

TENNESSEE VALLEY AUTHORITY

FINAL

ENVIRONMENTAL STATEMENT

**SEQUOYAH NUCLEAR PLANT
UNITS 1 AND 2**

EXTRA COPY

Index No: 72

Title: Sequoyah Nuclear Plant Units 1 and 2

Tennessee Valley Authority

FINAL ENVIRONMENTAL STATEMENT

SEQUOYAH NUCLEAR PLANT

UNITS 1 AND 2

Chattanooga, Tennessee

SUMMARY SHEET
ENVIRONMENTAL STATEMENT
SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2

[] Draft [X] Final environmental statement prepared by the Tennessee Valley Authority

For additional information contact:

J. A. Oppold, Acting Director
Division of Environmental Planning
268 401 Building
Chattanooga, Tennessee 37401
(615) 755-3161

1. [X] Administrative action [] Legislative action
2. This action is the construction and operation of a 2-unit nuclear power plant in Hamilton County, Tennessee.
3. Environmental impacts associated with the construction and operation of the Sequoyah Nuclear Plant include:
 - a. Minute additions of radioactivity to the air and water.
 - b. Release of large quantities of heat to the environment.
 - c. Change in approximately 525 acres of land for the plant site from rural nonfarm or agricultural to industrial use and easements on 2,700 acres of land for transmission lines.
 - d. Release of small quantities of nonradioactive materials to the air and water.
 - e. Temporary stress on social infrastructure (schools, roads, housing, and similar services).
 - f. Stimulus to area economic development (jobs, attraction of visitors, etc.).
 - g. Some loss of aquatic organisms due to entrainment in the condenser cooling water.
 - h. Operation of the cooling towers will result in evaporation of water and in occasional local fog and ice and some visual obstruction.

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

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

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

SUMMARY SHEET (continued)

Alternative heat dissipation systems considered in addition to the originally planned diffuser system included:

- a. Mechanical draft cooling towers.
- b. Natural draft cooling towers.
- c. Spray canal system.
- d. Cooling lake.

Considering feasibility, environmental impact, and cost, the natural draft cooling towers represent the best balance and will be added to supplement the original plant design to meet the recently adopted water temperature standards.

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

- a. 60-day holdup system.
- b. Hydrogen recombiners.
- c. Solvent absorption system.
- d. Cryogenic distillation system.

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

Tritium recycle by segregating drains and steam generator blowdown treatment by a reverse osmosis unit and an evaporator were adopted to reduce radioactive liquid discharges. Consideration of feasibility, environmental benefit, and cost shows that these systems represent the best balance, and TVA is proceeding to install these alternatives.

5. Comments have been 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 Department of Public Health
Tennessee Game and Fish Commission
Tennessee Historical Commission
Chattanooga-Hamilton County Regional Planning Commission

6. The draft statement was sent to the Council on Environmental Quality and made available to the public on October 19, 1971. The final statement was sent to the Council and made available to the public on February 13, 1974.

DETAILED TABLE OF CONTENTS

	<u>Page No.</u>
SUMMARY SHEET	frontispiece
DETAILED TABLE OF CONTENTS	(i)
1.0 INTRODUCTION	1.0-1
1.1 General Information	1.1-1
1. Location of the Facility	1.1-1
2. Physical Characteristics of the Facility	1.1-1
1.2 Environment of the Area	1.2-1
1. History	1.2-1
2. Topography	1.2-1
3. Geology	1.2-1
4. Seismology	1.2-2
5. Climatology and Meteorology	1.2-3
6. Hydrology and Water Quality	1.2-5
(1) Ground Water	1.2-5
(2) Surface Water	1.2-6
(a) Reservoir Description	1.2-6
(b) Streamflow	1.2-6
(c) Water Quality	1.2-7
(3) Water Use	1.2-11
7. Land Use	1.2-13
(1) Industrial Operations	1.2-13
(2) Farming	1.2-13
(3) Transportation	1.2-14
(4) Recreation	1.2-14
(5) Wildlife Preserves	1.2-14
(6) Population Distribution	1.2-14
(7) Waterways	1.2-15
(8) Government Reservations and Installations . .	1.2-15
8. Ecology	1.2-16
(1) Aquatic Ecology	1.2-16
(a) Fish	1.2-16
(b) Mussels	1.2-17

