1/1/73

TESTIMONY OF JAMES E. WATSON

In the Matter of The

TENNESSEE VALLEY AUTHORITY

(Watts Bar Nuclear Plant Units 1 and 2)

DOCKET NOS. 50-390, 50-391

My name is James E. Watson. My business address is the Power Building, Chattanooga, Tennessee. I am the Manager of the TVA Office of Power.

I received my engineering education at the University of Iowa in Iowa City, graduating in 1936 with a degree in mechanical engineering. After graduation I came to TVA's power organization, working in various engineering capacities in industrial power, power system planning, and power plant valuation. I became Chief of the Power Contracts Branch in 1947, responsible for developing and administering power contracts with TVA's customers--municipalities, electric cooperatives, industries, and government agencies. Subsequently, I was Director of Power Utilization responsible for the marketing of TVA power, including the administration of power contracts, forecasts of power requirements, electrical demonstration and promotional activities, development of electric rates, and broad concern for the financial integrity of TVA and of the more than 150 local electric systems depending upon TVA for their power supply.

I became Assistant Manager of Power in 1962, serving as the principal assistant to the Manager of Power in the management of all phases of TVA's power organization but especially in securing a supply of coal and nuclear fuel for the steam plants. In 1970 I was appointed Manager of Power.

Since then, in addition to overseeing the operation of the TVA power system, the Nation's largest, I have become an active participant in the demonstration phase of the Nation's nuclear breeder reactor development program. Currently, I am Vice Chairman

of the five-member Project Management Corporation--a corporation with the overall responsibility for developing and implementing plans for the design, construction, and management of the breeder demonstration plant. I am also a member of the three-man steering committee to coordinate PMC's overall effort.

I also serve as a member on several boards related to power supply, including the National Electric Reliability Council, the Electric Power Research Institute, the Atomic Industrial Forum, and the EBR II Review Committee.

I am a member of the Institute of Electrical and Electronics Engineers and the Chattanooga Engineers Club. I am a registered Professional Engineer in the State of Tennessee.

As Manager of Power, I direct the TVA power program. I am responsible to the TVA Board of Directors for the formulation and execution of plans, policies, and programs for the generation, transmission and marketing of electric power.

As Power Financing Officer, I am responsible to the TVA Board for the financial operations of the power program, including the issuance of bonds and notes to assist in financing power construction.

TVA Administrative Organization

TVA is a corporate agency of the federal government; its major policies, programs, organization, and administrative relationships are determined by a full-time three-member Board of Directors. Members of the Board are appointed by the President and confirmed by the Senate for nine-year terms.

The General Manager is TVA's principal administrative officer, with overall responsibility for execution of programs, policies, and decisions adopted by the Board. Responsibilities for conducting TVA programs, applying policies, and performing services are delegated to TVA offices and divisions.

The Office of Power is responsible for power planning and operations, and for the engineering and construction of transmission lines and substations. It recommends additions of power production capacity, including types, locations, and timing for overall system economy. It also assists in making safety analyses and technical evaluations of nuclear plant designs and proposals, and coordinates licensing activites. It has a well-qualified nuclear power staff and advises other divisions with regard to special aspects of nuclear technology, including core characteristics, fuel management, and nuclear safety.

The Office of Power is responsible for operating and maintaining TVA's power plants, including the Watts Bar Nuclear Plant, in accordance with established plans and administrative requirements. In the case of Browns Ferry, Sequoyah, Watts Bar, and any additional nuclear plants, an operational quality assurance program has been established to assure their safe and

reliable operation. This program meets the quality assurance requirements of Appendix B to 10 C.F.R. Part 50.

The Office of Engineering Design and Construction makes technical evaluations of nuclear plant designs and proposals and is responsible for most of TVA's major design and construction work, including dams and power plants. For the Watts Bar plant it has the responsibility for (1) the design of the plant, including engineering administration of the major equipment contract with Westinghouse and with all other suppliers of permanent equipment; (2) overall assurance for quality during design and construction; (3) inspecting, witnessing the testing, and observing the fabrication of equipment and materials at vendors' plants to assure that specification and drawing requirements are met; and (4) construction and attendant quality control of the project at the Watts Bar site.

The Office of Health and Environmental Science, which is independent of the Office of Power, will provide health services at the plant, participate in establishing radiological health protection standards, and act as liaison with local, state, and national health agencies in developing emergency radiological and medical plans. It will participate in the planning, design, and operation of nuclear plants with respect to radiological protection facilities, participate in development of radiological health standards, and conduct both onsite and offsite environmental monitoring.

Other TVA divisions, including Personnel, Finance, Purchasing, Law, and Property and Supply, are responsible for

management service activities affecting all the TVA programs, including the Watts Bar plant. The administrative relationships among these divisions and the line organizations directly responsible for the projects and programs are well established by written procedures.

The TVA Power System

The TVA power system is the nation's largest in terms of both generating capacity and production of electricity. It now has 19,883 megawatts of generating capacity in service: 4,374 in hydro plants and 15,509 in thermal plants. The hydroelectric capacity is included in 48 dams and the thermal capacity is included in 11 coal-burning steam plants and 16 gas turbine units. Two coal-fired units of 1,300 megawatts each, three nuclear units of 1,152 megawatts each (Browns Ferry Units 1-3), two nuclear units of 1,220 megawatts each (Sequoyah Units 1-2), twelve gas turbine units totaling 714 megawatts, and a pumped-storage hydro plant of 1,530 megawatts are now under way. These additions, together with the two Watts Bar nuclear units of 1,270 megawatts each (generator nameplate rating), will bring the system's generating capacity to more than 33,000 megawatts by about 1978. Additionally, TVA is planning to add approximately 7,500 megawatts of generating capacity between 1978 and 1982.

A characteristic of the TVA power system in the past has been its rapid load growth. This rapid growth is expected to continue. To keep up with the demand for power, TVA must add approximately 1,500 megawatts of new generating capacity each year. Large load additions resulting from increased power requirements of AEC at Oak Ridge and Paducah will require additional capacity beyond normal load growth.

Because the system is large and the loads are growing rapidly, it is desirable for TVA to install very large generating units and concentrate large amounts of capacity at individual

plants. TVA has pioneered in erecting large generating units and has proved its ability to adopt technological advances in their early development, even when the advances call for the installation of large and complex equipment, such as the Browns Ferry and Sequoyah nuclear units. The Sequoyah units, with a generator name-plate rating of 1,220 megawatts, are the largest so far approved by AEC for construction. Examples among coal-fired units are the 500-megawatt units at TVA's Widows Creek Steam Plant, which were the largest in the country when they were built; the 700-megawatt units at TVA's Paradise Steam Plant, likewise the largest; the 950-megawatt unit at TVA's Bull Run Steam Plant, which was one of the largest; the 1,150-megawatt unit at the Paradise Steam Plant, which is the largest unit now in service; and the 1,300-megawatt units being readied for service at the Cumberland Steam Plant, which are also recordbreaking in size.

TVA's transmission system contains about 16,000 miles of lines and about 600 substations. More than 8,000 miles of line operate at 161 kilovolts. About 1,300 miles of extra-high-voltage (500 kilovolt) lines are in service. TVA was the first power system in this country to place 500-kilovolt transmission lines in regular commercial operation.

TVA is primarily a wholesaler of power, operating generating plants and transmission facilities but no retail distribution systems. Its customers include 110 municipal electric systems and 50 rural electric cooperatives. In addition, TVA sells power directly to 48 industries whose power requirements are very large or otherwise unusual and to several agencies of the

federal government. The federal government is TVA's largest single customer, currently accounting for about one-seventh of total sales.

The municipal and cooperative electric systems distribute TVA power to more than two million residential, farm, commercial, and industrial customers. They supply power over an area of about 80,000 square miles in parts of seven southeastern states, containing about six million people.

TVA Nuclear Experience

TVA participated in some of the early nuclear power studies immediately after the war in 1946, including the Daniels power pile study at Oak Ridge and the work of the Parker Committee, which surveyed prospects of nuclear power application. In 1953, TVA started developing a nuclear power staff and began a more detailed study of possible uses of nuclear power on its own system. Members of the staff were assigned to various Atomic Energy Commission installations, including national laboratories and the Washington offices, to obtain training and experience.

In 1960, TVA agreed to operate the Experimental Gas-Cooled Reactor for AEC at Oak Ridge, and developed a technical and operating staff which included 43 engineers and physicists with many years of training and experience in nuclear technology, and 21 certified reactor operators and senior operators. The staff was responsible for the entire pre-operational program, including the development of the startup procedures and tests, safety analyses and core analyses, and was prepared to begin fuel loading when the project was terminated early in 1966. Many of these trained and experienced people are now assigned to TVA engineering and operating organizations that are directly involved in the planning, design, construction, and operation of TVA's nuclear plants. Today, TVA employs nearly 200 engineers and scientists with extensive training and experience in nuclear engineering.

TVA has an experienced, competent nuclear plant design organization, including a large number of engineers with many years

of steam power plant design experience. This organization has been engaged in planning and designing the three-unit Browns Ferry plant, the two-unit Sequoyah plant, and the two-unit Watts Bar plant. TVA has a similarly experienced construction organization which has been engaged in the construction of the Browns Ferry and Sequoyah plants. The skills and experience of this organization will be fully employed in the construction of the Watts Bar Nuclear Plant.

TVA has engaged the Westinghouse Electric Corporation to design, fabricate, and deliver to TVA two nuclear steam supply systems, turbogenerators, and other major elements and systems for a pressurized water reactor plant. Westinghouse will also furnish a complete core design and nuclear fuel supply for the initial cores and will furnish replacement fuel assemblies and fuel management services. TVA is responsible for procuring, erecting, and testing the containment systems. TVA will also specify and procure the remaining systems, components, and elements of the plant and will design and construct the complete integrated plant.

