above as they relate to interstate streams, the Tennessee Stream Pollution Control Board will cooperate with the Secretary of the Interior in order to assist him in carrying out his responsibilities under the Federal Water Pollution Control Act, as amended. 2.5

We feel that, although an existing standard may be met, reasonable pollution control measures are available to TVA to prevent degradation of the water to the extent standards may allow. In such a congested area as this where a major nuclear power plant is planned above (Watts Bar Dam) and an extremely heavy pollution load is already being carried especially below the proposed Sequoyah plant, such considerations are warranted.

Our second major area of concern is the entrainment of plankton, and planktonic fish eggs and larvae into the plant intake. TVA states that "Bypassed plankton should be stimulated by the increase in temperature." (P. 5-43). This is understood for the heated water outside of the mixing zone. However, those passing through the mixing zone (which spans 75% of the breadth of the stream) may encounter similar problems as those entrained in the intake. After entraining as much as 12% of the total flow, it appears possible that any further mortality in the mixing one might prove significant. We would ask if TVA has considered these possibilities and, if so, request that measures be planned in the future to alleviate the problem if it develops after operation begins. Again in connection with water quality, a significant amount of dead organic matter would tend to raise the BOD and further lower oxygen levels. 2.6.5(2)

In summary, the Tennessee Game and Fish Commission requests consideration of the following:

1. Answers to certain specific questions given in the text of this letter.

2. Further consideration of cooling towers or other cooling methods for discharge water for the following reasons:

   a. To meet a proposed coolwater temperature standard instead of the temperature standard set for warmwater fishes. Many coolwater species presently exist in Chickamauga Reservoir.

b. Protection of the particularly susceptible Chickamauga tailwater.

c. Protection of overbank and spawning areas of Chickamauga Lake.

d. Prevent further degradation of downstream waters which are already heavily polluted.

e. To comply with the Tennessee Antidegradation Statement of the Tennessee Water Quality Criteria.

3. Further consideration of the possible impact of organisms destruction due to entrainment and contact in the mixing zone and preparation of a plan to alleviate the problem if it proves significant.

Thank you for allowing us to comment on this project.

Yours very truly,

TENNESSEE GAME AND FISH COMMISSION

Harold E. Warvel
Assistant Director

HEW/DMS/jk

cc: Mr. Hudson Nichols
Mr. Robert Hatcher
Mr. Leary Jones
Mr. Ed Hockensmith

WINFIELD DUNN
GOVERNOR

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

STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH
NASHVILLE 37219

627 Cordell Hull Building

December 8, 1971

Mr. John Wellborn
Office of Urban and Federal Affairs
Suite 1025
Andrew Jackson State Office Building
Nashville, Tennessee 37219

Dear Mr. Wellborn:

In accordance with your memorandum of October 28, 1971, our Divisions of Water Quality Control, Air Pollution Control, and Industrial and Radiological Health have reviewed the Environmental Impact Statement on the Sequoyah Nuclear Plant Units 1 and 2. Please note their comments below.

DIVISION OF WATER QUALITY CONTROL

Page 5-6(3) states that the plant will have only minimal effects on the chemical and physical characteristics of the reservoir and will not alter the present usage of this portion of the Tennessee River.

Page 5-7 quotes the State of Tennessee Criteria. The figures quoted are those of the Stream Pollution Control Board which were not approved by the Environmental Protection Agency. Attached is a copy of the revised Criteria adopted by the Water Quality Control Board on October 26, 1971. The revised Criteria allows 5°F or 3°C variation with a maximum of 87°F or 31°C. This nuclear plant is designed for a 10°F rise not to exceed 93°F as the average temperature over the cross section. This will not meet the new criteria. 2.6.1

Page 5-27 notes that sodium chromate is used as a corrosion inhibitor. The report states that none will be released. No treatment of wastes is proposed for the water filtration unit. The size of the treatment plant is not stated; however, the Refuse Act of 1899 is requiring all water treatment plants to provide treatment of the sludge and backwash water. 2.5.1

DIVISION OF AIR POLLUTION CONTROL

It appears that there would be no air pollution emissions that would directly concern our division. While they will have some emission

Mr. John Wellborn
December 8, 1971
Page 2

in the form of gaseous wastes, the only releases of concern are radioactive gases which will be monitored at all times. This phase of the report will be reviewed by the Industrial and Radiological Health Division.

DIVISION OF INDUSTRIAL AND RADIOLOGICAL HEALTH

2.4.1(4)

Page 5-65 - Reference is made to the release of radioactive gases. We question here the good judgment of releasing gaseous wastes near the top of the reactor building. Ideally, such releases would be made through a high stack. By releasing these gases near the top of the reactor building, it may possibly permit their entry, with little dilution, into ventilating ducts during certain weather conditions.

2.4.1(2)

Page 5-67, Paragraph 3 - The intent of recycling and not releasing tritium waste having a tritium concentration higher than 50 percent of the concentration of the primary coolant is stated. This would, of course, require an analysis of such primary coolant prior to any release of tritium. However, the concentration of tritium in the waste, permitted to be released, would always be dependent upon the number of years the reactor had been operating and presumedly could be very high. Page 5-68 mentions that the tritium may not be recycled for the forty-year life of the reactor due to the necessity of maintaining the tritium in the primary coolant at a safe level. We feel that the criterion for environmental release of tritium should be stated and should not be based on the varying and increasing concentration of tritium in the primary coolant loop of the reactor.

2.4.1(2)

Page 5-68, Paragraph 1 - The term "acceptable limits" should be defined.

2.1

Page 5-72, last paragraph - The specific regulations of the U.S. Department of Transportation should be stated in place of the general reference to "applicable regulations".

Page 5-77 - In all probability, the values listed in items one (1) through four (4) of (d) have been taken from Section 173.393 of Department of Transportation regulations. If so, item two (2) should state additionally that "closed vehicles only will be used", to conform with the Department of Transportation requirement.

Table 2.4-

Page 5-85 - In the table on this page, last column of A. 1, the quantity of ten (10) curies is given as the proposed 10 CFR 50 Appendix I limit for the annual estimated total quantity (except tritium) of radioactive materials to be released in liquid effluents. As published June 9, 1971, in the Federal Register, Appendix I of 10 CFR 50, Item A. 1. lists the acceptable quantity as five (5) curies.

Mr. John Wellborn
December 8, 1971
Page 3

Appendix G

Page 5-99, Paragraph 2 - The use of the term "administrative controls" here suggests that such administrative controls may not necessarily be exercised. This term should at least be defined so that some judgment can be made of the appropriateness of the statement.

Page 5-99, Paragraph 3 - We question how it can be stated unequivocally that no operating transients will occur so as to exceed design limits of the fuel. We realize that this statement has been made on the basis that "the plant design incorporates a reactor protection system which limits the postulated transients", but we do not agree that a reactor protection system has been designed which will preclude all possible malfunctions.

Page 5-101, Paragraph 4 (including Table 23 which follows Section 10) - Herein is listed the noble gases and the iodines which would be released due to a primary to secondary leak. We question the omission of any mention of tritium, which would also presumedly be released from primary to secondary loop with the radioactive gases.

Table 2.4-2

Table 20 - By adding the individual quantities of radioactive materials, we obtained a total of 0.409 curies instead of 0.362 curies as stated in the table. Also, we are unable to understand why tritium was not listed, as tritium recycling was apparently not assumed in the preparation of this table (see note 2 on this table). Also, on comparing Table 20 with Table 11 1-4 of the Preliminary Safety Analysis Report, which has a title identical to that of Table 20, submitted by the Tennessee Valley Authority prior to issuance of a construction permit, it has been noted that there is a significant difference in the number of isotopes listed and the quantities estimated to be released, e.g., excluding the tritium which is listed separately from other isotopes in Table 11 1-4, the estimated totals given in the two (2) tables are as follows:

Table 11 1-4 of PSAR - 8.22×10^4 μCi (0.0822 curies)
Table 20 - 0.362 curies.

We wish to know the basis for calculating the estimated releases in each report.

If other information is needed, please advise.

Very truly yours,

David

David H. Booth
Assistant Director
Bureau of Environmental Health Services

DHB:bah

STATE OF TENNESSEE

Water Quality Control Board

General Water Quality Criteria Proposed Temperature Standards For:

Domestic Raw Water Supply

Section (g) to read: The maximum water temperature change shall not exceed 3°C relative to an upstream control point. The temperature of the water shall not exceed 31°C and the maximum rate of change shall not exceed 2°C per hour. The temperature in impoundments where stratification occurs will be measured at a depth of 10 feet and the temperature in flowing streams shall be measured at mid-depth.

Industrial Water Supply

Section (g) to read: The maximum water temperature change shall not exceed 3°C relative to an upstream control point. The temperature of the water shall not exceed 31°C and the maximum rate of change shall not exceed 2°C per hour. The temperature in impoundments where stratification occurs will be measured at a depth of 10 feet and the temperature in flowing streams shall be measured at mid-depth.

Fish and Aquatic Life

Section (e) to read: The maximum water temperature change shall not exceed 3°C relative to an upstream control point. The temperature of recognized trout waters shall not exceed 20°C. The temperature of water shall not exceed 31°C [illegible] maximum rate of change shall not exceed 2°C per hour. There shall be no abnormal temperature changes that may affect aquatic life unless caused by natural conditions. The temperature in impoundments where stratification occurs will be measured at a depth of 10 feet and the temperature in flowing streams shall be measured at mid-depth.

Recreation

Section (e) to read: The maximum water temperature change shall not exceed 3°C relative to an upstream control point. The temperature of the water shall not exceed 31°C and the maximum rate of change shall not exceed 2°C per hour. The temperature in impoundments where stratification occurs will be measured at a depth of 10 feet and the temperature in flowing streams shall be measured at mid-depth

TENNESSEE HISTORICAL COMMISSION
STATE LIBRARY AND ARCHIVES BUILDING
NASHVILLE, TENNESSEE 37219

ROBERT A. MCGAW, CHAIRMAN
NASHVILLE
VERNON SHARP, VICE-CHAIRMAN
NASHVILLE

MICHAEL J. SMITH
EXECUTIVE DIRECTOR

April 5, 1972

Mr. John Wellborn
Office of Urban and Federal Affairs
Andrew Jackson State Office Building
Nashville, Tennessee 37219

Dear Mr. Wellborn:

Reference is made to the Tennessee Valley Authority's Environmental Statement concerning the Sequoyah Nuclear Plant, dated October 19, 1971.

We concur in the statement that there are no properties on the National Register of Historic Places that would be affected by the construction of the Sequoyah Nuclear Plant.

However, we question the cultural effects on present and future generations in the Tennessee River Valley and Hamilton County that will result from economic growth spurred by this plant. The rosy picture presented in section 6.5 is not altogether convincing. After all, the cultural environment in which people live includes the physical landscape and if that landscape ceases to resemble its past, a portion of the people's history is also lost. Unplanned economic growth can produce these changes. If the Tennessee Valley Authority is aware of and has studied such long-range effects of this power plant, it is not evident in this Environmental Statement. 2.8

Sincerely,

Herbert L. Harper

Herbert L. Harper
Director of Programs

HLH;jg

November 13, 1973

Ms. Suzanne M. Bentley
Grant Review Coordinator
Office of Urban and Federal Affairs
Suite 1312
Andrew Jackson State Office Bldg.
Nashville, Tennessee 37219

Dear Ms. Bentley:

On December 29, 1971, in Mr. Wellborn's letter to Mr. A. J. Gray, your office provided comments on our draft environmental statement for the Sequoyah Nuclear Plant, Units 1 and 2. In that letter and enclosures it was requested that TVA provide additional information concerning alternative cooling systems before filing the final environmental impact statement with the Council on Environmental Quality.

TVA has conducted a detailed reevaluation of the proposed cooling facilities for Sequoyah. Based on this reevaluation, it is proposed that natural draft cooling towers be designed and installed to supplement the cooling capability of the once-through diffuser system. It is our intention to operate the composite cooling system in the open, helper, and closed modes as needed in order to comply with the revised thermal criteria.

Forty months will be required for design and construction of the cooling towers. During eight to nine months of the latter eleven months of that period, only one of the two nuclear units is to be operational. During this interim period, TVA expects to be able to meet applicable standards with the diffuser system and with minor regulation of streamflow.

The reevaluation of the proposed cooling facilities is reflected in the enclosed working draft of Section 2.6 "Heat Dissipation" to be included in the Sequoyah final environmental statement which we plan to file with CEQ by early December. We should be pleased to meet with you prior to that time to resolve any remaining questions concerning the alternative cooling systems for Sequoyah.

Sincerely,

M. I. Foster, Director
Division of Navigation Development
and Regional Studies

Enclosure

Chattanooga Hamilton County
REGIONAL PLANNING COMMISSION

November 22, 1971

Mr. A. J. Gray
Chief, Regional Planning Staff
Tennessee Valley Authority
Knoxville, Tennessee 37902

Dear Sirs:

After a careful review of the draft environmental statement for the Sequoyah Nuclear Plant, we have the following questions and comments:

Appendix L

(1) Has any consideration been given to the cumulative effects upon the environment of this region resulting from the installation of the three proposed nuclear facilities, Watts Bar, Sequoyah, and Browns Ferry? We have contacted the Division of Environmental Research and Development here in Chattanooga and they were not aware of any study of this nature at the present time.

(2) When will the type and degree of treatment for waste chemicals (p. 5-27) be determined? Also, what are the reasonable economic limits set for this treatment program? 2.5

(3) Mention is made on pages 5-32 of spawning and nursery sites approximately two to four miles downstream from the plant site. If the ecology of these areas is upset through increased water temperature and waste chemicals, will game fishing in the area be affected? 2.5 2.6.5

(4) What will be the mortality rate of the Gizzard Shad (pp. 5-40) and will a substantial reduction of these fish affect the game fishing in Chickamauga Lake? 2.6.5(2)

(5) What are the reasonable economic limits set forth on pages 5-61 for the treatment of radioactive wastes?