	<u>Page No.</u>
(c) Other Aquatic Life	1.2-17
(d) Aquatic Macrophytes	1.2-18
(e) Waterfowl	1.2-18
(2) Terrestrial Ecology.	1.2-19
(3) Rare and Endangered Species.	1.2-20
9. Historical and Archaeological Significance of the Site	1.2-20
1.3 Electric Power Supply and Demand	1.3-1
1. Power Needs	1.3-3
2. Consequences of Delays	1.3-4
1.4 Environmental Approvals and Consultations	1.4-1
1.5 Emergency Planning	1.5-1
1. Meetings with Outside Agencies	1.5-3
2. Responsible Agencies to be Notified in Case of a Transportation Accident	1.5-3
2.0 Environmental Impact of the Proposed Facility	2.0-1
2.1 Transportation of Nuclear Fuel and Radioactive Wastes	2.1-1
1. New Fuel Shipment	2.1-1
(1) Method and Frequency of Shipment	2.1-2
(a) Shipping Routes	2.1-2
(b) Shipment Activity	2.1-3
(2) Environmental Effects	2.1-3
(a) Normal Shipments	2.1-4
(b) Accident Occurrences	2.1-4
2. Spent Fuel Shipment	2.1-5
(1) Method and Frequency of Shipment	2.1-5
(a) Spent Fuel Shipping Routes	2.1-7
(b) Shipment Activity	2.1-7
(2) Environmental Effects	2.1-8
(a) Normal Shipment	2.1-8
(b) Accident Occurrences	2.1-10
3. Radioactive Waste Shipment	2.1-12
(1) Method and Frequency of Shipment	2.1-12
(a) Shipping Routes	2.1-13
(b) Shipment Activity	2.1-14

	<u>Page No.</u>
(2) Environmental Effects	2.1-15
(a) Normal Shipment	2.1-15
(b) Accident Occurrences	2.1-16
4. Shipping Safeguards	2.1-18
(1) Governing Regulations	2.1-19
(2) Package Design	2.1-21
(a) New Fuel Container Description and Licensing	2.1-21
(b) Spent Fuel Container Description and Licensing	2.1-22
(c) Radwaste Container Description and Licensing	2.1-25
(3) Transportation Procedures	2.1-27
(a) Onsite Procedures	2.1-27
(b) Offsite Procedures	2.1-27
(c) Accident Occurrences During Transport .	2.1-28
5. Conclusion	2.1-29
2.2 Environmental Aspects of Transmission Lines	2.2-1
1. General Conditions	2.2-4
2. Effects of Transmission Line Rights of Way	2.2-6
Clearing and Control Practices	2.2-6
(1) Shear Clearing	2.2-6
(2) The "Edge Effect" and Wildlife Benefits . . .	2.2-7
(3) Benefits to Wildlife From Right of Way Maintenance	2.2-8
(4) Chemical Maintenance of Rights of Way	2.2-9
(5) Multiple Use of Rights of Way	2.2-10
3. Solid Waste Disposal	2.2-11
4. Erosion Control Practices	2.2-12
5. Miscellaneous Impacts	2.2-14
(1) Ozone	2.2-14
(2) Compatibility with Communications Equipment .	2.2-15
(3) Historical and Archaeological Compatibility .	2.2-16
(4) Impacts on Aviation	2.2-16
(5) Impact of Support Facilities	2.2-17
(6) Others	2.2-17