TVA's Qualifications To Design and Construct Watts Bar Nuclear Plant

In 1933, TVA's Board of Directors adopted a policy that, insofar as feasible, TVA should design and construct its own projects with its own personnel. This approach, which has been found to afford greater flexibility and efficiency and has been proven the most economical, is still used today.

TVA's Office of Engineering Design and Construction has designed and constructed a number of projects costing nearly 3 billion dollars. This includes nine major coal-fired steam plants, consisting of 54 individual generating units, completed since 1949. Additional generating units totaling more than 10.7 million kilowatts are now under construction.

TVA's Office of Engineering Design and Construction has two major divisions--the Division of Engineering Design and the Division of Construction.

The Division of Engineering Design currently has a total of 1,330 employees, of which about 800 are engineers and architects, including 60 with extensive training and experience in nuclear engineering, and including many other engineers with significant experience obtained during the design of the Browns Ferry and Sequoyah Nuclear Plants. It has developed a comprehensive quality assurance program for the design and construction of the Watts Bar Nuclear Plant which conforms to the requirements of Appendix B to 10 C.F.R. Part 50, and has worked very closely with Westinghouse nuclear engineers and scientists in planning the design of the Watts Bar plant. It will work closely with

Westinghouse while the final design is being prepared, thereby utilizing the skills of both organizations to produce the best possible design.

In recognition of the increased work load due to the number of nuclear plants to be constructed and the necessity for continued emphasis on assuring quality, a new position, that of Assistant to the Manager for Quality Assurance, has been established. The job of this assistant and his staff will be to assure that the quality assurance programs for both design and construction are adequate in all respects and that the program is being implemented and executed in strict compliance with the requirements of Appendix B to 10 C.F.R. Part 50.

The Division of Construction has responsibility for building TVA's major engineering facilities, including steam plants, hydro plants, switchyards, and buildings. Direct responsibility for the construction of the Watts Bar plant is in the Project Manager who is assisted by the Construction Engineer and the Construction Superintendent. The Construction Engineer is responsible for quality assurance of all construction activites and directs the engineering section of the project organization, including approval of construction methods and performance of work in accordance with applicable specifications and design drawings. The Construction Superintendent directs the physical construction of the project, including scheduling construction operations and coordinating the activites of construction personnel. All have had extensive experience in the construction of large steam plants and are highly qualified.

For construction put into place at Watts Bar by TVA forces, quality assurance, which is under the direction of TVA's Construction Engineer, is supplemented by the inspection of the Westinghouse resident manager, both of whom must be satisfied with completed work. For the cases in which Westinghouse is responsible for construction, the construction work is the responsibility of Westinghouse's resident manager with review and inspection by TVA's Construction Engineer. In this case, too, both TVA and Westinghouse must be satisfied with the finished work. In cases where other contractors are used in construction, TVA's Construction Engineer has prime responsibility for inspection and control, and, to the extent that Westinghouse has responsibility, the work must also be satisfactory to the Westinghouse resident manager.

TVA's Financial Qualifications

Funds for design and construction of the Watts Bar plant will come from proceeds of the sale of bonds and notes and from available revenues of the power program. Congress has given TVA authority to sell bonds and notes to assist in financing its power operations. TVA is now authorized to have an outstanding indebtedness of $5 billion. Actual indebtedness on June 30, 1972, was $1,955,000,000. TVA's power bonds are of prime investment quality and have a "Triple A" rating by both Moody's and Standard & Poor's, the two principal bond rating agencies in the United States.

The current estimated total cost of the proposed facility is $685,000,000. This consists of $600,800,000 for the total nuclear production plant costs, $24,200,000 for transmission plant costs, and $60,000,000 for the nuclear fuel inventory cost for the first cores.

During the years in which the Watts Bar plant is being erected, about 26 percent of the funds required for the construction of power facilities will be provided by power revenues and 74 percent will be borrowed. The following table shows the estimated expenditures and sources of funds for the construction of the Watts Bar plant and other power facilities for fiscal year 1971 through fiscal year 1979.

ESTIMATED TVA CONSTRUCTION AND NUCLEAR FUEL EXPENDITURES FOR POWER FACILITIES

(Millions of Dollars)

	Fiscal Years									9-Year Totals
	1971	1972	1973	1974	1975	1976	1977	1978	1979	
Funds Required										
Watts Bar Nuclear Plant Units 1 and 2 (excludes nuclear fuel inventory)	2.2*	12.3	54.4	138.0	150.0	128.0	113.0	25.0	1.9	624.8
Watts Bar Nuclear Fuel Inventory Change**					11.2	30.8	7.9	-4.3	-2.0	43.6
Other Generating Units and Transmission (excludes nuclear fuel inventory)	458.0*	611.6	441.7	354.8	338.8	453.0	649.0	792.0	855.1	4954.0
Other Nuclear Fuel Inventory Change**	16.7*	43.8	59.4	3.9	-13.4	27.4	28.1	52.0	50.6	268.5
Total	476.9*	667.7	555.5	496.7	486.6	639.2	798.0	864.7	905.6	5890.9
Source of Funds										
Current Proceeds	117.6	94.3	119.9	150.4	177.3	189.2	208.0	229.7	240.6	1527.0 (26%)
Borrowings	359.3	573.4	435.6	346.3	309.3	450.0	590.0	635.0	665.0	4363.9 (74%)
Total	476.9	667.7	555.5	496.7	486.6	639.2	798.0	864.7	905.6	5890.9

* Actual figures

** Payment for nuclear fuel minus the value of the fuel burned

From the foregoing table it can be seen that TVA is well qualified to finance the Watts Bar Nuclear Plant. Additional financial information is contained in TVA's "Power Annual Report" for the fiscal year ended June 30, 1972. This report was prepared under the direction of the Manager of Power and correctly presents TVA's financial status. I would like it incorporated into the record as my testimony.

TVA Operator Training

The Watts Bar plant staff will be selected primarily from existing TVA forces. Most of those selected will have had significant experience in large conventional plants. Some will have had nuclear training and experience. Personnel from the staffs of the Browns Ferry and Sequoyah Nuclear Plants may be utilized should the schedules of the plants prove to be compatible in this regard. The training program will accommodate the needs of individuals from any of these backgrounds to provide the knowledge and skill required for the safe operation of the plant.

The plant personnel requiring licenses will be given necessary basic training courses as general preparation for their responsibilities in the operation of the plant. In general, those requiring an AEC license will be given courses as follows:

Basic Nuclear Course

Startup Training at a Low Power Reactor

Plant Technology Course

PWR Operator Training

Onsite Training, including:

- Plant Familiarization and Preparation of Manuals
- Participation in Preoperational Testing
- Preoperational Checkout of Operating Procedures
- Participation in Initial Fuel Loading and Startup Tests

Key supervisors, engineers, and other technical

personnel who are not required to have AEC licenses, but who are required to have a high level of technical competence in areas of plant engineering, operation, maintenance, and technical support activities, will participate in the plant technology and onsite indoctrination and training courses and will receive on-the-job instruction at Westinghouse facilities under the direction of its specialists. In addition, where desirable, supplemental academic training will be provided.

Specialists will receive training in their respective fields as follows:

Fuel Management

Radiation Protection

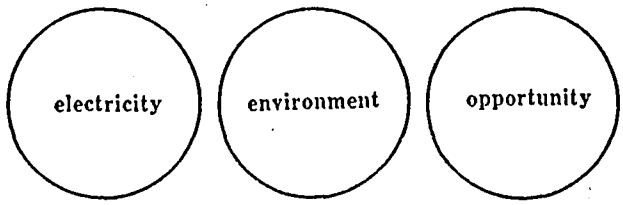
Radiochemistry

Control and Instrumentation

Additional special training will be planned and conducted within groups to meet specific needs.

POWER ANNUAL REPORT
TENNESSEE VALLEY AUTHORITY
1972

cover



America's promise to all is opportunity — an opportunity for each individual to have a decent life in a decent environment.

The cover design symbolizes the need for adequate electricity and a safe environment, if there are to be opportunities for improving the total quality of human life. Society, in the Tennessee Valley region and all of the Nation, must now carefully determine its priorities, proceeding wisely with a balanced approach toward meeting both its electrical and environmental needs.

This report notes many of the efforts being made by TVA to meet some of today's foremost challenges — those relating to power supply and the environment — so there will continue to be expanding opportunities in the region it serves.

TENNESSEE VALLEY AUTHORITY
A Corporation Wholly Owned by the United States of America

Board of Directors / Aubrey J. Wagner, Chairman
Don McBride, Member
General Manager / R. Lynn Seeber
General Counsel / Robert H. Marquis
Comptroller / Kenneth D. Hatcher
Manager of Power / James E. Watson

1972 POWER ANNUAL REPORT
for the fiscal year ended June 30

TVA is a corporate agency of the United States Government. It was established by Act of Congress in 1933 to develop the Tennessee River system and to assist in the development of other resources of the Tennessee Valley and adjoining areas.

The production and sale of electric power are part of TVA's resource development program. TVA supplies power at wholesale to 160 municipal and cooperative electric systems which in turn distribute power to more than 2 million customers in parts of seven states. TVA also serves directly 48 industrial customers with large or unusual power requirements and several Federal atomic, aerospace, and military installations.

Financially, the power program is separate from other activities. It is required to be self-supporting and self-liquidating. Power accounts are kept in accordance with the uniform system prescribed for electric utilities by the Federal Power Commission.

This report deals with TVA's electric power activities. Additional information about power or other activities may be obtained from the Director of Information, Tennessee Valley Authority, Knoxville, Tennessee 37902.