(6) In the unlikely event that possible adverse effects of radioactive releases in the form of gaseous wastes are detected, will these releases be stopped? 2.4.1(4)

(7) The City of Chattanooga appears to be in the area where the fogging conditions noted on pages 7-10 will probably occur. Will this fog be dissipated before it reaches the downtown area? 2.6.6(2)

OFFICE OF EXECUTIVE DIRECTOR ▫ 200 CITY HALL ANNEX ▫ CHATTANOOGA, TENNESSEE 37402 ▫ 267-6631

1.1.2

(8) In the May, 1970, brochure "Sequoyah Nuclear Plant," mention is made of using 2,400,000 pounds of ice to halt the buildup of heat and pressure within the containment vessel of the reactor. Will this ice be manufactured and stored at the plant site?

(9) We would like to suggest that copies of the final draft of the Sequoyah Environmental Statement be sent to both the Hamilton County Health Department and the Chattanooga-Hamilton County Air Pollution Bureau for their review and comments.

Of primary concern to us is the question, Is TVA considering the combined and cumulative environmental impact of its series of nuclear plants on the region as a whole? or are they writing individual environmental statements on each plant as though it existed in a vacuum?

Thank you for providing us the opportunity to review this environmental statement. If we can be of assistance in the future, we will be more than happy to comply.

Sincerely,

FOR THE EXECUTIVE DIRECTOR

Eugene F. Kelley

Eugene F. Kelley
Associate Planner

EFK:jb

7/12-1

UNITED STATES

ATOMIC ENERGY COMMISSION

WASHINGTON, D.C. 20545

NOV 1 1973

Mr. Lynn Seeber
General Manager
Tennessee Valley Authority
508 Union Avenue
Knoxville, Tennessee 37902

Dear Mr. Seeber:

The PFES of the Sequoyah Nuclear Plant, Units 1 and 2, is being reviewed by the AEC staff, and a partial list of comments is transmitted (Enclosure 1) at this time in order to permit you to continue the preparation of your FES. These comments have been transmitted by telephone to members of your staff. Additional comments will be forwarded by November 20, 1973 when the reviews are completed.

Sincerely,

Daniel R. Muller

Daniel R. Muller, Assistant Director
for Environmental Projects
Directorate of Licensing

Enclosure:
As stated

Enclosure 1

(1). The annual average, relative atmospheric dispersion (X/Q) values are not presented and the staff is unable to evaluate the analysis contained in the PFES. The equation shown in Appendix I, page I-2, apparently is in error, and if used as presented may produce resultant calculations that are not demonstrably conservative. The staff strongly recommends that appropriate values for the relative atmospheric dispersion at the Sequoyah Site be provided in the FES.

(2). Page 1.2-2, Section 4, Paragraph 1. The staff recommends the addition of the phrase, "all of which are tectonically inactive", to the second sentence.

(3). Pages 1.2-3 and 4, Section 5, Paragraphs 3 and 4. The staff believes the word "climate" is inappropriate as used in the discussion of air mass types, and suggests that the climate at Sequoyah is continental rather than the listed "interchangeable continental and maritime". The wide range of tempertures cited is a definitive characteristic of continental climates.

The staff believes that the probability of occurrence of tornadoes at the site cannot be appropriately described as "extremely low" when comparison is made to occurrences in other areas in the region. Reference should be made to the ESSA Report, Severe Local Storm Occurrences, 1955-1967, ESSA Technical Memorandum WBTM FCST 12, Sept. 1969.

(4) Page 1.2-7, flow tabulation. The statement should be made that the flow frequencies listed are also expected to apply in the future with operation of the reservoirs.

(5) Page 1.2-9, Last paragraph. The time history of the temperature observations should be given, and an assessment should be made of their relevance to future conditions.

(6) Page 1.2-12, last paragraph. The estimated water usage at the plant should be provided in tabular form.

(7) Page 1.2-53, figure 1.2-3. Tbe portion of the curve of hourly discharges between the 84th and 90th percentiles apparently is in disagreement with the text, pp 1.2-7.

(8) Page 2.4-27, first paragraph. The staff believes that it would be prudent to monitor radioactivity independent of the plant effluent.

(9) Page 8.2-6, Section (6). If the rate of loss due to evaporation and drift (73 ft^3/S) is the average loss, it should be identified as such. If it is a maximum (consistent with the listed annual maximum evaporative loss of 53,000 acre-feet) then an evaluation of the extremes of the losses during low streamflows would be useful.

(10) Appendix A-3, second paragraph. By the method suggested, and using the data given on page 1.2-4, the staff calculates the probability that a tornado will strike the plant to be 8.4×10^{-4}, or about one in 1195 years.

(11) Appendix A-8, Section (6), last paragraph. The staff notes that LCD for Chattanooga includes a record of a 24-hour snowfall of 12.0 inches in December, 1886, in the vicinity of Chattanooga.

(12) Appendix G-19, Section 10, last sentence. The staff suggests that the phrasing "1/4 of the dispersion conditions listed in Regulatory Guide 1.4", is more appropriate.

(13) The source terms listed for liquid and gaseous waste from the Sequoyah Nuclear Plant are reasonable and comparable to those of other PWR's of like size with similar radwaste treatment systems.

(14) Trucking of the radioactive liquid waste for offsite disposal is not acceptable to the staff as a method for disposal of tritiated water from the plant.

Enclosure 1

AEC Comment Number 1

The annual average relative atmospheric dispersion (X/Q) values are not presented, and the staff is unable to evaluate the analysis contained in the PFES. The equation shown in Appendix I, page I-2, apparently is in error and, if used as presented, may produce resultant calculations that are not demonstrably conservative. The staff strongly recommends that appropriate values for the relative atmospheric dispersion at the Sequoyah site be provided in the FES.

TVA Response

TVA has calculated annual average X/Q's (uncorrected for isotopic decay) for various points of interest, and they are as follows:

1. Maximum annual average X/Q at site boundary = 1.6×10^{-5} sec/m^3 (NE, 701 m)

2. Annual average X/Q at the nearest dairy farm = 1.05×10^{-6} sec/m^3 (NNE, 4,506 m)

3. Annual average X/Q at the cow location which resulted in the highest calculated dose = 1.05×10^{-6} sec/m^3 (NNE, 4,506 m)

The equation, $\Sigma_{zim} = \left(_{zim^2} + \frac{CA}{\Pi}\right) 1/2$ is equation 3.142 in "Meteorology and Atomic Energy, 1968." TVA has used this equation in the past in correcting the vertical plume standard deviation for the effects of the building turbulent wake. This equation is referenced on page 1.42-B2 of Regulatory Guide 1.42. For the calculations presented in Appendix I, A was taken as the minimum cross-sectional area, above grade, of one reactor containment building (1,800 m^2). The reactor containment building extends about 148 feet above grade vertically and is about 130 feet in diameter. If H^2 were substituted for A in the Appendix I dose calculations, the area correction term would be 2,035 m^2. This would lead to slightly lower values of X/Q at distances close to the plant, but it is believed that the differences would not be significant when one considers the overall conservatism included in this model for determining annual average X/Q's. In the third definition from the bottom, (m^3) should be (m^2).

AEC Comment Number 2

Page 1.2-2, section 4, paragraph 1. The staff recommends the addition of the phrase "all of which are tectonically inactive," to the second sentence.

TVA Response

TVA concurs with AEC's suggestion, and the first paragraph under section 4 should be revised to read as follows:

> 4. Seismology - The site lies within the borders of the southern Appalachian seismotectonic province. Figure 1.2-1 locates the nearest faults in the region, all of which are tectonically inactive.

AEC Comment Number 3

Pages 1.2-3 and -4, section 5, paragraphs 3 and 4. The staff believes the word "climate" is inappropriate as used in the discussion of air mass types and suggests that the climate at Sequoyah is continental rather than the listed "interchangeable continental and maritime." The wide range of temperatures cited is a definitive characteristic of continental climates.

The staff believes that the probability of occurrence of tornadoes at the site cannot be appropriately described as "extremely low" when comparison is made to occurrences in other areas in the region. Reference should be made to the ESSA Report, Severe Local Storm Occurrences, 1955-1967, ESSA Technical Memorandum WBTM FCST 12, September 1969.

TVA Response

The paragraph at the bottom of the page should begin, "The predominate air masses affecting the Sequoyah plant site may be described as interchangeably continental and maritime in the winter and spring, predominately maritime in the summer, and continental in the fall."

The tornado probability shown in Appendix A, page A-3, and referred to in the first sentence in the first full paragraph on page 1.2-4 was computed using Thom's method;1/ annual frequency of tornadoes in the 1-degree latitude-longitude square including the site for the period 1953-1962;1/ and area of a 1-degree latitude-longitude square centered at a latitude of 35° 30' N.1/ The probability computed by the AEC Regulatory Staff is based on the data period 1953-1967.2/ We agree that the later data period should be used.

It is worth noting that, while there were 15 tornadoes in the 1-degree square in which the Sequoyah Nuclear Plant (SNP) site is located during the period 1955-1967, there have been no tornadoes reported in Hamilton County (which includes the SNP site) during the period January 1916-August 1973.3,4,5/

The first two sentences in the first full paragraph on page 1.2-4 should read: "The probability of tornado occurrence at the site is not high. Data for the period 1955-1967 show that 15 tornadoes were reported in the 1-degree latitude-longitude square enclosing the site (response reference 2). These data were used to compute the probability of occurrence (Appendix A). However, it should be noted that in Hamilton County (site location) in the southeast corner of the 1-degree square, no tornadoes were reported during the period January 1916 through August 1973 (response reference 3,4,5).

References for Response

1/ Thom, H. C. S., 1963: "Tornado Probabilities." Monthly Weather Review, Volume 91, Nos. 10-12, pp. 730-736.

2/ U.S. Department of Commerce, NSSEC, SELS UNIT, September 1969: "Severe Local Storm Occurrences, 1955-1967." ESSA Technical Memorandum WBTM FCST 12, Weather Bureau (now NWS), Office of Meteorological Operations, Weather Analysis and Prediction Division, Silver Spring, Maryland.

3/ Vaiksnoras, John V., NOAA-Climatologist for Tennessee, April 15, 1971: "Tornado Occurrences in Tennessee." NOAA, National Weather Service Office, Nashville, Tennessee.

4/ _____, revised October 1972: "Tornadoes in Tennessee (1916-1970) with reference to Notable Tornado Disasters in the United States (1880-1970)." Issued by the University of Tennessee, Institute for Public Service, Knoxville, Tennessee.

5/ U.S. Department of Commerce, 1972-1973: Storm Data, Volume 14, Nos. 8-12; Volume 15, Nos. 1-8. NOAA, EDS Asheville, North Carolina.

AEC Comment Number 4

Page 1.2-7, flow tabulation. The statement should be made that the flow frequencies listed are also expected to apply in the future with operation of the reservoirs.

TVA Response

The flow data presented are not flow requirements, but are data based on long-term historic flows at Watts Bar and Chickamauga Dams. Flows vary each year depending upon climatic conditions and the resultant reservoir operations required for flood control, navigation, and power. However, the long-term average flow data presented could reasonably be expected to be similar in the future. TVA anticipates no significant changes in the present criteria for the operation of Watts Bar and Chickamauga Reservoirs due to the construction of the Sequoyah Nuclear Plant. Special operations could be made to meet flow requirements at the plant site should the need arise.

AEC Comment Number 5

Page 1.2-9, last paragraph. The time history of the temperature observations should be given, and an assessment should be made of their relevance to future conditions.

TVA Response

The last paragraph should be revised to read as follows:

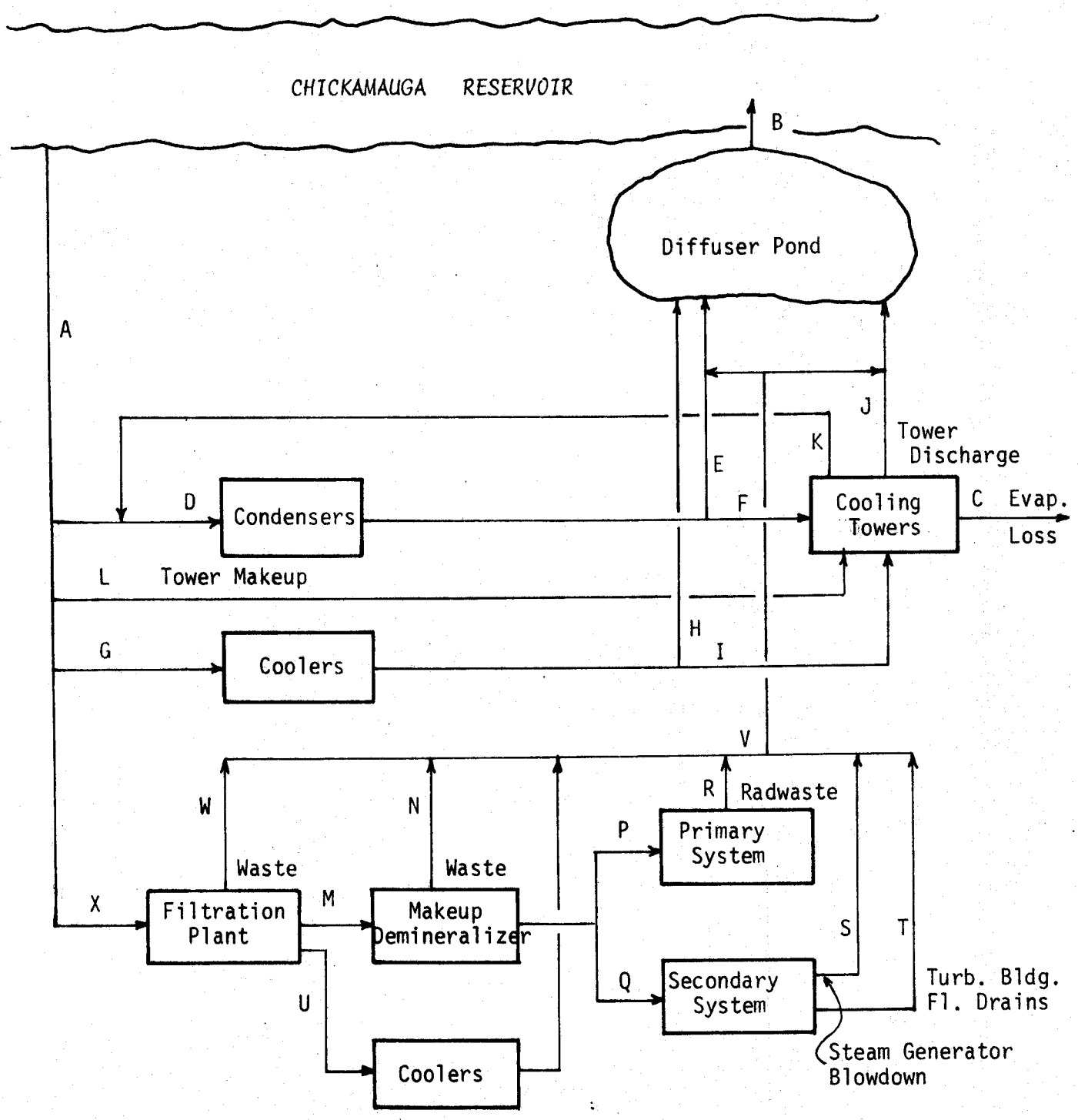
> "Water temperature observations at selected Tennessee River stations were included in the data collected during the water-quality surveys. These observations indicate that Chickamauga Reservoir is weakly stratified during summer months. Table 1.2-13 summarizes the water temperatures recorded during the period of 1969 through 1972 at the thermal monitor installed to collect preoperational data. Water temperature and dissolved oxygen observations from an early survey (July 12, 1960 through June 14, 1961) are presented in table 1.2-11. Future conditions are expected to be similar."