	<u>Page No.</u>
6. Transmission Line Route Selections	2.2-18
(1) Sequoyah-Widows Creek and Sequoyah-Charleston No. 1 161-kV Transmission Lines	2.2-19
(2) Sequoyah-Watts Bar and Sequoyah-Chickamauga No. 1 161-kV Transmission Lines	2.2-19
(3) Sequoyah-Chickamauga No. 2 and Sequoyah-East Cleveland 161-kV Transmission Lines	2.2-20
(4) Sequoyah-Concord 161-kV Transmission Line . .	2.2-21
(5) Sequoyah-Charleston No. 2 161-kV Transmission Line	2.2-22
(6) Sequoyah-Widows Creek and Sequoyah-Bull Run 500-kV Transmission Lines	2.2-22
(7) Sequoyah-Georgia State Line 500-kV Transmission Line	2.2-23
(8) Sequoyah-Franklin 500-kV Transmission Line. .	2.2-25
7. Summary	2.2-29
2.3 Radiological Effects of Accidents	2.3-1
2.4 Radioactive Discharges	2.4-1
1. Waste Management	2.4-1
(1) Liquid Radwaste System	2.4-2
(2) Tritium Recycle	2.4-4
(3) Solid Radwaste System	2.4-6
(4) Gaseous Radwaste System	2.4-7
(5) Extended Treatment of Gaseous Radwaste . .	2.4-11
(6) Extended Treatment for Steam-Generator Leak .	2.4-12
2. Alternative Waste Treatment	2.4-18
3. Environmental Radiological Monitoring Program .	2.4-22
(1) Atmospheric Monitoring	2.4-23
(2) Terrestrial Monitoring	2.4-24
(3) Reservoir Monitoring	2.4-25
(a) Water	2.4-26
(b) Fish	2.4-27
(c) Plankton	2.4-28
(d) Sediment	2.4-28
(e) Bottom Fauna	2.4-28

	<u>Page No.</u>
(4) Domestic Water Supplies Monitoring	2.4-28
(5) Quality Control	2.4-29
4. Estimated Increase in Annual Environmental Radioactivity Levels and Potential Annual Radiation Doses from Principal Radionuclides	2.4-29
(1) Radionuclides in Liquid Effluents	2.4-29
(2) Radionuclides in Gaseous Effluents	2.4-31
(3) Summary of Radiological Impact	2.4-32
2.5 Nonradioactive Discharges	2.5-1
1. Chemical Discharges	2.5-1
(1) Main Condenser Cooling Water System	2.5-1
(2) Raw Cooling Water and Essential Raw Cooling Water Systems	2.5-4
(3) Makeup Water Treatment Plant	2.5-5
(4) Makeup Water Treatment Plant Demineralizers .	2.5-6
(5) Steam Generator Blowdown	2.5-7
(6) Component Cooling Water System	2.5-9
(7) Reactor Coolant System	2.5-9
(8) Auxiliary Steam Generator Blowdown	2.5-10
(9) Chemical Cleaning During Construction	2.5-10
(10) Miscellaneous	2.5-10
(11) Alternatives Considered for Treatment of Nonradioactive Chemical Wastes	2.5-12
(a) Spent Demineralizer Regenerants	2.5-12
(b) Steam Generator Blowdown	2.5-14
(c) Spent Demineralizer-Generator Blowdown .	2.5-16
2. Yard Drainage System	2.5-16
3. Containment of Hazardous Liquids	2.5-17
4. Sanitary Wastes	2.5-19
5. Gaseous Emissions	2.5-20
6. Nonradiological Environmental Monitoring Program.	2.5-21
2.6 Heat Dissipation	2.6-1
1. Water Temperature Standards	2.6-1
2. Description of Heat Dispersal Facilities	2.6-3
3. Present Thermal Regime of Chickamauga Reservoir .	2.6-8