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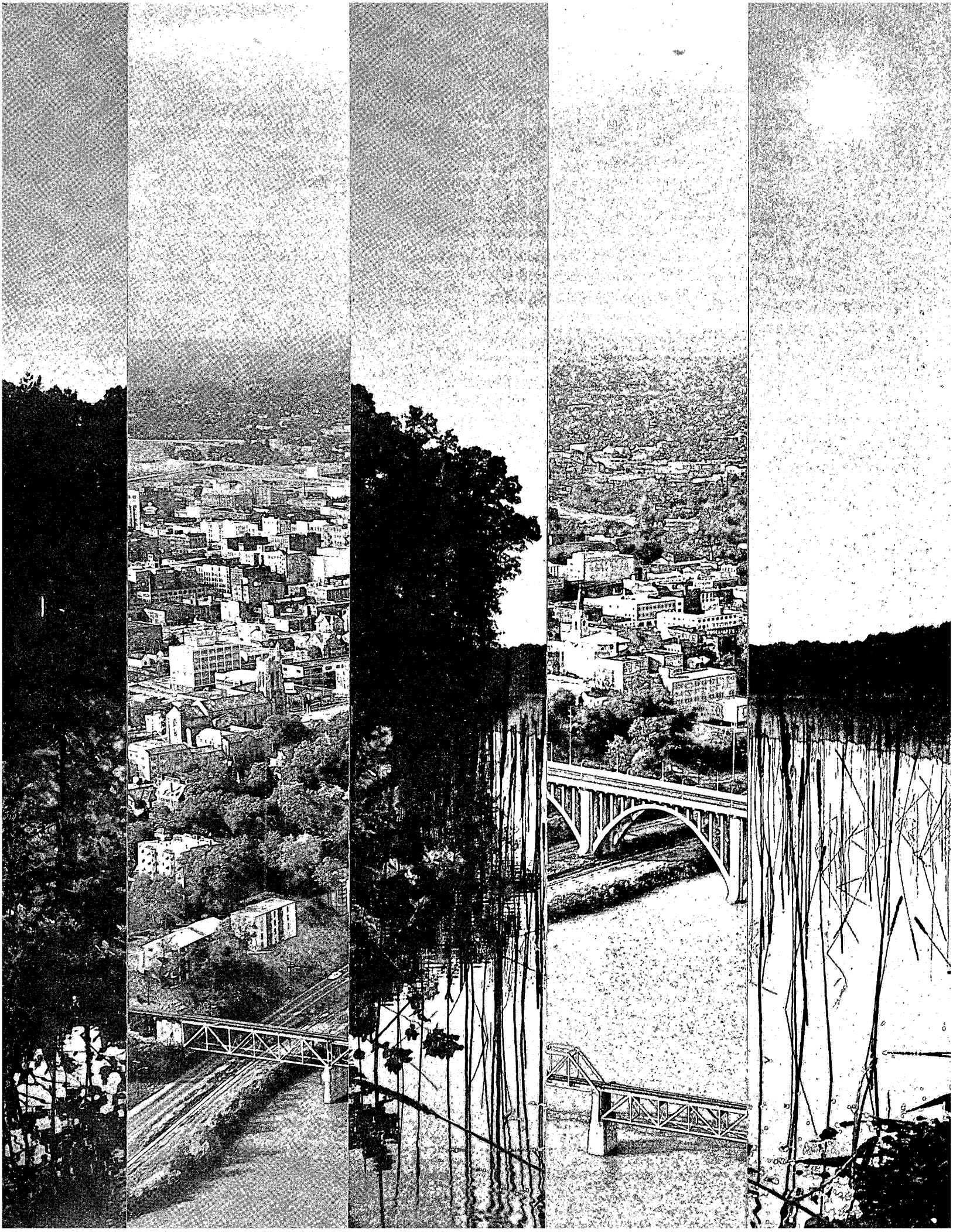


1972

Meeting electricity needs in troublesome times

TVA is deeply involved in efforts to provide an adequate power supply to the region it serves — in a clean and reliable manner, and at rates as low as possible.

Because of increasing power requirements, the uncertainty of fuel availabilities, licensing requirements and the application of environmental controls, no section or region can count itself immune from the possibility of power shortages. However, TVA has met the region's load requirements and expects to bring new generating units into operation in time to meet additional power demands.

Currently, 16 million kilowatts of capacity is under construction or on order, and more is planned. Most of the new capacity will be provided by large nuclear units which will be important additions for meeting base loads — power loads which remain about the same around the clock. Peaking capacity — normally used only during periods of highest power demands — is being boosted by a large, pumped-storage hydroelectric project and by gas turbines. This new capacity will be relied upon for additional power supply during this decade and beyond.

TVA also is continuing its program to provide additional environmental protection equipment at its generating plants now in service. Particular attention is being given to coal-fired plants to meet new state requirements covering their emission levels. Electrostatic precipitators to reduce particulates from stack emissions are being installed on a schedule that will have them in operation on all units by 1975 or 1976. And construction of one of the Nation's largest test demonstration facilities to reduce sulfur dioxide from stack gases is expected to get underway this fall.

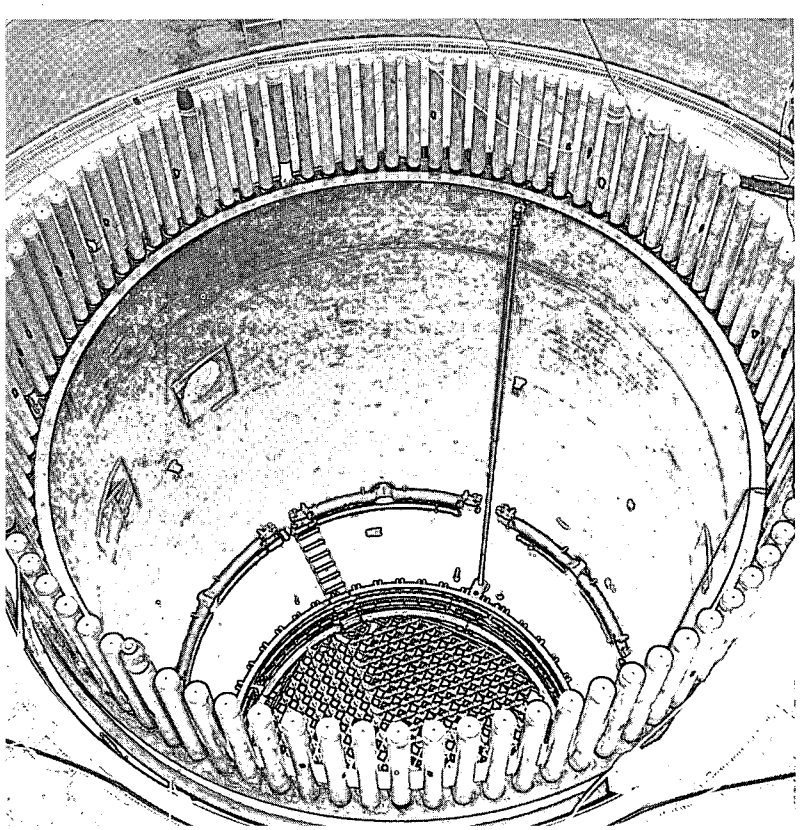
Looking ahead, TVA is supporting and cooperating in research and development programs aimed at meeting the challenge of future power supply. Technology gained later in this decade or early in the next from the demonstration breeder reactor plant to be located on the TVA system offers one of the most promising means of satisfying the region's and Nation's growing power needs. The breeder holds promise of providing abundant energy, in an environmentally acceptable manner, and at a relatively low cost.

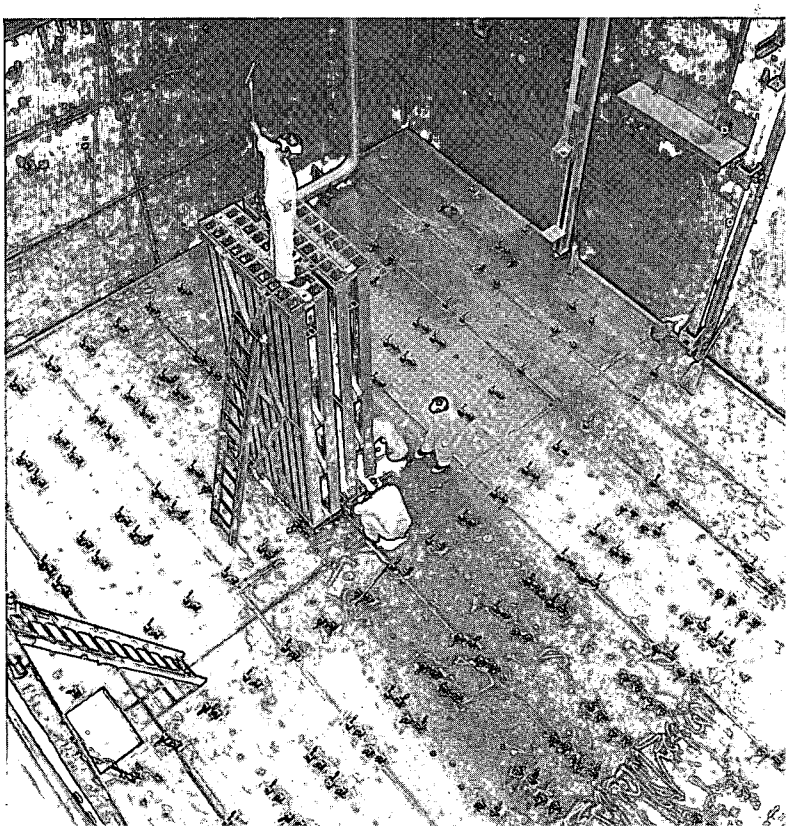
Highlights

	1972	1971
Kilowatt-hours sold, billions	91.1	90.6
Revenue, millions	$641.8	$598.0
Net income, millions	$112.1	$119.0
Repayment and dividend to the U. S. Treasury, millions	$ 75.8	$ 85.1
Average annual residential use, kilowatt-hours	14,040	14,400
Average residential cost per kilowatt-hour, cents	1.28	1.22
Number of electrically heated homes, June	680,000	637,500
Region's peak power load, kilowatts	16,664,000	16,745,000
Coal burned, millions of tons	31.9	32.5
Hydro generation, billions of kilowatt-hours	21.3	17.3
Construction expenditures, millions	$538.2	$433.3
Taxes and payments in lieu of taxes by TVA and the distributors, millions	$ 53.5	$ 45.3

Construction is continuing on the Browns Ferry Nuclear Plant. Its three units of 1,152,000 kilowatts each have been delayed; unit 1 is now scheduled for operation next year. When construction is completed, Browns Ferry should be one of the most environmentally acceptable steam-electric generating plants in the Nation.