AEC Comment Number 6

Page 1.2-12, last paragraph. The estimated water usage at the plant should be provided in tabular form.

TVA Response

The plant water use diagram and table show estimated plant water uses for the Sequoyah Nuclear Plant.



PLANT WATER USE DIAGRAM

Table - ESTIMATED PLANT WATER USES

Flow Rates in Gallons Per Day

	Both Units At Maximum Power			One Unit At Maximum Power One Unit Shut Down		
	Open	Helper	Closed	Open	Helper	Closed
A	1.654×10^9	1.654×10^9	9.78×10^7	8.47×10^8	8.47×10^8	5.03×10^7
B	1.654×10^9	1.605×10^9	4.91×10^7	8.47×10^8	8.22×10^8	2.53×10^7
C	-	9.88×10^7	4.88×10^7	-	2.50×10^7	2.50×10^7
D	1.613×10^9	1.613×10^9	1.613×10^9	8.07×10^8	8.07×10^8	8.07×10^8
E	1.613×10^9	-	-	8.07×10^8	-	-
F	-	1.613×10^9	1.613×10^9	-	8.07×10^8	8.07×10^8
G	4.10×10^7	4.10×10^7	4.10×10^7	4.04×10^7	4.04×10^7	4.04×10^7
H	4.10×10^7	-	-	4.04×10^7	-	-
I	-	4.10×10^7	4.10×10^7	-	4.04×10^7	4.04×10^7
J	-	1.572×10^9	4.88×10^7	-	8.22×10^8	2.50×10^7
K	-	-	1.613×10^9	-	-	8.07×10^8
L	-	-	5.66×10^7	-	-	9.60×10^6
M		1.45×10^5			7.90×10^4	
N		1.40×10^4			8.00×10^3	
P		2.00×10^3			2.00×10^3	
Q		1.29×10^5			6.90×10^4	
R		2.00×10^3			2.00×10^3	
S		1.15×10^5			5.80×10^4	
T		1.40×10^4			1.10×10^4	
U		1.80×10^5			1.68×10^5	
V		3.35×10^5			2.57×10^5	
W		1.00×10^4			1.00×10^4	
X		3.35×10^5			2.57×10^5	

Table - ESTIMATED PLANT WATER USES (Cont.)

Flow Rates in Gallons Per Day

	Both Units Shut Down		
	Open	Helper	Closed
A	4.02×10^7	4.00×10^7	4.00×10^7
B	3.90×10^7	3.78×10^7	3.78×10^7
C	-	1.15×10^6	1.15×10^6
D	-	-	-
E	-	-	-
F	-	-	-
G	3.90×10^7	3.90×10^7	3.90×10^7
H	3.90×10^7	-	-
I	-	3.90×10^7	3.90×10^7
J	-	3.78×10^7	3.78×10^7
K	-	-	-
L	-	-	-
M	1.00×10^4		
N	1.00×10^3		
P	2.00×10^3		
Q	7.00×10^3		
R	2.00×10^3		
S	-		
T	7.00×10^3		
U	-		
V	1.50×10^4		
W	5.00×10^3		
X	1.50×10^4		

AEC Comment Number 7

Page 1.2-53, figure 1.2-3. The portion of the curve of hourly discharges between the 84th and 90th percentiles apparently is in disagreement with the text, page 1.2-7.

TVA Response

The discussion on page 1.2-7 is directed to the flow durations from Chickamauga Dam instead of Watts Bar Dam. Updated flow durations based upon mean daily discharges from Chickamauga Dam for the period 1951-1972 are tabulated below.

Mean Daily Discharge, ft^3/s	Percent of Days Mean Daily Discharge is Expected or Exceeded
5,000	99.6
10,000	97.7
15,000	93.3
20,000	84.0
25,000	69.3
30,000	46.8
35,000	31.7

In addition, figures 1.2-3 and 1.2-4 are records of hourly discharges and the above tabulation is based upon daily discharges.

AEC Comment Number 8

Page 2.4-27, first paragraph. The staff believes that it would be prudent to monitor radioactivity independent of the plant effluent.

TVA Response

Water samples are collected from stations in the reservoir above and below the plant discharge and analyzed for suspended and total radioactivity. In addition, samples are collected from public water supplies downstream of the plant monthly, with a continuous sample being taken from the nearest downstream public water supply.

AEC Comment Number 9

Page 8.2-6, section (6). If the rate of loss due to evaporation and drift (73 ft^3/s) is the average loss, it should be identified as such. If it is a maximum (consistent with the listed annual maximum evaporative loss of 53,000 acre-feet), then an evaluation of the extremes of the losses during low streamflows would be useful.

TVA Response

The evaporative and drift loss rates are not expected to exceed 73 ft^3/s. Maximum yearly evaporative losses would occur if the cooling towers were operated all the time and would total about 53,000 acre-feet. For approximately 95 percent of the time, the hourly discharges from Chickamauga Dam equal or exceed 10,000 ft^3/s as shown in Figure 1.2-4. The maximum evaporation and drift loss of 73 ft^3/s represents only 0.73 percent of this reservoir flow. The insignificant size of the loss rates relative to the low streamflow occurrences will have no effect on the downstream water supplies.

AEC Comment Number 10

Appendix A-3, second paragraph. By the method suggested, and using the data given on page 1.2-4, the staff calculates the probability that a tornado will strike the plant to be 8.4×10^{-4}, or about one in 1,195 years.

TVA Response

TVA agrees that the tornado occurrence data for the period 1955-1967[1/] should be used to compute the probability of occurrence at the Sequoyah Nuclear Plant site. The original calculation is based on occurrence data from Thom.[2/] The probability of occurrence should be 8.4×10^{-5}, not 8.4×10^{-4}, and the recurrence should be once in 11,900 years, not 1,195 years.

The first full paragraph on page A-3 should read:

> "The probability of tornado occurrence is not high. Fifteen tornadoes occurred during the period 1955-1967 in 1-degree latitude-longitude square containing the site,[1/] and the probability of occurrence is calculated using these data. However, statistics show that Hamilton County (site location) southeast corner of the 1-degree square had no tornadoes reported during the period 1961 through August 1973,[4,5,6/] only six tornadoes during the period 1955-1967.[1/] Using the principles of geometric probability described by H. C. S. Thom,[2/] tornado occurrence data for 1955-1967,[1/] and average path area for east Tennessee[3/] the probability of a tornado striking any point in the plant site area is 8.4×10^{-5}, or about one in 11,900 years."

References for Response

1/ U.S. Department of Commerce, NSSFC, SELS UNIT, September 1969: "Severe Local Storn Occurrences, 1955-1967." ESSA Technical Memorandum WBTM FCST 12, Weather Bureau (now NWS), Office of Meteorological Operations, Weather Analysis and Prediction Division, Silver Spring, Maryland.

2/ Thom, H. C. S., 1963: "Tornado Probabilities." Monthly Weather Review, Volume 91, Nos. 10-12, pages 730-736.

3/ Vaiksnoras, John V., NOAA-Climatologist for Tennessee August 3, 1972: Personal Communication to TVA staff personnel. NOAA, NWS Office, Nashville, Tennessee.

4/ _____, April 15, 1971: "Tornado Occurrences in Tennessee." NOAA, NWS Office, Nashville, Tennessee.

5/ _____, revised October 1972: "Tornadoes in Tennessee (1916-1970) with Reference to Notable Tornado Disasters in the United States (1880-1970)." Issued by the University of Tennessee, Institute for Public Service, Knoxville, Tennessee.

6/ U.S. Department of Commerce, 1972-1973: Storm Data. Volume 14, Nos. 8-12, and Volume 15, Nos. 1-8. NOAA, EDS, Asheville, North Carolina.

AEC Comment Number 11

Appendix A-8, section (6), last paragraph. The staff notes that LCD for Chattanooga includes a record of a 24-hour snowfall of 12.0 inches in December 1886 in the vicinity of Chattanooga.

TVA Response

The maximum 24-hour snowfall over the 42-year period August 7, 1930, through December 31, 1972, of Lovell Field, Chattanooga, was 8.9 inches. However, the maximum 24-hour snowfall from existing and comparable exposures at other sites in the locality was 12.0 inches in December 1886.

AEC Comment Number 12

Appendix G-19, section 10, last sentence. The staff suggests that the phrasing "1/4 of the dispersion conditions listed in Regulatory Guide 1.4," is more appropriate.

TVA Response

The last sentence on page G-19 should read as follows: "As a result of the meteorological investigations at the site, TVA has concluded that the use of atmospheric dispersion factors which are one-quarter of those presented in Safety Guide No. 4 provides an appropriate basis for estimating the environmental effects of accidents. It is believed that this approach will be consistent with the approach used by the Atomic Energy Commission and others."

AEC Comment Number 13

The source terms listed for liquid and gaseous waste from the Sequoyah Nuclear Plant are reasonable and comparable to those of other PWR's of like size with similar radwaste treatment systems.

TVA Response

No comment required.

AEC Comment Number 14

Trucking of the radioactive liquid waste for offsite disposal is not acceptable to the staff as a method for disposal of tritiated water from the plant.

TVA Response

If the assumption is made that 2.5 μCi/gram is the maximum concentration which should be allowed in the primary coolant, some coolant will need to be removed from the primary system starting about 7 years after plant startup and building to a maximum amount of about 50,000 gallons annually about 14 years after plant startup. It may prove to be acceptable, however, to allow the tritium concentration to build up in the primary coolant to a level such that intentional releases (either to the environment or a disposal area) would not be required. If, for example, a concentration of about 4 μCi/gram were found to be acceptable, no releases other than those considered to be unavoidable would be necessary to maintain this level. This method of operation would not, however, give significant advantages from a radioactive dose assessment standpoint.

To properly assess the impacts associated with tritium recycle, TVA has considered several alternative methods of tritium disposal to cover the eventuality of having to dispose of some of the tritiated water removed from the primary system. These alternatives include:

1. Discharge of excess tritiated liquid to Chickamauga reservoir,

2. Discharge of excess tritiated water to atmosphere as water vapor in building exhaust air,

3. Solidification of excess tritiated water with cement and vermiculite and disposal in offsite burial ground, and

4. Offsite shipment of excess tritiated water to burial ground.

In addition to the fact that no significant advantage is gained in total offsite dose commitments by allowing the primary coolant tritium concentration to build up to its equilibrium value, doses to plant personnel during refueling operations would also exceed that for other alternatives.

A comparison of alternatives 3 and 4 shows that solidification of tritiated liquid prior to offsite shipment would cost approximately $40,000 annually more than shipment as liquid but would offer no advantage from a dose assessment standpoint.

It is recognized that by the time implementation of one of the alternatives would be required (14-18 years) regulations may predicate the disposition of tritiated liquid. The present plant design would not preclude adoption of any of the above alternatives, and TVA will dispose of tritiated liquids and other wastes in accordance with the results of a benefit cost analysis of the various alternatives and the method of disposal will comply with applicable regulations in effect at the time of disposal.

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

Docket Nos. 50-327
and 50-328

DEC 12 1973

Mr. Lynn Seeber
General Manager
Tennessee Valley Authority
508 Union Avenue
Knoxville, Tennessee 37902

Dear Mr. Seeber:

The AEC staff has completed its review of the Preliminary Final Environmental Statement of the Sequoyah Nuclear Plant, Units 1 and 2. My letter to you on November 13, 1973 contained some of the staff comments. The remainder of our comments are transmitted as Enclosure 1. All of these comments have been transmitted to your staff by telephone.

Sincerely,

Daniel R. Muller

Daniel R. Muller, Assistant Director
for Environmental Projects
Directorate of Licensing

Enclosure:
As stated

RECEIVED
DEC 14 1973
TVA
OFFICE OF THE
GENERAL MANAGER

ENCLOSURE 1

(1). The principal defect of the cost-benefit analysis in the preliminary FES by TVA for Sequoyah is indicated by the first sentence on page 9.0-1, which states:

> "The Sequoyah Nuclear Plant was initiated before NEPA became effective, and the TVA Board of Directors has determined that it is not practicable to reassess the basic course of action in the design and construction of this plant."