	<u>Page No.</u>
4. Thermal Discharges to Chickamauga Reservoir	2.6-9
5. Effects on Aquatic Life Resulting from Diffuser Discharges	2.6-13
(1) TVA Experience on Effects of Heated Water . . .	2.6-13
(2) Possible Impact of Heated Water on Aquatic Life	2.6-14
(a) Effects on Biota Passing through Condensers	2.6-14
(b) Effects on Fish in Receiving Waters . . .	2.6-17
(3) Implications of Withdrawal and Return of Cooling Water	2.6-19
(a) Nutrient Circulation	2.6-19
(b) Reduction of DO Concentration in the Condensers	2.6-20
(c) Effect of Entrainment on Dissolved Oxygen	2.6-21
(d) Effect of Elevated Stream Temperatures on Stream Purification Factors	2.6-22
(e) Combined Effects of the Elevated Stream Temperatures on the Dissolved Oxygen Resource	2.6-23
(4) Potential Hazards to Fish of Cooling Water Intake	2.6-24
(5) The Condenser Discharge Pond	2.6-24
6. Natural Draft Cooling Towers	2.6-25
(1) Physical and Chemical Characteristics of Tower Effluent	2.6-26
(2) Local Fogging and Icing	2.6-27
(3) Aesthetics	2.6-32
(4) Noise	2.6-32
7. Operating Procedure Following Tower Installation . .	2.6-32
8. Applicability of Section 401 Certification Requirement Permit	2.6-33
9. Alternative Heat Dissipation Methods	2.6-33
(1) Dry Cooling Towers	2.6-34

	<u>Page No.</u>
(2) Alternative Modes of Operation	2.6-37
(a) Closed Cycle Systems	2.6-37
(b) Combined Cycle System	2.6-37
(c) Percent of Time on Various Modes	2.6-38
(3) Mechanical Draft Cooling Towers	2.6-39
(a) Feasibility	2.6-39
(b) Environmental Considerations	2.6-40
(c) Aesthetics	2.6-43
(d) Noise	2.6-43
(e) Economic Considerations	2.6-43
(f) Land Requirements	2.6-45
(g) Construction Schedule	2.6-45
(4) Natural Draft Cooling Towers	2.6-45
(a) Feasibility	2.6-46
(b) Environmental Considerations	2.6-46
(c) Economic Considerations	2.6-46
(d) Land Requirements	2.6-48
(e) Construction Schedule	2.6-48
(5) Spray Canal System	2.6-48
(a) Feasibility	2.6-48
(b) Environmental Considerations	2.6-49
(c) Aesthetics	2.6-52
(d) Noise	2.6-52
(e) Economic Considerations	2.6-53
(f) Land	2.6-54
(g) Construction Schedule	2.6-54
(6) Cooling Lake System	2.6-55
(7) Other Heat Dissipation Methods	2.6-55
(a) Conversion of the Discharge Pond into a Spray Pond	2.6-55
(b) Construct a Pipeline to the Diffuser Pipes to Eliminate the Discharge Pond . .	2.6-56

	<u>Page No.</u>
(c) Operate the Cooling Towers for Auxiliary Essential Raw Cooling Water Continuously in a Combined Mode	2.6-56
(d) Modify the Circulating Water System to Reduce the Temperature Rise Through the Plant	2.6-56
(8) Evaluation of Alternative Heat Dissipation Methods	2.6-57
2.7 Construction Effects	2.7-1
1. General Construction Considerations	2.7-1
2. Yard Drainage and Discharge Ponds	2.7-2
3. The Diffusers and the Underwater Dam	2.7-4
4. Siltation Effects and Control	2.7-5
5. Solid Waste	2.7-9
6. Sanitary Wastes	2.7-9
7. Chemical Cleaning	2.7-9
8. Noise Abatement	2.7-10
9. Miscellaneous	2.7-10
2.8 Socioeconomic Impact	2.8-1
1. Construction Employment Impact	2.8-1
(1) Population Impact	2.8-2
(2) Impact on Schools	2.8-2
(3) Impact on Economy; Personal Income	2.8-3
(4) Impact on Economy; Wholesale Trade	2.8-3
(5) Impact on Housing	2.8-3
(6) Impacts on Traffic	2.8-5
2. Permanent Employment Impact	2.8-5
2.9 Other Impacts	2.9-1
1. Land Use Compatibility	2.9-1
2. Water Use Compatibility	2.9-2
3. Aesthetics	2.9-3
4. Miscellaneous	2.9-4
(1) Recreation	2.9-4
(2) Normal Solid Waste Disposal	2.9-5
(3) Channel Siltation	2.9-6
(4) Archaeology	2.9-7