At the Browns Ferry Nuclear Plant, these photos taken in April show unit 1's reactor vessel (left) and the setting of fuel racks for the unit (right).





Environmental needs being met on broad front

Resource development undertaken in the Tennessee Valley over the years has had a major impact on the people and their environment. Such things as regulating the river and its tributaries, replanting forests, introducing new fertilizers, and making low cost electricity widely available, for example, have improved the living environment and broadened opportunities.

A more productive economy, though, requires more extensive measures to avoid harmful effects upon the natural environment. This is especially true in the generation of electricity, now that additional large thermal generating units are being added to the power system in response to the region's additional power requirements. On this front, expanded action is being taken to keep pollutants in check.

In the production of electricity at steam-electric plants, unwanted byproducts are produced which could adversely affect air and water quality if measures were not taken to control pollutants. TVA exercises these control measures responsibly to meet environmental needs.

Older coal-fired steam plants are being equipped with electrostatic precipitators to increase the efficiency of removing fly ash from stack emissions. Newer plants already have similar equipment. When this overall air cleaning program is completed, the efficiency of fly ash removal will be greatly improved.

Processes for removing sulfur dioxide from stack gases do not present as promising a picture near-term, although TVA plans to test the limestone wet scrubbing process on a large generating unit to help advance technology. In the meantime, control for avoiding harmful SO_2 concentrations at ground level is being accomplished by dispersing these gases from very tall stacks and by cutting back on generation at a plant when local meteorological conditions interfere with proper dispersal.

Large amounts of cooling water are needed in the operation of a stream-electric plant to condense the steam exhausted by the turbine, for recycle to the boiler in the closed system. This heat, picked up by the condenser cooling water, is then dissipated by one of several discharge systems or by a combination of them. TVA is designing heated water discharge systems on new plants for optimum effectiveness at each plant site. Where a large body of cool, flowing water is available, water is taken in upstream, passed through the plant's condensers, and discharged downstream in a once-through system. At some locations, once-through cooling cannot be used in its simplest form with assurance that the rise in temperature will not harm aquatic life, and more elaborate designs are employed, such as passing the heated water out through large diffuser pipes laid across the bottom of the river channel so the heated water, jetting from the pipe's thousands of holes, mixes rapidly with the cooler, overflowing river water. Where these systems are insufficient to protect aquatic life or satisfy applicable water temperature standards, other means such as cooling towers are utilized. With this system, the temperature of the discharged water is lowered as it gives up its heat to the tower's cool air updrafts, and the cooled water is cycled back to the plant. Towers are costly but versatile — they can cool all of the discharge water or provide supplementary cooling in combination with other systems.

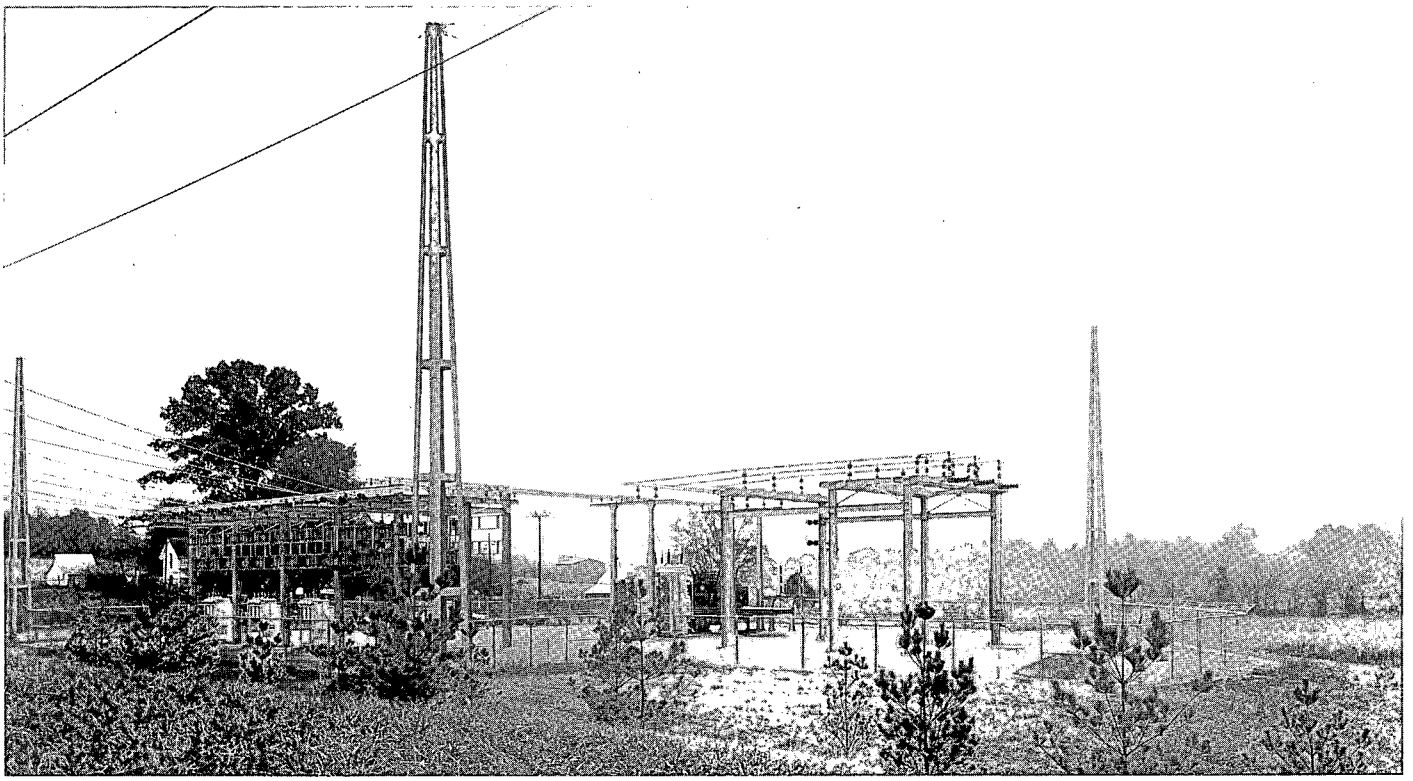
Radioactive materials released from nuclear power plants are held to only a small fraction of the naturally occurring background radiation. During the year, TVA ordered additional waste treatment systems for the Browns Ferry Nuclear Plant. With these additions, the plant's gaseous and liquid radioactive releases will be only a small fraction of the Atomic Energy Commission's conservative guidelines. Other nuclear power plants being built or planned will have comparable waste treatment systems.

There are other environmental impacts related to the production of electricity, and TVA is taking action on these fronts.

Contracts for strip mine coal now involve a two-step bidding procedure, requiring the producer to submit a detailed mining and reclamation plan that must be approved by specialists in these fields before the producer can qualify as an approved bidder. To provide a more workable enforcement procedure, a portion of the contract payments is withheld by TVA in a reserve account, to be paid with interest when the required reclamation is satisfactorily completed. If it is not, this money is then available for TVA's use in completing any needed work.

TVA not only includes these provisions in new coal contracts, but is seeking to renegotiate existing coal supply contracts to incorporate the new reclamation clause. These provisions greatly strengthen the land reclamation requirements TVA has had in its strip-mine contract awards since 1965.

Visual consideration is included in the design and construction of the transmission system which



The low-profile design given this substation reduces its visual impact in this rural setting. Landscaping with trees and shrubs adds to the aesthetic treatment of the power facility.

delivers power from generating plants to load centers. Substation sites are selected to fit in with local topographic conditions where possible. Topography, vegetation, and other means are being used to improve the substation's appearance. Depending on location, they may be landscaped with trees and shrubs, enclosed in decorative walls or fences, painted in harmonizing colors, and incorporate a low profile design that has unobtrusive lines.

When transmission lines must parallel highways, they are set back from the road to allow trees and ridges to screen them from view. Line crossings of major roads in the vicinity of intersections and interchanges are avoided where possible, and in general, necessary highway crossings are made at a right angle to minimize any visual impact.

A cooperative program with landowners and other interested groups is well established for the use of transmission line rights-of-way for pasture or cropland, or for ground cover and food supply for wild game. All rights-of-way that have been cleared since 1970 have been cut to near ground level, thoroughly cultivated, and seeded with pasture-type grass. Where trees exist at an intersection of lines and roads, selective landscape treatment is used to leave a natural shield.

TVA believes the present enviromental concerns associated with its steam-electric plants can be met responsibly through actions already underway or planned, at an estimated cost of $75 million annually. Added control measures either already required by state or Federal regulations or being actively proposed and considered, however, could boost the average cost per year to 9 to 10 times that amount.

Strong research and development effort continues

The research and development projects TVA is engaged in or supporting cover a wide range of power-related activities, ranging from basic fuels to consumer use — from better fuel utilization to improved generation efficiencies — from environmental protection to more efficient consumer use of electricity.

One of the more important current projects is the development of a successful process for removing sulfur dioxide from coal-burning power plant stack gases. Federal and state regulations already have been established, to be effective in the 1975-78 period depending on the state, pertaining to the ambient (ground-level) concentrations of sulfur dioxide,

and drastically limiting the emission (stack top) levels of SO_2 into the atmosphere.