The result is that one of the main advantages of the Sequoyah Nuclear Plant, its economics compared with a coal-fired plant, is not adequately treated. There is a table on this subject on page 4.1-2, but it is based on a comparison made in 1968 and does not apply to the current situation. It is important that an up-to-date comparison be presented.

(2). The methods to be used for cleaning out the condensers and the cooling towers should be discussed.

(3). Pages 2.6-5 and 2.6-24 include discussion of the velocity of circulating water toward the travelling screens. The approach velocity is 2.2 feet per second. Velocity through the screens will be higher. The effect of impingement of fish on the screens should be estimated and evaluated. Recent experience with impingement at the Browns Ferry Nuclear Plant may provide additional insight to the evaluation.

The preliminary FES does not include calculations which would allow the reader to judge the significance of impingement and entrainment losses. For example, on page 2.6-16 it is reported, without comments, that 181 million larval fish will be killed each year. The methods by which TVA has judged the acceptability of this occurrence should be reported or referenced. Since the plant can be operated on a closed cycle, this cannot be considered an unavoidable effect.

(4). TVA has indicated their intent to operate the cooling system on open cycle or helper modes to the maximum possible extent. One of the limiting water quality criteria established by the Tennessee Water Quality Board is: "The maximum water temperature change shall not exceed 3°C relative to an upstream control point."

This serves to limit abrupt changes in river temperature, but does not limit the gradual escalation of ambient temperature as plant is added upon plant along the river. The ultimate extrapolation of this practice is the maintenance of the entire river at the other limiting criterion: "The temperature of the water shall not exceed 30.5°C..."

TVA should determine the extent to which the temperature at the upstream sensor (p. 2.6-3) is influenced by the operation of upstream plants existing or proposed and approved for operation during operating life time of the Sequoyah plant. The potential influence of the Sequoyah plant on intake temperatures at downstream locations should also be identified.

(5). p. H-7 The statement that ".....all persons along the shoreline receive the same dose rates as a person boating or skiing" is probably and underestimate of the shoreline dose because buildup on sediments was apparently not considered (see pp. F-23 through F-26, vol. 2, WASH-1258).

(6). p. 2.4-47 The large difference (0.75 vs. 12 mrem/yr) between infant thyroid doses from milk consumption calculated using TVA methods and those contained in Regulatory Guide 1.42 should be addressed in more detail. Also, it would be helpful to present the numberical values for Vg, M, CR and DCF (p. I-7) rather than references to the literature.

(7). The substance of the following discussion should be added to Section 2.3 on accidents:

The AEC is currently performing a study to assess, more quantitatively, the risks from nuclear accidents. The initial results of these efforts are expected to be available in early 1974. This study is called the Reactor Safety Study and is an effort to develop realistic data on the probabilities and sequences of accidents in water cooled power reactors, in order to improve the quantification of availabe knowledge related to nuclear reactor accident probabilities. The Commission has organized a special group of about 50 specialists under the direction of Professor Norman Rasmussen of MIT to conduct the study. The scope of the study has been discussed

with EPA and described in correspondence with EPA which has been placed in the AEC Public Document Room (letter, Daub to Dominick, dated June 5, 1973).

As with all new information developed which might have an effect on the health and safety of the public, the results of these studies will be made public and will be assessed on a timely basis within the AEC regulatory process on generic or specific bases as may be warranted.

Enclosure 2

AEC Comment Number 1

The principal defect of the cost-benefit analysis in the preliminary FES by TVA for Sequoyah is indicated by the first sentence on page 9.0-1, which states:

> "The Sequoyah Nuclear Plant was initiated before NEPA became effective, and the TVA Board of Directors has determined that it is not practicable to reassess the basic course of action in the design and construction of this plant."

The result is that one of the main advantages of the Sequoyah Nuclear Plant, its economics compared with a coal-fired plant, is not adequately treated. There is a table on this subject on page 4.1-2, but it is based on a comparison made in 1968 and does not apply to the current situation. It is important that an up-to-date comparison be presented.

TVA Response

A coal-fired plant for operation on the TVA system could not be operational until about 1979. The following economic analysis presents a comparison of a coal-fired plant for operation in 1979 to the Sequoyah plant:

1. Plant Types

   a. Light water nuclear plant - Sequoyah
   b. Low-sulfur coal plant (LSC) utilizing western coals assumed to be supplied from Montana-Wyoming region
   c. High-sulfur coal plant (HSC) utilizing coal originating from western Kentucky coalfields

2. Interest Rate - 8 percent

3. Plant Investment Costs

a.	Sequoyah	$650 million
b.	Low-sulfur coal-fired plant	$700 million
c.	High-sulfur coal-fired plant	$825 million*

   *Includes about $145 million for SO_2 removal equipment. Note that low-sulfur coal plant would have a larger boiler, with offsetting costs, due to lower heat content of the coal.

4. Implicit in the economic analysis is the assumption that the sulfur removal equipment operates with the high reliability required for utility service. While such reliability has not been demonstrated, it is assumed for purposes of this analysis.

5. Fuel Costs - cents per MBtu

a.	Sequoyah	20.5
b.	LSC	70
c.	HSC	50

6. Net Plant Heat Rate - Btu/kWh

a.	Sequoyah	10,210
b.	LSC	9,070
c.	HSC	9,040

7. Net Plant Output - megawatts electrical

a.	Sequoyah	2,250
b.	LSC	2,530
c.	HSC	2,490

8. Operation and Maintenance Expense - mill/kWh

a.	Sequoyah	0.6
b.	LSC	0.8
c.	HSC	2.0 (includes estimate of 1.2 mill/kWh for sulfur removal equipment)

9. Capacity Factor - 80 percent

10. Plant Life - 35 years

The results are summarized on a mills/kWh basis as follows:

	Sequoyah	LSC	HSC
Investment	3.5	3.4	4.2
Fuel	2.1	6.4	4.5
O&M	0.6	0.8	2.0
Total	6.2	10.6	10.7
Difference	Base	4.4	4.5

Based on the 4.4 and the 4.5 mills/kWh difference indicated above, the Sequoyah plant would have an annual savings of about $69 million when compared to the coal-fired plant using low-sulfur coal and about $71 million when compared to the high-sulfur coal alternative.

In addition to the monetary savings, the coal-fired plants would burn about 7 million tons of high-sulfur coal and 9 million tons of low-sulfur coal each year. Air pollutant emission levels would be expected to be comparable for the two coal plants assuming the scrubber on the high-sulfur plant worked dependably. Land requirements for the two plants would be roughly equivalent, with the low-sulfur coal plant requiring more space for ash disposal (low-sulfur coal generally has higher ash content than high-sulfur coal), and the high-sulfur coal plant requiring an offsetting amount of land for scrubber effluent disposal.

TVA is committed to the construction of the Sequoyah Nuclear Plant at an investment cost of $650 million. As of September 30, 1973, TVA had invested $372 million in the Sequoyah plant. Also, to construct a coal-fired plant would delay the required capacity by over three years.

AEC Comment Number 2

The methods to be used for cleaning out the condensers and the cooling towers should be discussed.

TVA Response

With reference to page 2.5-3, the last paragraph, an automatic, on-line ball-type mechanical system will be used for cleaning the condenser tubes. Therefore, no chemical treatment of the condenser circulating water should be necessary. TVA does not foresee a need to clean the cooling towers with their proposed method of operation.

AEC Comment Number 3

Pages 2.6-6 and 2.6-24 include discussion of the velocity of circulating water toward the traveling screens. The approach velocity is 2.2 feet per second. Velocity through the screens will be higher. The effect of impingement of fish on the screens should be estimated and evaluated. Recent experience with impingement at the Browns Ferry Nuclear Plant may provide additional insight to the evaluation.

The preliminary FES does not include calculations which would allow the reader to judge the significance of impingement and entrainment losses. For example, on page 2.6-16 it is reported, without comments, that 181 million larval fish will be killed each year. The methods by which TVA has judged the acceptability of this occurrence should be reported or referenced. Since the plant can be operated on a closed cycle, this cannot be considered an unavoidable effect.

TVA Response

The maximum velocity of water through the traveling screens averaged over the surface of the screens will be about 2.2 ft/sec. The velocity just ahead of the traveling screens under the same conditions will be about 1.2 ft/sec.

TVA is currently conducting a number of studies designed to document fish impingement occurrences, to determine causes of fish impingement, and to determine feasible ways to reduce impingement. Meaningful estimates of fish impingement cannot be made without extensive studies such as these. Experience gained from the Browns Ferry fish impingement studies will give insight into the magnitude of the local fish impingement potential and can hopefully be of benefit in determining what factors influence impingement and in estimating the effects on the reservoir of impinging a given number and distribution of fish. Estimates of actual impingement at the Sequoyah plant can be made only by actual observation.

The presence of the skimmer wall at the mouth of the intake channel extending almost 40 feet below the surface should minimize fish impingement at the Sequoyah plant.

A discussion of the effects of condenser-entrained larval fish losses is included in the statement (pages 8.2-3 and 8.3-3). The skimmer wall will also reduce entrainment relative to a shoreline intake at the plant site. Assuming a survival to adulthood of 1 in 10,000 larval fish, a yearly loss of 18,000 adult fish is estimated. TVA does not believe this number is significant. The long-term effects of larval fish removal on the population dynamics of the species in Chickamauga Reservoir, however, is unknown and can only be determined by intensive preoperational and postoperational monitoring of larval fish.

While the numbers of fish lost due to both entrainment and impingement could be reduced by operation of the plant in the closed-cycle mode, the disadvantages of such operation could far outweigh the reduction

in environmental cost. Operation of the cooling system continuously in the closed mode would result in an economic penalty in excess of $17 million. In addition, a significant commitment of energy resources would be required as a result of the capability loss associated. This capability loss is approximately 31.8 megawatts and is roughly equivalent to a commitment of 92,000 tons of coal,or 355,000 barrels of oil annually to replace the generation.

AEC Comment Number 4

TVA has indicated their intent to operate the cooling system on open-cycle or helper modes to the maximum possible extent. One of the limiting water quality criteria established by the Tennessee Water Quality Board is: "The maximum water temperature change shall not exceed 3° C. relative to an upstream control point."

This serves to limit abrupt changes in river temperature, but does not limit the gradual escalation of ambient temperature as plant is added upon plant along the river. The ultimate extrapolation of this practice is the maintenance of the entire river at the other limiting criterion: "The temperature of the water shall not exceed 30.5° C. . . ."

TVA should determine the extent to which the temperature at the upstream sensor (page 2.6-3) is influenced by the operation of upstream plants existing or proposed and approved for operation during the operating life time of the Sequoyah plant. The potential influence of the Sequoyah plant should also be identified.

TVA Response

The temperature of the upstream sensor at Sequoyah will not be influenced by existing or proposed generating plants upstream from the plant. The Watts Bar Nuclear Plant, currently under construction approximately 44 miles upstream from the Sequoyah site, will operate its cooling towers in the closed mode because of limiting flow conditions at the Watts Bar site, and therefore will not affect downstream temperatures at Sequoyah. The potential influence of Sequoyah on downstream plants for a maximum allowable temperature rise is outlined in Appendix M of the proposed final environmental statement (see Enclosure 3). TVA will observe the applicable water temperature standard at Sequoyah as well as at any future installations.

Additional AEC Comment - Number 5

P. H-7. The statement that ". . .all persons along the shoreline receive the same dose rates as a person boating or skiing" is probably and underestimate of the shoreline dose because buildup on sediments was apparently not considered (see pp. F-23 through F-26, vol. 2, WASH-1268).

TVA Response

The maximum shoreline dose has been calculated using an equation developed by J. K. Soldat, Battelle Northwest Laboratory,

$$C_{ishore} = 100\ T_{1/2}\ C_{iwater}$$

where,

C_{ishore} = concentration of nuclide i on the shoreline (pCi/m^2)

$T_{1/2}$ = half life of nuclide i (days)

C_{iwater} = concentration of nuclide i in adjacent water (pCi/liter)

100 = an empirical number between 30 and 300 with units ($liter/m^2$-day) and the "External Dose Factors" listed in table A-4, page F-53, Vol. 2, WASH-1258. For this calculation it is assumed that an individual stands 365 days per year, and that the water concentration corresponds to dilution of the effluents with 50 percent of the river.

The maximum external shoreline dose is calculated to be:

Whole body: 4.55 (-1) mrem/yr.
Skin: 5.31 (-1) mrem/yr.

Additional AEC Comment - Number 6

P. 2.4-47. The large difference (0.75 vs. 12 mrem/yr) between infant thyroid doses from mild consumption calculated using TVA methods and those contained in Regulatory Guide 1.42 should be addressed in more detail. Also, it would be helpful to present the numerical values for Vg, M, CR, and DCF (p. I-7) rather than references to the literature.

TVA Response

The differences between the infant thyroid doses from milk consumption calculated using TVA methods and those contained in Regulatory Guide 1.42 occur because of differences between the predicted quantities of radioiodine released. In calculating a dose of 0.75 mrem/yr. in Appendix I, the quantity of I-131 assumed to be released was 0.00647 Ci/yr. (as listed in Table 2.4-2, page 2.4-37). In calculating a dose of 12 mrem/yr. in Appendix II (calculations based on Regulatory Guide 1.42), the quantity of I-131 assumed to be released was 0.1 Ci/yr. The dose model used in calculating the I-131 doses is the same as that specified in Regulatory Guide 1.42, although the TVA terminology is different. The TVA dose model is based upon the same reference (reference 12 of Appendix I) as the dose model developed in Regulatory Guide 1.42. Values of the parameters used in the TVA I-131 dose model are given below:

$v_g = 0.01$ m/sec.

$M = 0.647 \frac{Ci/l}{Ci/m^2 - day}$

CR = 1 l/day

$DCF = 1.71 \times 10^{10} \frac{\text{mrem committed}}{\text{Ci intake}}$

8.0 BENEFIT-COST ANALYSIS

This section provides an overall assessment of the economic, technical, and other benefits of the Sequoyah Nuclear Plant weighed against the environmental costs, with the alternatives considered which would affect the balance of values.