	<u>Page No.</u>
3.0 Adverse Environmental Effects Which Cannot be Avoided	3.0-1
1. Water Pollution	3.0-1
(1) Construction	3.0-1
(2) Operation	3.0-2
2. Air Pollution	3.0-3
3. Impact on Land Use	3.0-4
4. Damage to Life Systems	3.0-5
5. Threats to Health	3.0-5
6. Conclusions	3.0-6
4.0 Alternatives	4.0-1
4.1 Alternative Generation	4.1-1
1. Electric Power Purchases	4.1-1
2. Other Generation Alternatives	4.1-1
4.2 Alternative Sites	4.2-1
1. Access	4.2-1
2. Land Requirements and Ownership	4.2-2
3. Population	4.2-2
4. Foundation Conditions	4.2-3
5. Cooling Water	4.2-3
6. Seismology	4.2-4
7. Meteorology	4.2-4
8. Transmission Interconnections	4.2-4
9. Economic Considerations	4.2-4
5.0 Short-Term Uses Versus Long-Term Productivity	5.0-1
6.0 Irreversible and Irretrievable Commitments of Resources	6.0-1
7.0 Agency Review Comments	7.0-1
8.0 Benefit-Cost Analysis	8.0-1
8.1 Benefits	8.1-1
1. Electric Power Produced and Sold	8.1-1
2. Payments in Lieu of Taxes	8.1-3
3. Regional Gross Product	8.1-4
4. Recreation	8.1-5

	<u>Page No.</u>
5. Air Quality	8.1-5
6. Employment	8.1-6
7. Education	8.1-6
8.2 Monetary and Environmental Costs	8.2-1
1. Effects on Natural Surface Water Body	8.2-1
(1) Cooling Water Intake Structure	8.2-1
(2) Passage Through the Condensers of:	8.2-1
(a) Primary Producers and Consumers	8.2-1
(b) Fish	8.2-3
(3) Discharge Area and Thermal Plume	8.2-3
(a) Physical Water Quality	8.2-3
(b) Dissolved Oxygen	8.2-4
(c) Aquatic Biota	8.2-4
(d) Wildlife	8.2-4
(e) Migratory Fish	8.2-5
(4) Chemical Discharges	8.2-5
(5) Radionuclides Discharged to Water Body . . .	8.2-5
(a) Aquatic Organisms	8.2-5
(b) People - External	8.2-5
(c) People - Ingestion	8.2-6
(6) Consumption of Water	8.2-6
(7) Plant Construction	8.2-6
(a) Physical Water Quality	8.2-6
(b) Chemical Water Quality	8.2-6
(8) Other Impacts	8.2-7
(9) Combined or Interactive Effects	8.2-7
(10) Net Effect on Guntersville Reservoir	8.2-7
2. Effects on Ground Water	8.2-7
(1) Raising or Lowering of Ground Water Levels .	8.2-7
(2) Chemical Contamination of Ground	8.2-7
(3) Radionuclide Contamination of Ground Water .	8.2-8
(a) People	8.2-8
(b) Plants and Animals	8.2-8
(4) Other Impacts on Ground Water	8.2-8