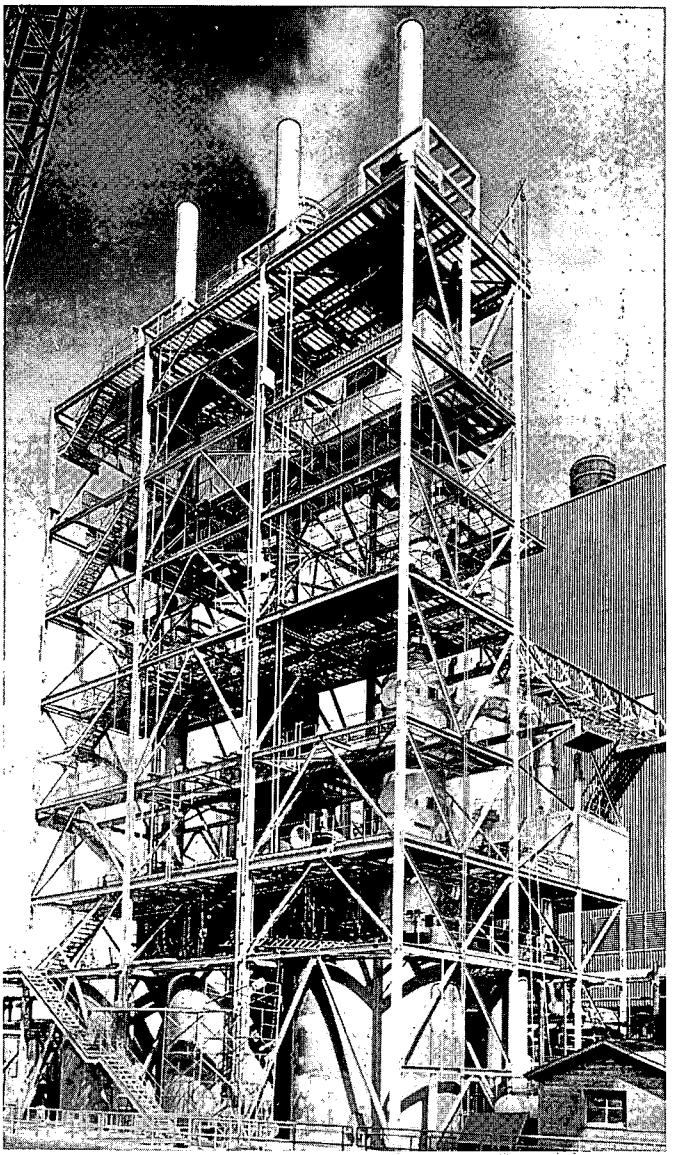
No major difficulty is anticipated in meeting the Federal and state ambient standards that have been adopted. A variety of methods can be used to control concentrations of sulfur dioxide at ground level — in the air people breathe.

The foreseeable options open to TVA for meeting the emission standards are: to secure a total supply of coal that has a very low sulfur content; to reduce or stop generation at coal-fired steam plants; to modify the plants and switch to another low sulfur fossil fuel; or to use a process that would remove SO_2 from stack emissions. However, none of the options is clearly workable at this time. It is unlikely that enough low sulfur coal could be produced for the TVA system and others likewise affected. Reducing generation at these plants to levels required to meet the standards would cut out a major part of TVA's power capability and seriously endanger the region's power supply. Assuming the plants could be modified to burn low sulfur fuels in time to meet the new requirements, the modification work would be costly and there is no assurance that adequate supplies of such fuels would be available. Moreover, there is, at present, no commercially demonstrated process for removing sulfur gases from large generating units. It does not appear at this time that it will be possible to meet new emission standards within existing time limits and at the same time meet the region's power supply needs.

Several SO_2 removal processes are being tested in cooperation with the Environmental Protection Agency. Also, at the Widows Creek Steam Plant in northeast Alabama, TVA proposes to equip the 550,000-kilowatt unit 8 with a full scale test scrubber which should help advance technology for controlling sulfur dioxide emissions. The proposed installation will make use of findings from small prototype and test installations at other coal-fired steam plants on the TVA system and other power systems.

Wet limestone scrubbing is considered the most promising control process for earliest development on large power plants. The process "scrubs" the stack gases leaving the furnace with a mixture of water and powdered limestone to capture the sulfur dioxide produced by burning coal. The scrubber also traps ash particles, and this fly ash and the reacted limestone are carried off to a settling pond.

The tentative cost estimate for this installation is $35-40 million, in comparison to a total original cost of about $62 million for the generating unit itself,



A limestone-based scrubbing process for the removal of SO_2 from coal-fired steam plant stack gases is being tested with this facility at the Shawnee Steam Plant. Funds for the test were provided by the Environmental Protection Agency, which is cooperating in the project. This fall, TVA proposes to begin construction of a full-scale test facility at its Widows Creek Steam Plant, using a wet limestone scrubbing process.

which was completed in 1965. Including operating expense, the proposed scrubber system is expected to increase the cost of power production on unit 8 to as much as double the present cost. Operation of the facility is scheduled for 1975.

Inside a quonset hut at TVA's Norris Engineering Laboratory, on a concrete scale model about the size of a basketball court, a five-mile-long stretch of Wheeler Lake is being simulated. This model provides a way to measure and predict the effects on lake water temperatures from the various methods to be used in discharging the heated water from the Browns Ferry Nuclear Plant's condensers.

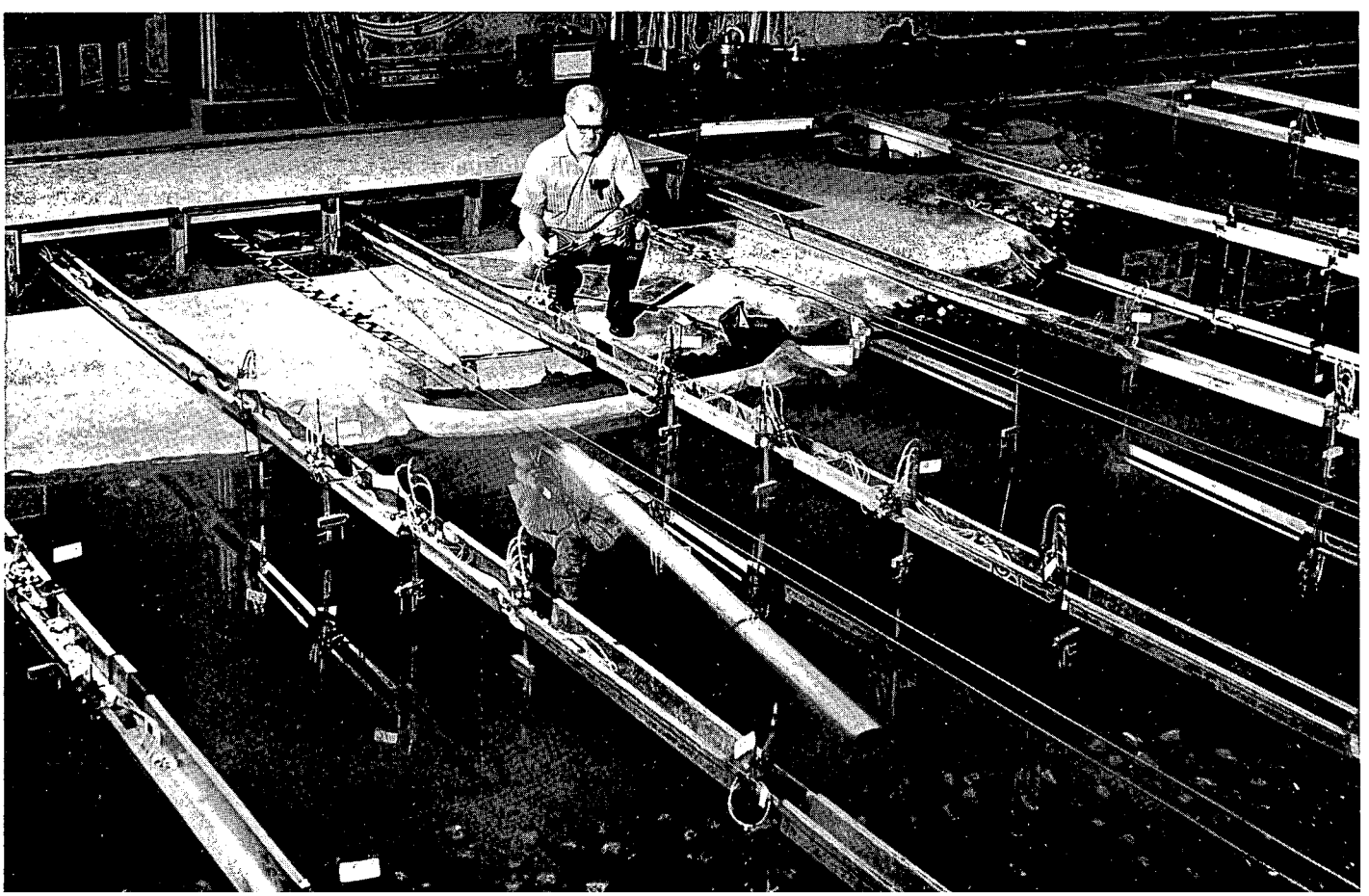
The Laboratory's computer is programmed to simulate various river and operating conditions through electronic control of valves that can reproduce the actual conditions in the model. The results of this study will be useful in meeting the strict water temperature limitations for this location, and will add to the general body of knowledge about controlling waste heat from large power plants as well.

The development of revolutionary improvements in food production techniques, by making use of the heated discharges from steam-electric plants, could result in a partial solution to the waste heat disposal problems. TVA currently is studying uses of heated water in heating and cooling greenhouses, extending the crop growing season, and fish farming. The use of waste heat from power plants for the production of human food and fiber could have a major impact on total resource development.