TVA from its very inception has been deeply committed to the tasks of environmental improvement. The President in transmitting to Congress in 1933 the bill that became the TVA Act said that TVA ". . . should be charged with the broadest duty of planning for the proper use, conservation, and development of the natural resources of the Tennessee River drainage basin and its adjoining territory for the general social and economic welfare of the Nation." It is on the basis of these principles that TVA plans and conducts all its activities, be they planning, constructing, and operating a nuclear power plant; planning, building, and operating a water control project; providing research to develop a new fertilizer; setting aside areas for fish and wildlife; developing improved hardwood tree strains; or seeking ways to utilize the rugged scenic qualities of some of the region's natural streams. In all of these and many other varied resource development programs, TVA is deeply conscious of its responsibilities to the people in the TVA region and in the Nation. This posture invariably calls for a balancing of a variety of interests and, finally, decision and action in which differences are reconciled insofar as possible to best serve the needs of the greatest number over the longest possible time. Inherent in this is the requirement of finding a balance between the needs of man, including his need for useful employment, and the safeguarding of his physical environment.

In TVA electric power is regarded as a tool for economic development. Its use has been encouraged as a means for improving the quality of life in the region. Fitted into a comprehensive, unified development program, it has helped ease the burdens of drudgery; provide more jobs and more productive employment; bring the amenities of life to an ever-increasing number of people; and generally improve the health, education, and living conditions of the people.

An ample supply of low-cost electric energy, integrated with a total resource development program, has been a major factor in the progress achieved by the TVA region since 1933. Employment, income, and productivity have all increased with a shift from a primarily agricultural to an industrial economy.

The uses of electricity are many. To the residential user it provides lighting, refrigeration, cooking, washing and drying of clothes, heating, air conditioning, and education and entertainment via radio and television, to name but a few. Most stores, banks, and other commercial ventures are dependent on electricity for conducting business. In industry it is an essential element by which productivity has been increased with an attendant improvement in living standards. While in most industrial activities the cost of electric power is a small fraction of the total cost of production, without electricity modern industry could not provide the Nation with the goods and services it demands. In the aluminum, electrochemical, and metallurgical industries, electricity is a significant component required in the manufacture of these essential products.

The addition of the Sequoyah Nuclear Plant to the TVA system will enable TVA to continue to carry out its responsibility to provide an ample supply of electricity for the TVA region. The benefits of the plant include the value of the electrical power to be generated, the potential for reduction of releases of combustion products to the atmosphere which would be associated with a fossil-fired station of equal capacity, the recreational and educational value to visitors to the plant, increased payments to local governments in lieu of tax payments, and a stimulant to the economic growth of the region by helping to assure an abundant supply of electrical power and increased employment potentials.

The costs of the plant include the commitment of about 525 acres of land (including the 48-acre embayment) for the lifetime of the plant and about 1,620 acres of forested land for transmission line rights of way; the rejection of about 1.60×10^{10} Btu/h to the air directly and via Chickamauga Reservoir; the annual loss of 181 million larval fish; the consumptive use by evaporation of about 73 ft^3/s of water when operating with cooling towers; minor releases of radioactivity to the air and to the reservoir; erosion of soil during construction; a very low probability of releasing radioactivity due to an accident in the plant or an accident during the transport of radioactive materials; and the monetary costs to construct, operate, and maintain the plant.

TVA has attempted, insofar as practicable, to detail those applicable benefit-cost items covered in the Atomic Energy Commission's Regulatory Guide 4.2 (issued March 2, 1973) in the estimates of benefits and costs given in sections 8.1 and 8.2. The weighing and balancing of benefits and costs of alternative sites and subsystems is presented in section 8.3

While various benefits and environmental costs have been quantified, some are necessarily expressed in qualitative terms. For example, the effect of natural draft cooling towers on aesthetics is treated qualitatively. Moreover, of those factors subject to quantification, all cannot reasonably be expressed in monetary values. Although the number of Btu's added to the cooling system discharge can be numerically quantified, translation of that number to a monetary value is not reasonable in view of the wide range of variables influencing the significance of the impact. Environmental impacts, therefore, are quantified in commonly used terms such as numbers of Btu's of heat, gallons of water, and tons of earth.

Since the basic course of action in adding the Sequoyah plant to the TVA power system was decided prior to the enactment of NEPA, the Sequoyah Nuclear Plant environmental review has consisted of an analysis of the alternatives for limiting environmental impacts during the remaining construction of the project and the environmental impacts which will result from the subsequent operation of the plant. During this environmental review, the design concepts for the plant have been modified so as to provide a plant which approaches a minimum impact plant. Specific system design concepts were modified as follows:

Gaseous Radwaste - The gaseous radwaste system has been modified to provide a radioactive decay period of 60 days (in lieu of 45 days) for radioactive gases.

Liquid Radwaste - The liquid radwaste system design has been modified to permit recycling of tritiated water to the

maximum extent practicable and to permit treating steam generator blowdown and subsequently recycling the treated liquid within the plant.

Heat Dissipation - Heat dissipation will be by means of combined-cycle natural draft cooling towers in conjunction with use of the reservoir diffuser originally designed for the plant.

Nonradioactive Discharges - Plans are being developed for the installation of a concentrator to treat waste sludge from the makeup water filter plant.

With normal operation from the plant the maximum radiation dose to the hypothetical individual will be about 4 percent of that received from natural background radiation and the population dose within 50 miles of the plant in the year 2010 is projected at less than 0.04 percent of the dose from natural background radiation. Therefore, radiation resulting from operation of the Sequoyah Nuclear Plant will result in no undue risk to the health and safety of the public.

Conclusion - This environmental review has evaluated the expected environmental impacts of the proposed project and has considered alternatives which would lessen environmental impacts. After weighing the environmental and monetary costs and the technical, economic, environmental, and other benefits of the project and adopting certain 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.

8.1 Benefits - The benefits of the Sequoyah plant are detailed below and are summarized in Table 8.1-1.

1. Electric power produced and sold - Sequoyah Nuclear Plant includes two units with a dependable capacity of 1,125 MW electrical each, or a total plant capacity of 2,250 MW electrical. The units are scheduled for commercial operation as follows: unit 1, June 1976, and unit 2, February 1977. Since capacity is planned for on a system basis, it is not possible to identify the specific loads which the Sequoyah nuclear units will serve. For the purpose of the benefit analysis, it has been assumed that the plant serves loads based on the incremental increase in loads for each class of customers estimated between F.Y. 1972 and F.Y. 1980. The estimated peak load and sales for these years are identified in the following table:

	F.Y. 1972		F.Y. 1980		Increase	
	Load	Percent Total	Load	Percent Total	Load	Percent Total
Estimated Peak Demand (MW)	16,664		30,300		13,636	
Estimated Sales (million kWh):						
Residential	28,072	30.8	45,833	28.2	17,761	24.8
Commercial	11,901	13.1	22,667	13.9	10,766	15.0
Industrial	32,908	36.2	55,907	34.4	22,999	32.1
Government	13,815	15.2	30,873	19.0	17,058	23.8
Other Sales	4,249	4.7	7,320	4.5	3,071	4.3
TOTAL SALES	90,945	(100)	162,600	(100)	71,655	(100)

The value of a unit of electric energy to the user varies widely depending on the availability and cost of alternative energy sources. No attempt was made to identify such values in this analysis. However, the price customers pay for electric energy presumably establishes a minimum value to the user. Based on the present rate structures of TVA and the distributors of TVA power, the following average prices to the ultimate consumer are estimated:

Residential	1.451 ¢/kWh
Commercial	1.374 ¢/kWh
Industrial	0.761 ¢/kWh
Government	0.656 ¢/kWh
Other	1.058 ¢/kWh

For the purpose of estimating the present value of the revenue received from the sale of this energy it has been assumed that the Sequoyah plant will operate as shown in the following table during its 35-year life:

Years	Capacity Factor	Annual Net Generation (million kWh)	Total Transmission and Distribution Losses (million kWh)	Annual Energy Available For Sale (million kWh)
1-15	80%	15,768	1,080	14,688
16-25	55%	10,840	742	10,098
26-35	40%	7,884	540	7,344

Using the energy available for sale and the current prices paid for electricity shown above, a discount rate of 8 percent, and the assumption that both units operate for the same time period, a value of the sales from the plant was estimated and is presented in the benefit description form. The results are summarized below:

ELECTRIC POWER PRODUCED AND SOLD - SEQUOYAH NUCLEAR PLANT

Levelized Annual Energy Generation (kWh)	$14,211 \times 10^6$
Levelized Total Annual Losses (kWh)	973×10^6
Levelized Annual Energy Available for Sale (kWh)	$13,238 \times 10^6$

	Average Annual Energy Available For Sale - kWh	Value of Sales During Plant Life 1973 Dollars	Average Annual Value - Dollars
Energy Sold:			
Residential	$3,283 \times 10^6$	555,000,000	47,600,000
Commercial	$1,986 \times 10^6$	318,000,000	27,300,000
Industrial	$4,249 \times 10^6$	377,000,000	32,300,000
Government	$3,1^{-}1 \times 10^6$	241,000,000	20,700,000
Other	569×10^6	70,000,000	6,100,000
Total Sold	$13,238 \times 10^6$	1,561,000,000	134,000,000

Historically, electricity rates have declined until the mid-1960's. Events of the more recent years have caused this trend to reverse. Higher prices for fuels, higher interest rates, increases in construction costs, and costs of pollution control equipment have been significant factors causing the increases in rates for electric utilities. It was necessary for TVA to increase its rate schedules in 1967, 1969, 1970, and 1973. The effect of these rate increases has resulted in the average cost of electricity to the consumer increasing by 62.4 percent. Thus, the use of current rates could significantly understate the future sale price.

2. Payments in lieu of taxes - Estimates of payments in lieu of taxes include estimates of payments to state and local governments by TVA and by distributors of TVA electricity. Estimates are based on current rates of payment related to the energy which will be generated by the plant.

3. Regional gross product - Benefits of the Sequoyah plant to regional gross product cannot be exactly quantified monetarily. However, a correlation has been made of the average annual dollar flow of gross product with the use of the Sequoyah electrical power in the TVA power service region. This correlation is based on using the average power generation and relationships between gross product and kilowatt-hours equivalent of all energy consumed. The industrial gross product factor was obtained as a product of the relationship between value added and kWh equivalent (Census of Manufacturers, 1967) and the relationship between gross product from manufacturing and value added by manufacturing (Census of Manufacturers, 1967 and Survey of Current Business). The numerical value of the industrial gross product factor was found by this method to be $0.0649 per kWh. The commercial gross product factor was obtained by comparing gross product from commercial activities and an assumed electrical energy output of 25 percent of total energy input to the commercial sector (Energy in the American Economy, 1850-1975, Shurr and Netschert). Numerical values of this factor were $0.187 per kWh for 1967 and $0.184 per kWh for 1969. Giving slightly more weight to the recent figure, $0.185 per kWh was selected as the commercial gross product factor. Industrial power consumed was assumed to include government use of electrical energy. The resulting average annual dollar flow of gross product is estimated at about $880 million.

As noted above, no additional quantification to arrive at a monetary benefit is considered possible. This is because the comparison of dollar value of products produced and energy consumed does not consider other variables in the production of products, such

as wages of workers and efficiencies of individual production processes. It should be noted that a plentiful energy source has long been considered essential in the economic and industrial expansion of any region. As required by the TVA Act, as amended, TVA maintains an ample supply of electrical energy in the area in which it conducts its operations. A comparison of statistics in the TVA region with national statistics implies there are some beneficial effects of this plentiful energy source. In 1960 gross regional product was 2.26 percent of national; in 1970 this had increased to 2.69 percent. In 1960 personal income in the region was 64 percent of the national value; in 1970 this had increased to 75 percent. TVA considers that the ample availability of electricity as an energy source has helped realize these growth rates.

4. Recreation - The recreational benefits of the Sequoyah plant are estimated at 6,000 visits per year. This estimate of recreational visits is exclusive of the estimate of educational visits to the plant, which is given below. At a value of $0.75 per visit, the annual value of these visits is estimated to be $4,500.

5. Air quality - Since the Sequoyah plant is a base-load plant, approximately 4.9 billion kWh will be available during the base-load period to replace coal-fired generation which would otherwise have consumed about 2.1 million tons of coal per year. This will result in annual reductions in particulate emissions of about 2,200 tons, SO_2 emissions of about 112,000 tons, and NO_x emissions of about 15,900 tons when based on replacing coal-fired generation which uses coal of the quality now being burned and current technology.

6. Employment - Benefits to employment have been listed as the average annual number of workers whose jobs could be related to the consumption of electrical power produced by the Sequoyah plant. An industrial employment factor, relating kWh equivalent consumed in manufacturing to employment in manufacturing, was determined from national data from the Census of Manufacturers, 1967. A value of 5.4588 workers per million kilowatthours was obtained. A commercial employment factor was obtained by analysis of data from Energy in the American Economy, 1850-1975, by Schurr and Netschert. For 1967 this relationship was 14.83 workers per million kWh; for 1969, 13.39 workers per million kWh. The intermediate value of 14 was chosen for estimating the commercial portion of the employment value listed. Based on the portion of the Sequoyah Nuclear Plant generation allocated to commercial and industrial use, the potential exists for expanding the number of new jobs by about 68,190.

7. Education - The educational benefits of the Sequoyah plant are estimated to be 150,000 visits per year after the plant is operational. These visits have been valued at $1.85 each, based on recently developed TVA estimates. Thus, the annual value of these visits is $278,000. Educational visits by persons to the plant during its construction are estimated to be about the same number as after the plant is operational.