	<u>Page No.</u>
3. Effects on Air	8.2-8
(1) Fogging and Icing Caused by Evaporation and Drift	8.2-8
(a) Effects on Local Ground Transportation.	8.2-8
(b) Effects on Air Transportation	8.2-9
(c) Local Effects on Water Transportation .	8.2-9
(d) Effects on Plants	8.2-10
(2) Chemical Discharge to Ambient Air	8.2-10
(3) Radionuclides Discharged to Ambient Air . .	8.2-11
(a) People - External	8.2-11
(b) People - Ingestion	8.2-11
(c) Plants and Animals	8.2-11
(4) Other Impacts on Air	8.2-11
4. Effects on Land	8.2-11
(1) Preemption of Land	8.2-11
(2) Plant Construction	8.2-12
(a) Noise Effects on People	8.2-12
(b) Accessibility of Historical Sites . . .	8.2-12
(c) Accessibility of Archaeological Sites .	8.2-12
(d) Wildlife	8.2-12
(e) Erosion Effects	8.2-12
(3) Plant Operation	8.2-12
(a) Noise Effects on People	8.2-12
(b) Aesthetic Effects on People	8.2-13
(c) Wildlife	8.2-13
(d) Flood Control	8.2-13
(4) Salts Discharged in Drift From Cooling Towers	8.2-13
(5) Transmission Route Selection	8.2-13
(a) Preemption of Land	8.2-13
(b) Land Use and Land Value	8.2-13
(c) Aesthetic Effects on People	8.2-14
(6) Transmission Facilities Construction	8.2-15
(a) Land Adjacent to Rights of Way	8.2-15
(b) Land Erosion	8.2-15
(c) Wildlife	8.2-15

	<u>Page No.</u>
(7) Transmission Line Operation	8.2-15
(a) Land Use	8.2-15
(b) Wildlife	8.2-16
(8) Other Land Impacts	8.2-16
(9) Combined or Interactive Effects	8.2-17
(10) Net Effects on Land	8.2-17
5. Cross Category Effects	8.2-17
(1) Transportation	8.2-17
(2) Accidents	8.2-18
8.3 Weighing and Balancing of Alternative Subsystems . . .	8.3-1
1. Heat Dissipation	8.3-1
2. Gaseous Radwaste System	8.3-3
3. Liquid Radwaste System	8.3-5
4. Chemical Wastes	8.3-6
9.0 Conclusion	9.0-1
Appendix A Climatology and Meteorology	A-1
Appendix B Fishery Resources	B-1
Appendix C Sequoyah Vegetation	C-1
Appendix D Radiological Analysis for Transportation of Spent Fuel and Radioactive Waste	D-1
Appendix E Relation of 10 CFR Part 71 Accident Requirements to Actual Shipping Environment	E-1
Appendix F Ozone Production and its Potential Effects .	F-1
Appendix F1 Program for Chemical Treatment of TVA Transmission Line Rights of Way	F1-1
Appendix G Outline of Accident Analyses	G-1
Appendix H Radiological Impact of Liquid Effluents . .	H-1
Appendix I Radiological Impact of Gaseous Effluents . .	I-1
Appendix II Child Thyroid Dose Rate from Ingestion of Radioiodine Calculated Using Methods Specified in Regulatory Guide 1.42	II-1
Appendix J Estimation of Potential Internal Dose from Radioactive Particulates	J-1

Appendix K	Radiological Impact of External Dose from Refueling Water, Primary Water, and Condensate Storage Tanks	K-1
Appendix L	Cumulative Radiological Impact on the Tennessee River from the Operation of TVA Nuclear Plants	L-1
Appendix M	Reservoir Thermohydrodynamics and the Diffuser System	M-1

PREFACE

This detailed statement of environmental considerations, prepared by the Tennessee Valley Authority, evaluates the effects on the environment of the construction and operation of the Sequoyah Nuclear Plant (AEC Docket Nos. 50-327, 50-328) and is made in accordance with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. Section 4331 et seq.).

TVA, a corporate agency of the Federal Government, and the Atomic Energy Commission, a regulatory agency of the Federal Government, have agreed that TVA is the lead agency for the preparation and circulation of the detailed statement of environmental considerations for the Sequoyah Nuclear Plant. A draft statement for the Sequoyah plant was circulated for review and comments by other Government agencies on October 19, 1971.

In accordance with the lead agency agreement, TVA has consulted AEC in the preparation of this final detailed environmental statement. Copies of AEC's comments on this statement and TVA's responses are included in Section 7.0.

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