In addition to previous demonstrations which showed that strip-mined lands could be effectively reclaimed, TVA has begun a new demonstration aimed at returning strip-mined mountainside land to its original contour. The demonstration, being done under contract on TVA's Koppers reserve in East Tennessee, also will establish the costs incurred in this kind of reclamation.

TVA is cooperating with the City of Memphis in its proposal to build a scaled-up recycling plant for recovery of energy and usable materials from city

At the Norris Engineering Laboratory, this model of a 5-mile-long stretch of Wheeler Lake reproduces lake water temperatures which will result from operation of the Browns Ferry Nuclear Plant. Four hundred thermistors are suspended in the water and linked to a computer to measure and record water temperatures resulting from various combinations of waterflow, temperature, and plant operation.



refuse. The city's plan contemplates recovery of metals, glass, and possibly paper for reuse. In addition, sludge from the city's secondary sewage treatment facilities would be dewatered and combined with the combustible residue from the refuse to make a fuel supplement which is to be burned in the Allen Steam Plant, if feasible.

For many years, TVA has supported important research projects undertaken by the Electric Research Council, an organization representing all segments of the electric utility industry; projects include research into air pollution, extra-high-voltage and ultra-high-voltage transmission, underground transmission, reactor vessel testing, and bulk power security. Other projects for support have now been added, including research into high pressure boiler cleaning, magnetohydrodynamic power generation, boiling-water-reactor water chemistry, and coal gasification. TVA anticipates that substantial funds will be contributed as the region's share in a program by the entire electric industry to establish a national research and development organization.

Breeder demonstration program underway

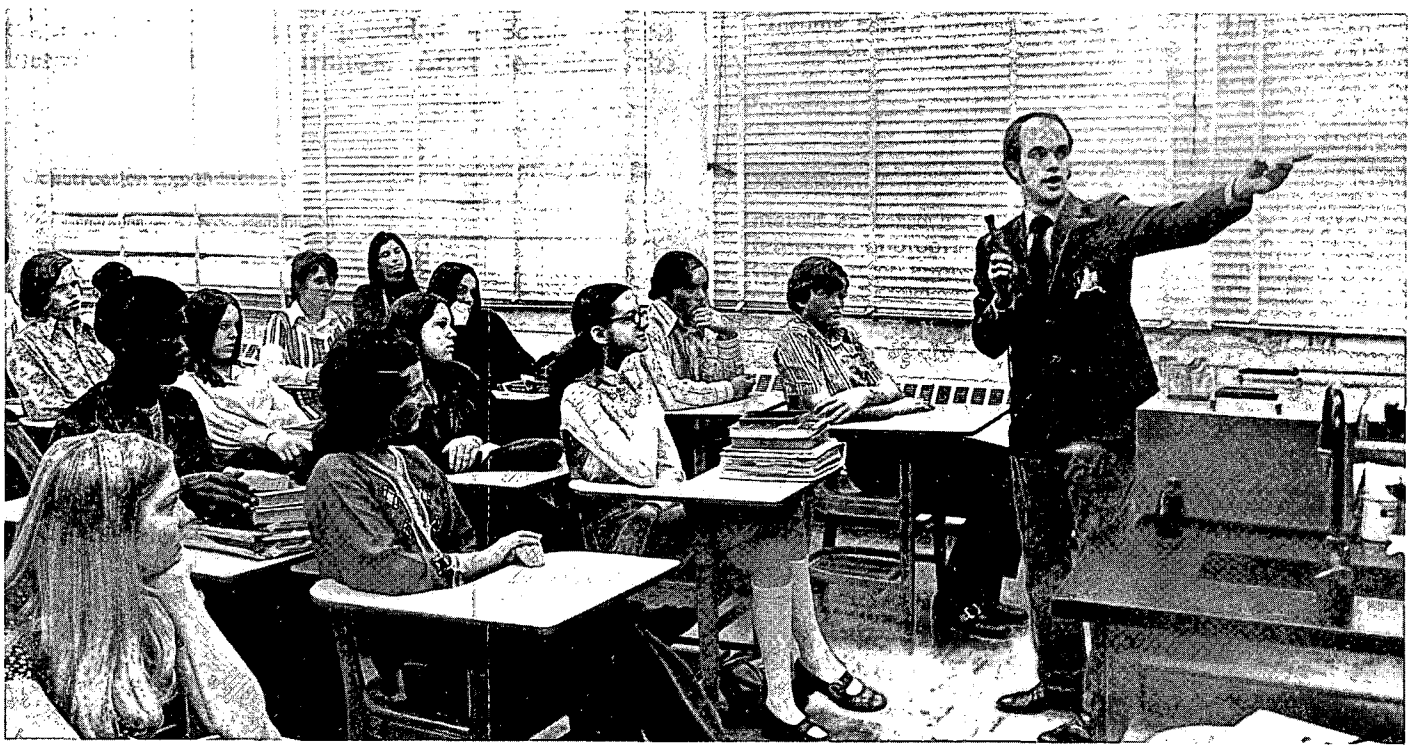
The Nation is seeking new sources of energy production and TVA is an active participant in the search.

The most promising and significant avenue that now appears within reach for commercial power production is the breeder reactor. Twenty years of research and development have brought breeder technology to the point where the next step is to build America's first breeder plant on an operating power system, to test its commercial application and feasibility.

In January 1972, the Atomic Energy Commission upon recommendation of its utility advisory panels, accepted as a basis for further negotiation the joint proposal submitted by the Commonwealth Edison Company of Chicago and TVA for building and operating the Nation's first breeder reactor demonstration plant. The selection was made from among four proposals that had been submitted.

The Commonwealth-TVA plan contemplates a breeder reactor plant of about 350,000 to 450,000

The University of Tennessee and TVA jointly sponsor "This Atomic World," a traveling exhibit and presentation prepared by Oak Ridge Associated Universities. Presented in the classroom and school assemblies, the students find the presentation entertaining as well as informative.



kilowatts located on the TVA system. The plant site, announced in August 1972, is a 1300-acre tract provided by TVA on the Clinch River near Oak Ridge.

The breeder reactor, while consuming nuclear fuel, produces more nuclear fuel than it consumes. While today's light water reactors use only about two percent of the energy available in uranium, the breeder is estimated to capture from 60 to 80 percent of the potential energy available.

This greater efficiency, and the fact that more fissionable fuel is being produced, should extend economically recoverable uranium reserves for centuries, in comparison to the few decades of availability if light water reactors alone were used. The breeder also will release less waste heat to the environment than do present nuclear plants, since its thermal efficiency will be higher. And the breeder holds promise of generating electricity at lower costs than other methods now known.

Two corporations have been formed to oversee this breeder demonstration. The Breeder Reactor Corporation will provide senior counsel, arrange for utility financial support, and serve as liaison with participating utilities. The Project Management Corporation will have major responsibility for developing and implementing plans for the design, construction, management, and operation of the breeder demonstration plant. A steering committee to coordinate the overall effort will be composed of representatives from Commonwealth, TVA, and the Atomic Energy Commission.

Proposals for the plant's equipment have been received from Atomics International, General Electric, and Westinghouse. These complex proposals are currently being evaluated as is the selection of an architect-engineer.

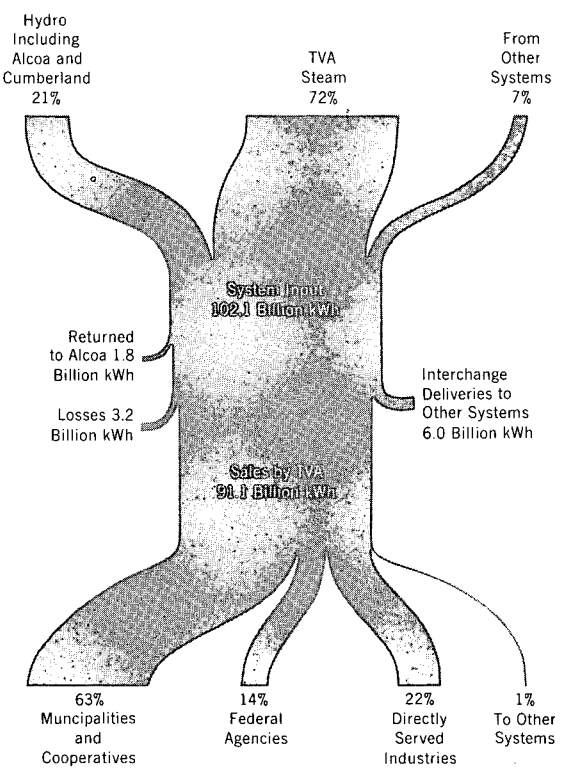
No precise schedule has been determined as yet, but it is anticipated that the plant should be ready for operation by about 1980. AEC has established the cost of this demonstration plant program at about $700 million.