Table 8.1-1

SEQUOYAH NUCLEAR PLANT - BENEFITS

Direct Benefits	
Expected Levelized Annual Generation in Kilowatthours	14,211,000,000
Dependable Capacity in Kilowatts	2,250,000
Proportional Distribution of Electrical Energy - Expected Levelized Annual Delivery in Kilowatthours:	
Residential	3,283,000,000
Commercial	1,986,000,000
Industrial	4,249,000,000
Government	3,151,000,000
Other	569,000,000
Annual Revenues from Electrical Energy Generated in Dollars:	
Residential	47,600,000
Commercial	27,300,000
Industrial	32,300,000
Government	20,700,000
Other	6,100,000
Annual Indirect Benefits	
In Lieu of Tax Payments (local, state) in Dollars	5,700,000
Regional Product	See Text
Environmental Enhancement	
Recreational - Dollars	4,500
Air Quality (Potential to reduce pollutants in tons)	
SO_2	112,000
NO_x	15,900
Particulates	2,200
Employment - Potential jobs provided	68,190
Education - Dollars	278,000

8.2 Monetary and Environmental Costs - The monetary (generating) and environmental costs of the Sequoyah plant for the minimum impact and plant design combinations of subsystems are detailed below and are summarized in Table 8.2-1. Incremental generating costs and differences in environmental costs for alternative subsystems are given in section 8.3.

Generating costs - The generating costs for the alternative combinations of subsystems have been computed using the following assumptions: current plant capital cost estimates of $470 million (1973 dollars); a levelized power generating cost 2.35 mill/kWh ($0.00235/kWh); a declining plant capacity factor as discussed in section 8.1-1; incremental generating costs for alternative subsystems as shown in section 8.3; an 8 percent discount rate; and an assumed plant lifetime of 35 years. The results are summarized in Table 8.2-1.

1. Effects on natural surface water body -

(1) Cooling water intake structure - The skimmer intake located near the bottom of the reservoir should reduce fish entrainment and impingement due to its location and the lower velocity at the skimmer opening (0.5 ft/s). Larval fish mortalities expected as a result of entrainment are discussed in paragraph 2 below.

(2) Passage through the condensers of -

(a) Primary producers and consumers - Estimates of total daily quantities of plankton (by weight) were made based on concentrations taken during limited sampling in 1972 and 1973, estimates of the withdrawal volumes, and the assumptions of linear flow at water intake level and uniformity of sample distribution

in horizontal cross sections. Additionally, phytoplankton biomass was determined from chlorophyll sampling using Wright's conversion factor[1] of 1 μg chlorophyll a equals 0.12 mg dry weight biomass. Daily phytoplankton dry weight entrainment estimates are approximately 7,640 pounds in winter, 22,000 pounds in spring, 13,400 pounds in summer, and 4,130 pounds in fall.

The inherent weakness in the estimates of plankton amounts are as follows:

1. The quarterly samples are "grab" samples that are not replicated throughout the day, nor throughout the quarter.
2. Phytoplankton cell numbers may double in as short an interval as one day.
3. Zooplankton standing crop is estimated with limited numbers of samples.
4. Zooplankton standing crop may change drastically within as short an interval as one week.
5. Communities of phytoplankton genera are measured and described - not species populations and/or size and age groups within species populations.
6. Only indirect biomass estimates have been made to date.
7. Season trends develop within phytoplankton stocks as the result of changing solar energy values. The future monitoring program would underestimate these trends during the winter and spring quarters and overestimate in the fall quarter since samples are taken

during the first or second week of the quarter. However, present sample schedules fit existing flow or discharge cycles in the river.

8. Dry weights for the various zooplankton species were obtained either from existing literature (Comita, 1972;[2] Cummins, et. al., 1969;[3] and Patalas, 1970[4]) or extrapolation for some species represented at the site.

(b) Fish - Larval fish which pass through the plant in the cooling water flow will be killed. An accurate assessment of the effects on larval fish populations cannot be made at this time since there is insufficient data on larval fish populations in Chickamauga Reservoir. However, in an attempt to quantify larval fish entrainment, concentrations of larval fish in Wheeler Reservoir were used to project an annual mortality of 181 million larval fish (18,100 adults). Relatively low concentrations of larval fish are expected in the withdrawal area since the skimmer wall will take water from depths of 40 feet in the reservoir. The impact of larval fish mortality on the entire reservoir is unknown.

(3) Discharge area and thermal plume -

(a) Physical water quality - The maximum plant heat rejection to Chickamauga Reservoir will be 16.0×10^9 Btu/h when operating on open cycle. The maximum volume of water in the mixing zone for cooling water discharges for open and helper operation is expected to be about 100 acre-feet. For closed cooling system operation, the mixing zone for tower blowdown discharges would depend on final configuration of the blowdown diffuser. In any case, the volume is expected to be much smaller than for open-helper operation.

(b) Dissolved oxygen - DO concentrations below 5 mg/l have been observed historically in the portion of the Tennessee River between Chickamauga Dam and former Hales Bar Dam. Even with the addition of secondary treatment at Chattanooga, DO concentrations below 5 mg/l would reasonably be expected to occur in a portion of the Hales Bar Reservoir. Since this portion of the river could be below 5 mg/l DO, the 147,700 acre-feet volume of the Hales Bar Reservoir at normal summer pool elevation has been assumed to conservatively represent the volume of water below 5 mg/l DO without the operation of the Sequoyah Nuclear Plant. Since the thermal impact of Sequoyah's operation on the DO resource would primarily occur in this same reach of the river, the volume of 147,700 acre-feet has been assumed to represent the impacted volume for both the minimum impact plant and the current plant design.

(c) Aquatic biota - Less than 8 percent of the mean annual flow becomes part of the plant's process water. The percentage of plankton organisms that will be entrained cannot be accurately estimated. The 29.5°F thermal rise in the condensers and mechanical damage will be lethal to nearly all plankton. Organisms entrained in the diffuser discharges will experience an increase in respiration rates and other metabolic activities in response to the elevated temperatures. Organisms living in areas below the plant and subjected to increases in temperature will probably exhibit Q_{10} effects when the plant begins operation. In the overbank area, spawning times and egg development rates may be slightly increased.

(d) Wildlife - No significant effects on any area wildlife are anticipated from the thermal discharges to Chickamauga Reservoir.

(e) Migratory fish - It has been judged that a barrier, in the strict sense of preventing or significantly decreasing or retarding fish migration, will not result from thermal discharges.

(4) Chemical discharges - As discussed earlier in section 2.5, the concentrations of chemicals in the reservoir after plant discharge are within established stream guidelines except for phosphates. The concentration of phosphates naturally occurring in the reservoir already exceeds the established guideline. No significant impacts from chemical discharges are anticipated.

(5) Radionuclides discharged to water body - Doses are calculated according to the methods described in Appendix H. Tritium doses are included for an annual release of 350 Ci. Maximum annual dose rates or dose commitments for each annual intake are reported. Population doses are estimated for the entire Tennessee Valley region.

(a) Aquatic organisms - Dose rates (rads/yr) are for internal and external exposure to benthic invertebrates living in the vicinity of the Sequoyah Nuclear Plant.

(b) People - external - Calculations of the external dose rate to people involved in above-water activities (skiing, fishing, boating), in-water activities (swimming), and shoreline activities are described in Appendix H. The external dose to people involved in shoreline activities is expected to be very small. The simplifying assumption is made that all persons participating in shoreline activities receive the same dose rate as a person boating or skiing. The estimated individual dose rate of

6.5×10^{-8} rem/yr from shoreline activities exceeds the more realistic estimates for above-water activities and in-water activities.

(c) People - ingestion - Maximum dose commitments to the thyroid for the water and fish pathways are described in Appendix H for both the individual and the population.

(6) Consumption of water - Although estimated evaporation and drift loss rates total about 73 ft^3/s (144 acre-feet per day), no significant effects on either downstream water supplies or irrigation supplies occur due to the insignificant size of these loss rates relative to average streamflow (32,800 ft^3/s at Chickamauga Dam, 13 miles downstream). Yearly evaporative losses would be a maximum of about 53,000 acre-feet.

(7) Plant construction -

(a) Physical water quality - During the construction period there will be unavoidable dredging of material in Chickamauga Reservoir. A major portion of the dredging construction has already been completed. Construction activity is being conducted so as to meet all applicable water quality standards. Thus, no dilution volume is required.

(b) Chemical water quality - Chemicals used during construction, including but not limited to chemical cleansing agents, water treatment chemicals, and chemicals used in sewage treatment, will only be released to Chickamauga Reservoir in solutions with concentrations which meet chemical water quality standards. Thus, no reservoir dilution volume is required.

(8) Other impacts - The cooling water discharge pond will remove about 48 acres from the surface area of Chickamauga Reservoir (see section 2.7, Construction Effects).

(9) Combined or interactive effects - There is no evidence to indicate that the combined effects of a number of impacts on any population or resource is not adequately indicated by the measures of the separate impacts listed above.

(10) Net effect on Chickamauga Reservoir - The construction and operation of the Sequoyah Nuclear Plant, considering the alternatives utilized to minimize environmental effects, is not expected to have any significant effect on Chickamauga Reservoir. Neither is it expected to prohibit any of the normal uses of the reservoir.

2. Effects on ground water -

(1) Raising or lowering of ground water levels - Water withdrawals for the Sequoyah plant should have no effect on local ground water levels since relatively small quantities of water are withdrawn and since Chickamauga Reservoir water levels are maintained according to TVA's reservoir operating guides. Normal fluctuations in water levels in the reservoir are from elevation 675 in winter to elevation 682.5 in late spring. Minor local ground water disturbances may occur as a result of plant construction, but no permanent ground water level changes are anticipated.

(2) Chemical contamination of ground water - Chemicals discharged from the plant are at such concentrations when discharged that water quality standards are met. Within the plant tanks, drains, pipelines, and transfer and storage lines are

isolated from the ground by concrete and other barriers. Thus, no chemical contamination of ground water is expected.

(3) Radionuclide contamination of ground water -

(a) People - Dose commitments for the annual intake of ground water are based on the calculations described in Appendix H. Conservative assumptions are made for these calculations because accurate data are unavailable. Therefore, the population dose commitments from contaminated ground water are overestimated.

(b) Plants and animals - Calculations of doses to aquatic plants and animals living in the Tennessee River near the Sequoyah Nuclear Plant are described in Appendix H. Doses to organisms exposed to ground water are expected to be less than the estimates of the doses from Tennessee River water, Table H-5 of Appendix H, because of the dilution afforded by uncontaminated water. The maximum dose does not include the dose to benthic organisms from sedimentation which is not appropriate in this case.

(4) Other impacts on ground water - No other significant impacts on ground water have been identified.

3. Effects on air -

(1) Fogging and icing caused by evaporation and drift -

(a) Effects on local ground transportation - The analysis of the effects of fogging and icing on local ground transportation from the heat dissipation alternatives is based on the procedural methods described in section 2.6 and an

empirical model for predicting river steam fogging. The model was derived for the Green River adjacent to the Paradise Steam Plant and modified for Chickamauga Reservoir on the Tennessee River at the Sequoyah Nuclear Plant site. As indicated in section 2.6, the original diffuser system and the natural-draft towers operating as a closed or combined system should seldom, if ever, affect ground transportation. Mechanical-draft towers operating as closed or combined systems could affect ground transportation 544 and 123 hours per year, respectively. Spray canals operating as closed or combined systems could affect ground transportation 567 and 115 hours per year, respectively.

(b) Effects on air transportation - Analysis of Paradise Steam Plant natural-draft tower plume behavior shows that the maximum extent of plumes or fogs from cooling tower systems is about 5 miles. Since the nearest commercial airport is in Chattanooga, Tennessee, about 15 miles southwest of the Sequoyah plant site, no interference with commercial airport operation is anticipated from any of the heat dissipation alternatives.

(c) Local effects on water transportation - Analysis of the effects of the heat dissipation alternatives on water transportation is based on the procedural methods described in section 2.6 and the steam fogging prediction model noted in (a) above. Closed-cycle natural-draft towers should seldom, if ever, affect water transportation. Closed-cycle mechanical-draft towers and spray canals could affect water transportation 822 and 864 hours per year, respectively. Water transportation could also be affected by fogs resulting from heated water releases from the original

diffuser system, and by operation of the natural-draft towers, the mechanical-draft towers, and the spray canals (combined systems). Water transportation could be affected 237 hours per year by operation of the original diffuser system. Open-helper-closed system natural-draft towers, mechanical-draft towers, and spray canals could affect water transportation 48, 306, and 310 hours per year, respectively.

(d) Effects on plants -

Vegetation should not be adversely affected by fogs or plumes from the heat dissipation alternatives because exposure to excessive moisture on any one day should be of short duration (5 hours or less) and should usually occur during predawn through postdawn periods when vegetation is normally exposed to naturally occurring high relative humidities and dew.

(2) Chemical discharge to ambient air -

Resulting annual average ambient pollutant levels due to gaseous emissions from the plant's auxiliary boilers and diesel generators have been estimated assuming combustion of 6.6×10^6 gallons per year of fuel oil with 0.5 percent sulfur content. Resulting annual average ambient levels for shorter averaging time periods assume a consumption rate of 750 gallons per hour. The maximum levels, as percents of the ambient air quality standards, are listed below:

Pollutant	Percent of Secondary Ambient Air Quality Standard	Emissions in Tons per Year
Particulates	0.19	26.3
Sulfur dioxide	0.08	25.7
Carbon monoxide	2.86×10^{-5}	0.1
Hydrocarbons	0.15	6.6
Nitrogen oxides	0.02	254.0

No odor originating from normal operation of the plant should be perceptible at any point offsite.

(3) Radionuclides discharged to ambient air -

(a) People - external -

Individual and population external dose rates from the nuclides expected to be released to the air are computed as described in Appendix I. The maximum external dose to any organ, including the whole body, is the dose delivered to the skin. This dose rate is presented for all alternatives.

(b) People - ingestion -

Individual and population thyroid doses from the ingestion of iodine released to the air are computed as described in Appendix I. This dose rate is presented for all alternatives.

(c) Plants and animals -

The dose rate to plants and animals from radionuclides expected to be discharged to the air is assumed to be the same as the external dose rate to people.

(4) Other impacts on air - No other significant impacts on the air have been identified.

4. Effects on land -

(1) Preemption of land - Site land requirements are about 525 acres for the base plant. The only feasible alternatives for heat dissipation requiring additional land are the spray canal systems, which require 170 additional acres.