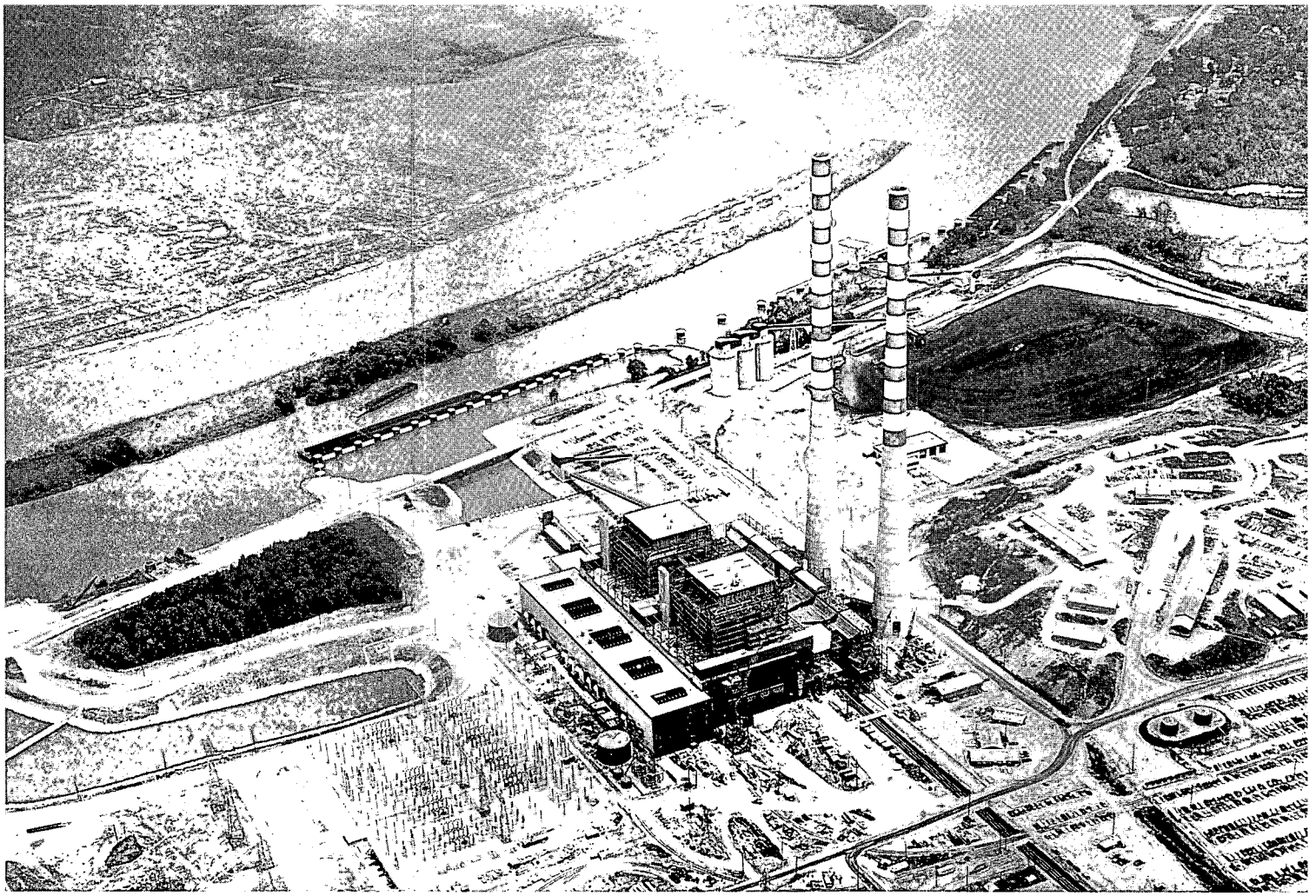
The funding of the breeder program is an unprecedented cooperative endeavor. Pledges amounting to about $250 million have been made by all segments of the electric utility industry. Both public and private power systems will contribute, following an industry-wide financial formula of one-quarter of a mill per kilowatt-hour, based on 1970 retail sales. The amount will be paid by each utility participating in the program in ten annual equal installments beginning in 1972. TVA has pledged about $22 million as this region's share under the formula, representing the participation of local distribution systems as well. In addition, TVA and Commonwealth Edison will provide approximately $2 million each in nonreimbursable services to the project. TVA also will provide the plant site and transmission line connections at no cost to the project. These amounts constitute all of the utility financial contributions to the project.

AEC will finance all of the remaining costs of the program, including technical support and other services and the supply of nuclear fuel. Reactor manufacturers and suppliers of services to the program are expected to make a contribution also.

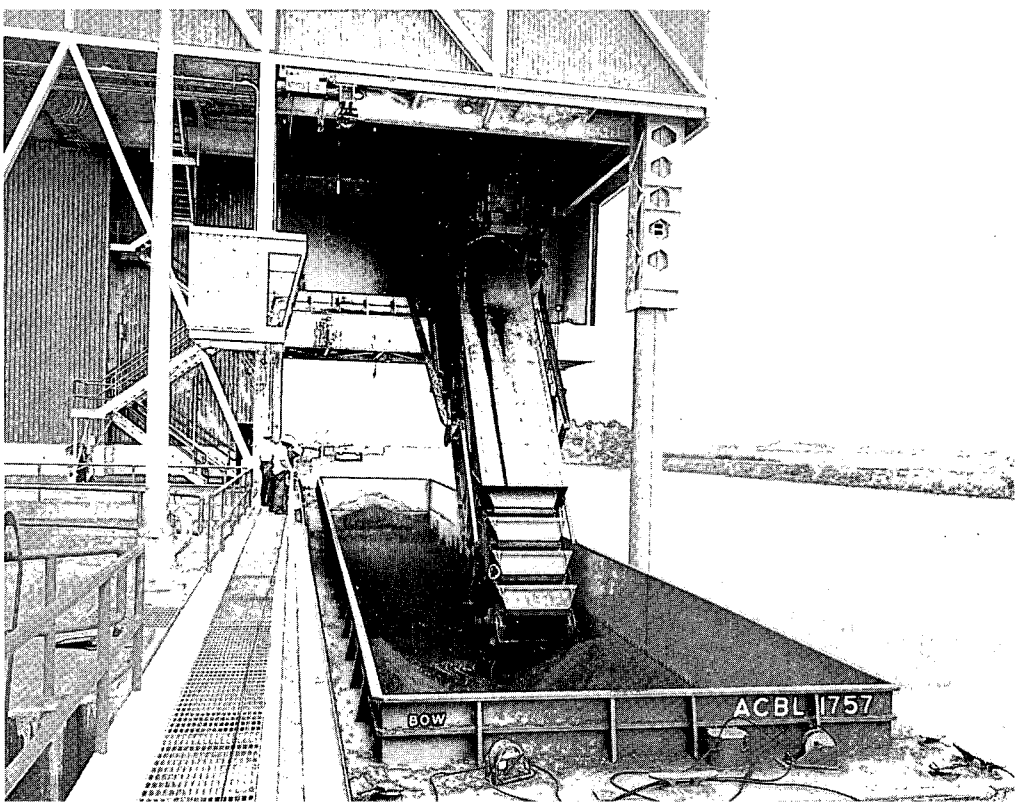
This demonstration will advance nuclear technology and attempt to show that a breeder will fit in feasibly with an operating power system — an important step in introducing large breeders into commercial operation in the middle or late 1980's. Its successful development will help provide the Nation with the abundant energy it needs to maintain both a vigorous economy and a high quality environment.

Source and Disposition of Electric Energy—Fiscal Year 1972





At the Cumberland Steam Plant, the 1,300,000-kilowatt unit 1 was placed in test operation and helped TVA meet hot weather power demands in the summer of 1972. This generating unit is the first of its size in the world. Unit 2, with the same amount of capacity, is expected to be placed in service next spring.



Automation helps expedite the delivery of coal to the Cumberland Steam Plant. Coal is carried by four-mile and ten-mile covered belt lines from mines in Kentucky to the Ohio River where the coal is loaded onto barges for transportation to the plant site. The coal is then automatically unloaded from the barges and conveyed to the plant's coal stockpile.

Total power sales increase moderately

The total amount of power sold increased only moderately over sales of the previous year because of the continuing effect of the recession on the region's large industrial loads and a warmer than normal winter.

Despite these conditions, sales in fiscal 1972 to municipalities and cooperatives increased 4 percent. Sales to Federal agencies were up 6 percent over the previous year, but sales to the large industries which TVA serves directly were down 8 percent. These changes resulted in an increase in total sales of only one-half percent.

As the year drew to an end, load growth had begun again. Such things as record numbers of new customers being added, increased housing construction, climbing industrial production, and growing AEC requirements were evident.

Sales

	Millions of kilowatt-hours	
	1972	1971
Municipalities and cooperatives	57,820	55,535
Industries	19,592	21,278
Federal agencies, including interdivisional	13,138	12,428
Electric utilities	540	1,407
Total	91,090	90,648

Revenues sufficient for year; rates hold

Revenues improved by $43.8 million and were sufficient in meeting expenses for the year to keep the power program financially sound. The lower sales to industries resulted in a slight drop in revenues from them. Revenues from electric utilities decreased by $3.8 million, also because of lower sales.

Revenues

	Millions	
	1972	1971
Municipalities and cooperatives	$415.3	$379.2
Industries	124.3	125.0
Federal agencies, including interdivisional	76.7	65.0
Electric utilities	6.3	10.1
	$622.6	$579.3
Rents	19.2	18.7
Total	$641.8	$598.0

The improvement in revenues covered the $31.8 million increase in operating expenses. These expenses were not as large as expected since they were affected favorably by record hydroelectric generation which, coupled with moderate power requirements, lessened the need for more expensive coal-fired generation. Even so, production expenses were up $19.5 million. Some of the other large increases in operating expenses occurred in provision for depreciation, up more than $3 million, and in payments in lieu of taxes, up nearly $6 million.

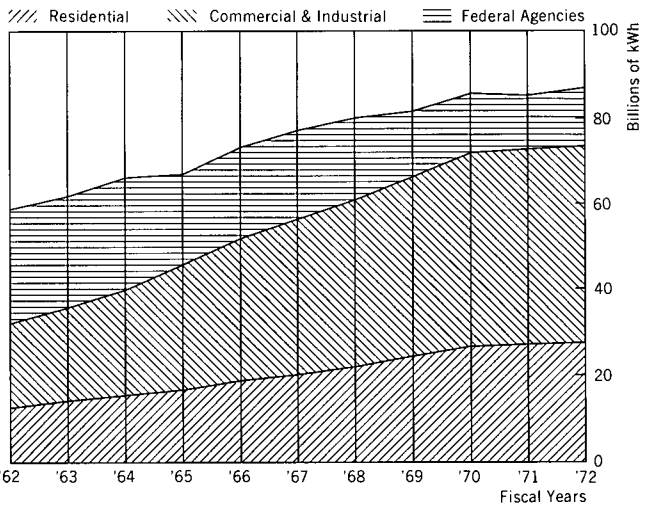
TVA paid $25.7 million in 1972 to state and local governments in lieu of taxes. The amount represents 5 percent of revenues during the preceding year, excluding revenue from sales to Federal agencies. These payments will continue to increase in line with revenue growth. Taxes or tax equivalents also are paid to state and local governments by the distributors of TVA power. Their payments were $27.8 million. The combined TVA-distributor payments of $53.5 million were about 7 percent of their combined operating revenue, excepting TVA's revenue from Federal agencies. This percentage is about mid-way in the range of comparable percentages paid by neighboring utilities to state and local governments.