(2) Plant construction -

(a) Noise effects on people - Ambient noise levels due to construction of the Sequoyah plant are not expected to pose any problems to the surrounding population. The surrounding land has a low population density which will minimize the effects of construction noise.

(b) Accessibility of historical sites - No areas of known historical significance are on the Sequoyah site.

(c) Accessibility of archaeological sites - No significant archaeological evidence is known to exist on the Sequoyah site.

(d) Wildlife - No effects on wildlife are expected except for the dislocation of wildlife in the immediate site area and as discussed in section 2.2.

(e) Erosion effects - The average amount of soil displaced by erosion due to construction activities at the Sequoyah site is estimated to be about 950 tons per year throughout the construction period. This estimate includes the effects of direct erosion of cleared land and also the displacement of dredge material in Chickamauga Reservoir.

(3) Plant operation -

(a) Noise effects on people - Operation of the plant is essentially noiseless at the site boundary except for the very infrequent operation of the air blast circuit breakers.

(b) Aesthetic effects on people - The design of the Sequoyah Nuclear Plant has had as one objective the creation of harmony between plant and environment. This objective has resulted in a site developed to have a pleasing appearance and to provide a tasteful transition from the rural surrounding land. The addition of cooling towers is expected to provide a more abrupt transition.

(c) Wildlife - No effects on wildlife are expected except for the dislocation of wildlife in the immediate site area.

(d) Flood control - The Sequoyah project has no implication for flood control.

(4) Salts discharged in drift from cooling towers - During operation of the cooling towers in the helper mode the cooling water salt content will be almost identical to that in the makeup water as indicated in section 2.5. During closed-mode the salt content will be about twice that of the makeup water. However, in both cases the salt content of the cooling system water would be within the limits of the applicable standards. No significant effects are expected from drift discharges from the towers.

(5) Transmission route selection -

(a) Preemption of land - The Sequoyah plant will require 147 miles of new transmission lines. New land area required for transmission line right of way is estimated to be about 2,700 acres.

(b) Land use and land value - TVA attempts to locate new transmission lines so as to minimize the

total effect of the lines on the environment. As planned at Sequoyah, areas of high population density were avoided by a careful selection of transmission line routes. As can be expected, it has not been possible to obscure all views of the numerous river crossings at the plant site. However, by utilizing a corridor location concept and double circuit towers, only a limited section of the reservoir area will be affected.

Recent investigations have revealed no discernible loss in value attributable to the transmission lines outside the right of way proper. The only measurable impact occurs within the right of way where buildings are prohibited. Investigations in other agricultural, residential, and industrial areas throughout the TVA power service area show similar land value behavior characteristics, and TVA anticipates no adverse effects by transmission lines on land values from the Sequoyah Nuclear Plant. TVA can find no evidence that the presence of the transmission line system will inhibit orderly land development and normal transition in highest and best use from agricultural use to residential, commercial, and industrial use when future demands require such transition.

(c) Aesthetic effects on people - In the siting of new transmission lines for Sequoyah, the minimum of undesirable features has been sought. Unavoidable state, U.S., and interstate highway crossings will number 19, and major river crossings will number 7. However, no crest, ridge, or other high point crossings are expected. Also, no long views of transmission lines parallel to major roadways are anticipated. Only 4 of the 19 perpendicular line crossings have relatively long views. Because of the open-

type terrain which occur at these crossings, views in both directions along the line routes cannot be avoided. In addition, minor views of line occur at six other highway crossings. However, the use of existing terrain and scattered tree cover limit the views to only one direction at these crossings.

(6) Transmission facilities construction -

(a) Land adjacent to rights of way - Normally no permanent access roads are installed in conjunction with transmission line construction. Some existing field roads and lanes are improved and are left for use by the landowners.

(b) Land erosion - The removal of existing trees and shrubs will increase the potential for erosion until new ground cover is planted and is well established. TVA minimizes this potential by a policy of minimum soil disturbance and speedy ground cover replacement during the transmission line construction phase.

(c) Wildlife - As indicated in section 2.2, the creation of the interface zone between a transmission line right of way and forested land will adversely affect some species and benefit others. No lasting adverse effects on animal species or populations are anticipated during the brief construction period.

(7) Transmission line operation -

(a) Land use - Approximately 20 percent of the new transmission line rights of way are now under cultivation and can remain in this use if the individual owners so desire. An additional 20 percent is uncultivated open land. The remaining 60 percent is woodland which is generally in poor quality

timber. As indicated in section 2.2, various uses of cleared rights of way are permitted. The percentage of rights of way for which no multiple-use activities are planned cannot be estimated since individual landowners have this option on their individual land holdings.

(b) Wildlife - Section 2.2 provides a discussion of wildlife effects. Wildlife habitat for edge- and open-loving species is increased because of creation of the interface zone.

(8) Other land impacts - The Sequoyah Nuclear Plant site was acquired primarily in the late 1930's as a part of the lands required for the Chickamauga Reservoir. One additional tract, containing some 103 acres, was sold during the surplus land sale program but was reacquired in 1957. Additional acquisition has been confined to the land and land rights required for the access road and railroad. During the period before and after construction began in 1970, TVA has observed real estate activity in the vicinity of the project. The experience at Sequoyah confirms earlier studies at Browns Ferry and Watts Bar which indicate that no adverse effects on property values have occurred as a result of the site location.

Studies indicate that 545 building permits for new residential construction have been issued since 1970 in the census tract in which the site is located. This is an annual rate of 6 percent of the 1970 housing stock. Development generally is confined, however, to the lakefront and along major roads in this planning district. Construction of the access road has contributed to the growth of the area.

All types and classes of residences are now under development. Lakefront lots sell in the price range of $20,000 and lots in the New Salem Community are selling for $3,500. Houses range in value from the $20,000 class in New Salem to $50,000 just downstream from the site.

Forecasts made in 1967 for Chattanooga by a consulting firm indicate that residential land requirements in this planning district would average just over 100 acres a year from 1970 through 1975. The conversion rate now occurring in near proximity to the plant site is more than twice the 1967 forecast.

TVA studies indicate that with reasonable planning no adverse effect will result from proximity to a nuclear site. TVA expects no such problem to occur in the Sequoyah area.

(9) Combined or interactive effects - There is no evidence to indicate that the combined effects of a number of impacts on any population or resource is not adequately indicated by the measures of the separate impacts listed above.

(10) Net effects on land - The net effect of the Sequoyah Nuclear Plant on the land resources is the commitment of about 525 acres of land for the use of power production during the plant's lifetime and the restriction on the use of about 2,700 acres of transmission line rights of way during the lifetime of these lines.

5. Cross category effects -

(1) Transportation - In a normal year Sequoyah will receive about 10 truck shipments of new fuel; will make about 130 truck, or about 13 rail, shipments of spent fuel; and will

make about 50 shipments of radioactive wastes. In addition, deliveries of fuel oil and chemicals will require receiving about 486 tank-truck shipments. The transportation requirements for offsite disposal of tritium would be about 13 tank-truck shipments per year, should its disposal be required around the seventh to twelfth year of plant operation. The environmental review has demonstrated that the transportation shipments to and from the plant, considering normal and accident conditions, can be accomplished with a minimum impact.

(2) Accidents - A spectrum of postulated accidents ranging in severity from trivial to very serious has been divided into 9 classes by AEC. This characterization of accidents by classifications brackets the qualitative assessment of environmental costs and benefits. Table 2.3-2 of section 2.3 gives a summary of the radiological consequences of the postulated accidents. This environmental risk, for the range of postulated accidents, considering the probability of occurrence indicates that the annual potential exposure to the population from all postulated accidents is a very small fraction of the exposure of the same population from natural background radiation and, in fact, is well within naturally occurring variations in background radiation levels.

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Table 8.2-1

SEQUOYAH NUCLEAR PLANT - GENERATING AND ENVIRONMENTAL COSTS

Alternative			Plant with Minimal Environmental Impact	Current Plant Design
Subsystems				
Cooling			Closed-Cycle Natural Draft Cooling Towers	Combined-Cycle Natural Draft Cooling Towers (open/helper/closed)
Gaseous Radwaste Treatment			Gaseous Absorption[a] or Cryogenic Distillation	60-Day Holdup
Liquid Radwaste Treatment			Filtration and Evaporation	Filtration and Evaporation
Chemical Treatment			Evaporation of Spent Demineralizer Regenerant Solutions and Precipitation of Phosphates in the stream generator blowdown	Neutralization of Spent Demineralizer Regenerant Solutions
Generating Cost	Total Value (1973 Dollars)		$867.79 x 10^6	$850.84 x 10^6
	Annualized		$ 74.46 x 10^6	$ 73.00 x 10^6
Environmental Effects				
1. Natural Surface Water Body	Chickamauga Reservoir			
1.1 Cooling Intake Structure	1.1.1 Fish Mortality		See Text	See Text
1.2 Passage through the Condenser of	1.2.1 Phytoplankton and Zooplankton		See Text	See Text
	1.2.2 Larval Fish		See Text	181 x 10^6 (See Text)

a. Minimum system with respect to primary impacts to offsite population due to plant gaseous releases.

Table 8.2-1
(continued)

SEQUOYAH NUCLEAR PLANT - GENERATING AND ENVIRONMENTAL COSTS

Alternative			Plant with Minimal Environmental Impact	Current Plant Design
1.3 Discharge Area and Thermal Plume	1.3.1	Physical Water Quality - Btu/h Heat Rejection	1×10^7	Open mode - $15.9\ 6 \times 10^9$ Helper - 7.543×10^9 Closed mode - 0.010×10^9
		Acre-Feet of Water Affected - 5.4°F Isotherm	See Text	100
	1.3.2	Water Quality, Oxygen Availability - Acre - Feet of Water DO-below 5, 3, and 1 mg/l, respectively	147,700 0 0	147,700 0 0
	1.3.3	Aquatic Biota	See Text	See Text
	1.3.4	Wildlife - Acres Affected by Thermal Discharge	None	None
	1.3.5	Fish Migration	No barrier	No barrier
1.4 Chemical Effluents	1.4.1	Chemical Water Quality - Dilution Volume to Meet Standards	0	0
	1.4.2	Aquatic Biota - Affected Population	0	None Expected
	1.4.3	Wildlife - Acres Affected by Chemical Discharges	0	0

Table 8.2-1
(continued)

SEQUOYAH NUCLEAR PLANT - GENERATING AND ENVIRONMENTAL COSTS

Alternative			Plant with Minimal Environmental Impact	Current Plant Design
	1.4.4	People - Lost User Recreational Days	0	0
1.5 Radionuclides Discharged to Water Body	1.5.1	Aquatic Organisms - rad/yr	2.0 (-1)*	2.0 (-1)
	1.5.2	People, External - rem/yr	2.1 (-6)	2.1 (-6)
		man-rem/yr	2.6 (-1)	2.6 (-1)
	1.5.3	People, Ingestion - rem/yr	1.2 (-4)	1.2 (-4)
		man-rem/yr	3.0 (+1)	3.0 (+1)
1.6 Consumptive Use (Evaporative Losses)	1.6.1	People - Acre-Feet of Water Evaporated per Year	53,000	32,000
	1.6.2	Property - Acre-Feet of Water Evaporated per Year	Same as 1.6.1	Same as 1.6.1
1.7 Plant Construction	1.7.1	Physical Water Quality - Dilution Volume	0	0
	1.7.2	Chemical Water Quality - Dilution Volume	0	0
1.8 Other Significant Impacts	1.8.1	Fish Habitat Lost - Acres	48	48

*2.0 (-1) = 2.0×10^{-1}

Table 8.2-1
(continued)

SEQUOYAH NUCLEAR PLANT - GENERATING AND ENVIRONMENTAL COSTS

Alternative		Plant with Minimal Environmental Impact	Current Plant Design
1.9 Combined or Interactive Effects		See Text	
1.10 Net Effect		None Noticeable	None Noticeable
2. Ground Water			
2.1 Raising/Lowering of Ground Water Levels	2.1.1 People - Gallons of Water Affected	0	0
	2.1.2 Plants - Acres Affected	0	0
2.2 Chemical Contamination of Ground Water	2.2.1 People - Gallons of Water Contaminated	0	0
	2.2.2 Plants - Acres Affected	0	0
2.3 Radionuclide Contamination of Ground Water	2.3.1 People rem/yr	0.77 (-4)*	0.77 (-4)
	man-rem/yr	0.30	0.30
	2.3.2 Plants and Animals	See Text	
2.4 Other Impacts on Ground Water		None	None
3. Air			
3.1 Fogging and Icing Caused by Heat Dissipation System Evaporation and Drift	3.1.1 Ground Transportation - Hours per Year	0	0
	3.1.2 Air Transportation - Hours per Year	0	0

*0.77 (-4) = 0.77×10^{-4}

Table 8.2-1
(continued)

SEQUOYAH NUCLEAR PLANT - GENERATING AND ENVIRONMENTAL COSTS

Alternative			Plant with Minimal Environmental Impact	Current Plant Design
	3.1.3	Water Transportation - Hours per Year	0	48
	3.1.4	Plants - Acres Affected	0	0
3.2 Chemical Discharge To Ambient Air	3.2.1	Air Quality, Chemical	See Text	
	3.2.2	Air Quality, Odor	No offsite odor	No offsite odor
3.3 Radionuclides Discharged to Ambient Air	3.3.1	People, External rem/yr	3.6 (-3)*	5.5 (-3)
		man-rem/yr	1.2 (+1)	2.0 (+1)
	3.3.2	People, Ingestion rem/yr	3.3 (-4)	3.3 (-4)
		man-rem/yr	2.3	2.3
	3.3.3	Plants and Animals - rad/yr	3.6 (-3)	5.5 (-3)
3.4 Other Impacts on Air			None	None
4. Land				
4.1 Preemption of Land	4.1.1	Land, Amount, in Acres	525	525
4.2 Plant Construction	4.2.1	People, Noise	No effects expected	No effects expected
	4.2.2	People, Accessibility of Historical Sites	Not applicable	Not applicable
	4.2.3	People, Accessibility of Archaeological Sites	No access restriction	No access restriction
	4.2.4	Wildlife	Site area	Site area
	4.2.5	Land, Erosion T/yr	750	950

*3.6 (-3) = 3.6×10^{-3}

Table 8.2-1
(continued)

SEQUOYAH NUCLEAR PLANT - GENERATING AND ENVIRONMENTAL COSTS

Alternative			Plant with Minimal Environmental Impact	Current Plant Design
4.3	Plant Operation	4.3.1 People, Noise	See Text	
		4.3.2 People, Aesthetics	See Text	
		4.3.3 Wildlife Affected Area	0	0
		4.3.4 Land, Flood Control	No Implication	No Implication
4.4	Salts Discharged from Cooling Towers	4.4.1 People	See Text	See Text
		4.4.2 Plants and Animals, Acres Affected	0	0
		4.4.3 Property Resources - Effect in Dollars per Year	0	0
4.5	Transmission Route Selection	4.5.1 Land, Amount, in Acres	2,700	2,700
		4.5.2 Land Use and Land Value	Restriction on Right of Way Use No Expected Change in Value Outside Right of Way	
		4.5.3 People, Aesthetics	See Text	
4.6	Transmission Facilities Construction	4.6.1 Land Adjacent to Right of Way	See Text	
		4.6.2 Land, Erosion	See Text	
		4.6.3 Wildlife	Habitat Modification	Habitat Modification
4.7	Transmission Line Operation	4.7.1 Land Use, Right of Way	Multiple Use Permitted	Multiple Use Permitted
		4.7.2 Wildlife	Habitat Change	Habitat Change

Table 8.2-1
(continued)

SEQUOYAH NUCLEAR PLANT - GENERATING AND ENVIRONMENTAL COSTS

Alternative			Plant with Minimal Environmental Impact	Current Plant Design
4.8	Other Land Impacts - Land Value Effects		None	None
4.9	Combined Effects	Interactive	See Text	
4.10	Net Effects	Commitment of 525 Acre Site and 2700 Acres of T/L Right of Way		Same
5.	Cross Category Effects			
5.1	Transportation	5.1.1 Transport of Fuels and Radioactive Material	See Text	
5.2	Accidents	5.2.1 Radiological Effects	See Text	

8.3 Weighing and Balancing of Alternative Subsystems - In TVA's environmental review process for Sequoyah Nuclear Plant, alternative subsystems which would reduce environmental impacts were considered. This section presents the weighing and balancing of the costs and benefits associated with each of these subsystems.

1. Heat Dissipation - The original plant design called for condenser waste heat dissipation by means of diffusers on the bottom of Chickamauga Reservoir. The original method was designed to permit a maximum 10°F temperature rise which was the proposed Tennessee thermal water quality criteria at the time of initial plant planning. A recent change in the proposed Tennessee thermal criteria limiting the temperature change to a maximum of 5.4°F concurrent with the environmental review of Sequoyah, prompted TVA to give further consideration to alternative methods of heat dissipation. The alternatives considered were mechanical and natural draft cooling towers, a spray canal, and a cooling lake. Details on these alternatives, including cost estimates when deemed feasible, are given in Section 2.6 of this volume.

Analyses were performed using the following factors as a basis: feasibility, environmental considerations, and economic considerations. The analyses were carried to the extent required to determine the acceptability of each alternative when considering these factors. This resulted in a complete analysis of only the wet cooling tower alternatives.

Estimates of environmental impacts were made as discussed in Section 8.2. The results are summarized in Table 8.3-1.

The spray canal alternative would require a cooling canal approximately 3 miles in total length and 200 feet wide with 400 spray modules and would require the purchase of an additional 170 acres of land. The analysis of the spray canal alternative showed no significant reductions in environmental impacts that could not be accomplished with the cooling tower alternatives. Due to the limited operating experience with spray canals and the absence of any installations with a heat rejection of the magnitude of Sequoyah, the spray canal was not considered a feasible alternative for this plant.

The cooling lake alternative would require a lake of approximately 3,500 acres. Due to the unfavorable topography at the Sequoyah site, impoundment of a reservoir of this size would require many miles of canals and high dikes and would have resulted in a lake level 50-150 feet above the existing reservoir. Thus, it was concluded that a cooling lake is not a feasible alternative for this plant.

A comparison of the natural and mechanical draft cooling tower alternatives was made in the same operating mode. The principal disadvantages of natural draft cooling towers when compared to mechanical draft cooling towers are the higher capital expenditure and the nearly 2-year longer lead time for construction. However, the natural draft cooling showed a much lower potential for fogging and icing in an area of expanding growth and recreational activity. The natural draft towers could be operational by November 1976 resulting in only 5 months of 1-unit operation without towers. Based on the considerations of cost, feasibility and environmental impacts, TVA has concluded that the natural draft cooling towers offer the best balance of these factors for providing auxiliary cooling for the Sequoyah plant.

The natural draft cooling towers to be installed can operate in the open, helper, or closed mode. The combined cycle information presented in Table 8.3-1 is based on using the heat dissipation capability of the reservoir and reflects operation about 4 percent of the time in the closed mode, about 16 percent of the time in the helper mode, and about 80 percent of the time in the open mode. The combined-cycle natural draft towers have an economic advantage of $17.25 million over closed-cycle natural draft towers.

While the environmental impacts to the reservoir will be greater for combined cycle operation, the only potentially significant impact is that resulting from larval fish mortality due to condenser passage. The significance of these larval fish mortalities is not known. TVA has not been able to predict the amount of increased production of fish resulting from slightly increased downstream temperatures. TVA plans to utilize the combined cycle operating method due to the significant economic advantage. TVA has the capability to modify plant operation during critical periods should environmental monitoring indicate significant adverse effects on fish populations in Chickamauga Reservoir.

2. Gaseous radwaste system - As discussed in Section 2.4, alternatives for a gaseous radwaste treatment system were analyzed during the environmental review process to determine the best system with respect to expected performance, proven reliability, and cost. The following alternatives were evaluated:

1. 45-day holdup
2. 60-day holdup

3. Cryogenic distillation

4. Gas absorption

5. Hydrogen recombiner

Table 8.3-2 presents an evaluation of these alternatives. As shown in the table, the 45-day holdup system, assuming 0.25 percent fuel defects, results in an external annual dose to a person at the site boundary of 6.5 mrem. The 60-day holdup system results in an external annual dose to a person at the site boundary of 5.5 mrem and has a cost of $100,000 relative to the 45-day holdup system. The use of a cryogenic distillation system at a relative cost of $600,000, or of a gas absorption system at a relative cost of $400,000, would result in decreases of dosage rates to 3.6 mrem for each alternative. The hydrogen recombiner system with a relative cost of $400,000 would have an annual dose rate of 5.4 mrem. Neither the cryogenic distillation or gas absorption system has demonstrated performance and reliability in nuclear plant service. The cryogenic distillation system is a complex system compared to the gas decay system and could experience operating problems and presents the potential for accidental release of concentrated waste to the environment. The only experience to date with the gas absorption system has been with bench and pilot size systems. The hydrogen recombiner system would reduce the volume of gas to be stored, thus extending the holdup time. However, due to the long half-life of krypton-85 the predominant isotope present after a 60-day holdup, the use of a hydrogen recombiner would have little effect on the total release.

Based on this analysis TVA has concluded that the 60-day holdup alternative, which results in a dose rate of 5.5 mrem per year, represents the best balance of economic cost, reduction in environmental impact, and feasibility. TVA believes the benefits to be gained by further reducing the radioactive gaseous releases are not commensurate with the cost associated with the reduction. The very low "fence post dose" is less than the numerical guidance provided by the proposed Appendix I to 10 CFR Part 50. It also represents only about 4 percent of the naturally occurring background dose.

3. Liquid radwaste system - Three methods were considered for use in extended treatment of steam-generator blowdown; evaporation, ion exchange, and reverse osmosis. The evaporator and reverse osmosis system would reduce the amount of packaged solid wastes approximately 5,000 ft^3 per year when compared to a demineralizer system. The installed cost of reverse osmosis equipment was estimated to be about $1,000,000. The cost of the evaporator system was not estimated because it was known that it would be much greater than the cost of either of the other two systems. The evaporators could not be fitted into the existing buildings and the cost of an additional building would be prohibitive. At 25-ppm total dissolved solids in the blowdown, the present worth of reverse osmosis operating costs is estimated to be about $130,000; for the demineralizer system the comparable figure is about $1,050,000. Since radioactivity and chemical releases for the two systems would be essentially the same, the lower cost system, reverse osmosis, was selected.

4. Chemical wastes - As discussed in Section 2.5, alternatives for treating the spent demineralizer regenerants and for removing the phosphates from the main steam generator blowdown were considered for the Sequoyah Nuclear Plant.

The alternative for treatment of the spent demineralizer regenerants included evaporation of these wastes and appropriate disposal of the evaporator bottoms as solid wastes. The present worth of the total economic cost of adding this alternative amounts to $938,000.

The alternative for treatment of the main steam generator blowdown was phosphorus removal by chemical precipitation. The present worth of the total economic cost of adding this alternative amounts to $258,000.

The performance and economic costs of the alternative treatment methods are summarized in Table 8.3-3.

In most cases, the reductions in the respective chemical parameters that would be realized by the implementation of either or both of the alternative chemical treatment systems would be less than the minimum detectable amounts of the analytical procedures used to measure the specifically affected water quality parameters. TVA concluded that the implementation of the alternative chemical treatment system(s) is not justified because of the negligible (and, in most cases, analytically unmeasurable) effluent reduction and stream reduction benefits that would be achieved in relation to the required economic costs.

Table 8.3-1

SEQUOYAH NUCLEAR PLANT

ALTERNATIVES FOR HEAT DISSIPATION SYSTEM

COSTS WHICH VARY FROM BASE PLANT

Alternative Heat Dissipation System		Original Diffuser System	Mechanical Draft Towers		Natural Draft Towers		Spray Canals	
			Closed	Combined	Closed	Combined	Closed	Combined
Estimated Incremental Generating Cost (millions of dollars)		base	64.21	41.91	62.27	45.02	68.66	46.74
Reservoir Heat Input (by mode) (Btu/h x 10^{-9})	Open	15.986	--	15.986	--	15.986	--	15.986
	Helper	--	--	6.595	--	7.543	--	5.738
	Closed	--	0.010	0.010	0.010	0.010	0.010	0.010
Water Consumed (acre-feet/day) (by mode)	Helper	--	--	85	--	76	--	92
	Closed	--	144	144	144	144	144	144
Transportation Affected (h/yr)								
Ground		0	544	123	0	0	567	115
Water		237	822	306	0	48	864	310
Additional Land Required (acres)		0	0	0	0	0	170	170
Erosion (tons/yr)		900	750	950	750	950	950	1200

Table 8.3-2

SEQUOYAH NUCLEAR PLANT

ALTERNATIVES FOR GASEOUS RADWASTE SYSTEM

COSTS WHICH VARY FROM BASE PLANT

Alternative Gaseous Radwaste System	45-Day Holdup	60-Day Holdup	Cyrogenic Distillation	Gas Absorption	Hydrogen Recombiner
Incremental Generating Cost (thousands of dollars)	Base	100	600	400	400
Dose Rates to People from External Contact					
rem/yr	6.5(-3)*	5.5(-3)	3.6(-3)	3.6(-3)	5.4(-3)
man-rem/yr	2.48(+1)	2.1(+1)	1.18(+1)	1.18(+1)	1.88(+1)
Internal **Dose** Rates					
rem/yr	3.5(-4)	3.4(-4)	3.4(-4)	3.4(-4)	3.4(-4)
man-rem/yr	2.5	2.5	2.5	2.5	2.5
Dose Rate to Plants and Animals					
rad/yr	6.6(-3)	5.5(-3)	3.6(-3)	3.6(-3)	5.3(-3)

* 6.5(-3) = 6.5×10^{-3}

Table 8.3-3

SEQUOYAH NUCLEAR PLANT

ALTERNATIVES FOR CHEMICAL WASTE TREATMENT SYSTEM

COSTS WHICH VARY FROM BASE PLANT

	Neutralization--Spent Demineralizer Regenerants	Evaporation--Spent Demineralizer Regenerants	Phosphate Removal--Main Steam Generator Blowdown	Evaporation--Spent Demineralizer Regenerants and Phosphate Removal Main Steam Generator Blowdown
Capital cost of adding capability	Base	$775,000	$165,000	$940,000
Annual O&M Cost	Base	$14,000	$8,000	$22,000
Resulting effluent and stream reduction benefits	Base	No Identifiable Benefits (See Text p. 2.5-14)	No Identifiable Benefits (See Text p. 2.5-16)	No Identifiable Benefits (See Text p. 2.5-16)

9.0 CONCLUSION

The Sequoyah Nuclear Plant was initiated before NEPA became effective, and the TVA Board of Directors has determined that it is not practicable to reassess the basic course of action in the design and construction of this plant. However, the environmental impacts considered at the outset of the project have been reevaluated so as to minimize adverse consequences. For example, extended radwaste treatment, additional chemical treatment facilities, and natural draft cooling towers have been provided. In addition, construction methods are being employed to minimize adverse impacts.

This environmental statement reflects the manner in which TVA has incorporated environmental considerations into the decision-making process for the Sequoyah Nuclear Plant. The plant will interact with the environment in three principal ways: (1) release of minute quantities of radioactivity to the air and water, (2) release of large quantities of heat to the environment, and (3) change in land use from rural nonfarm or agriculture to industrial.

The addition of the Sequoyah Nuclear Plant to the TVA system will enable TVA to continue to carry out its statutory responsibility to provide an ample supply of electricity for the TVA region.

After weighing the environmental costs against the technical, economic, 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 the plant can be operated without significant risk to the

health and safety of the public; therefore, the action called for is the continued construction and the operation of the Sequoyah Nuclear Plant.