Operating income was $12 million more than in 1971. But an increase in interest expense due to larger indebtedness resulted in a $6.9 million decline in net income, $112.1 million compared to $119 million in 1971.

The power program is required to charge rates that will produce sufficient revenues to meet costs by a margin considered desirable by the TVA Board. Revenues were adequate in 1972 and no change in rates was made.

The adequacy of rates is reviewed each quarter and the TVA Board determines what adjustment, if any, may be necessary. Such reviews in fiscal 1973 will show whether rates now in effect will adequately cover the much higher costs expected during that year, particularly for fuel and interest.

Sales to Ultimate Customers by TVA and Distributors



Financing the self-supporting power program

The power program is a self-supporting and self-liquidating operation, bearing all costs related to power supply. New power facilities are financed largely from borrowings made through the sale of power bonds and notes, and in part from power revenues which also must cover operating and other costs. The Federal appropriations invested in the power system are being repaid with annual $20-million payments, and a dividend is also being paid annually on the remaining unrepaid appropriations.

During the year, power bonds were sold in July, October, January, and April, and short-term notes were sold each month. These sales provided funds for use in continuing the construction of power facilities. The interest costs of the bonds and notes were lower than they had been for some time. A note sale in February brought an interest cost of 3.55 percent, the lowest since TVA began its note program in fiscal 1964. The interest costs of the four bond issues were 7.31, 7.36, 7.04, 7.41 percent, and the average interest cost of the twelve note issues was 4.62 percent.

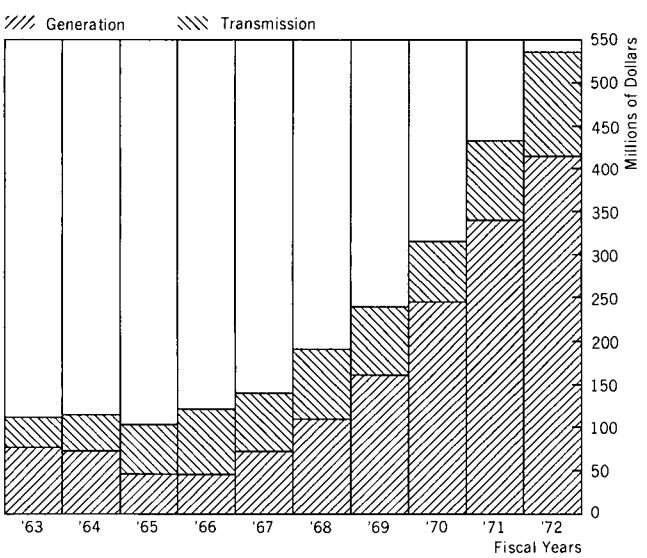
The amount of borrowings outstanding increased by $500 million. At June 30, TVA had $1,955 million in bonds and notes outstanding. (See note 6 to the Financial Statements.)

Net income in 1972, less the dividend payment to the U. S. Treasury, provided a $56.3 million increase in retained earnings. After deducting the capital repayment to the U. S. Treasury from the increase in retained earnings, the resulting amount of $36.3 million was less than 6 percent of operating revenues, and together with depreciation accruals was invested in power assets.

Payments to the U. S. Treasury totaled $75.8 million. TVA paid $55.8 million as a dividend on the Government appropriations invested in the power system and repaid $20 million as a reduction of appropriation investment. The dividend is determined each year by applying the Government average interest rate payable on marketable Treasury securities at the beginning of the fiscal year to the Government's net appropriation investment in TVA facilities at the same date. For 1972, the average interest rate was 5.21 percent, compared to 5.986 percent the previous year. The net appropriation investment was $1,071 million. TVA has now paid more than a billion dollars into the Treasury.

Under the TVA Bond Resolution, bondholders have first call on net power proceeds. These are defined as proceeds from operations and from the sale of facilities. They were $15.5 million greater than in 1971.

Construction Expenditures



Net Power Proceeds

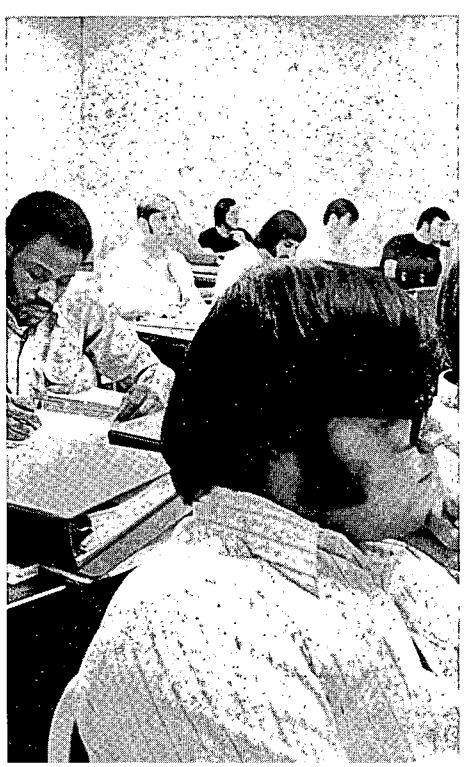
Fiscal years	1972	1971
	(thousands)	
Source		
Proceeds from operations		
Income before interest charges	$212,464	$196,669
Add back noncash items	31,759	31,910
	244,223	228,579
Proceeds from sale of facilities	480	610
Total	$244,703	$229,189
Disposition		
Interest on borrowings	$100,168	$ 77,606
Return on appropriations	55,810	65,147
Repayment of appropriations	20,000	20,000
Invested in power assets	68,725	66,436
Total	$244,703	$229,189

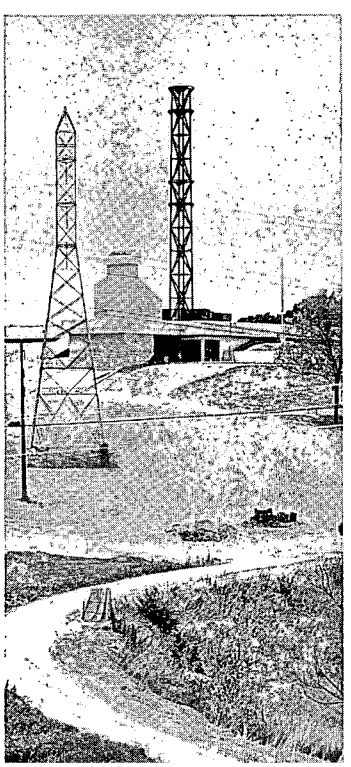
Region's expanding economy requires more power

Power requirements in the Tennessee Valley region in the decade of the 1960's, exclusive of Federal agency needs, more than doubled. Growth in these requirements has been fairly small between 1970 and 1972, and growth in this decade is not expected to be at as great a rate as during the previous one. Nevertheless, for the 1970's, it is anticipated that these requirements will almost double.

The Sequoyah Nuclear Plant's two generating units are expected to be in service in 1974 and 1975, to help supply the region's growing power requirements. Each nuclear generating unit will contribute 1,220,580 kilowatts to power supply.

It's a two-year program of intensive training for these employees who want to become nuclear plant assistant unit operators. For eighteen months they concentrate on classroom work learning the practical applications of nuclear physics, steam power generation, and reactor technology. In the remaining six months, they become familiar with the operation of nuclear systems and putting into practice what they have learned. To advance to the unit operator's level and beyond, students must gain additional training and experience to equip themselves to pass an Atomic Energy Commission examination for a license.





TVA's new Power System Control Center is under construction on the Chickamauga Dam Reservation. The new center will be equipped with sophisticated systems of automatic and economic control of generation and of monitoring and analyzing power system operating conditions.

By far the greatest part of this growth has been and will be due to rising standards of living, industrial development with better job opportunities and incomes, and a rising population.

Building the power facilities to serve these requirements is an enormous task. But TVA is committed to having the power supply ready when it is needed — a power supply that is reliable, environmentally clean, and as low in cost as possible.

More of the region's people have better social and economic opportunities than ever. Total personal income more than doubled in the last decade, from $8.8 billion in 1960 to $19.7 billion in 1970; the increase was 124 percent, while the national increase was 100 percent. Manufacturing wages rose from less than $2 billion in 1960 to nearly $4.6 billion in 1970, a 133 percent increase compared to 81 percent nationally. The increase is attributed to rapid growth in manufacturing employment in the region and to wages more closely approaching national levels than in the past. The region's per capita income has climbed to about 75 percent of the national average; it was 64 percent of the national level in 1960.

In calendar 1971, 471 new industrial plants or expansions were announced for the region supplied with TVA power, involving an estimated investment of $300 million by industries and creating some 28,000 new jobs.

New industrial plants and expansions announced in calendar 1971

	Investment (millions)	New jobs
Transportation equipment industry	$ 49	1,905
Rubber and plastic products	33	1,727
Printing	25	698
Stone-clay-glass products	19	740
Apparel	19	7,842
Electrical equipment	18	2,502
Primary metals	18	1,000
Food products	17	666
Nonelectrical machinery	16	1,205
Chemical industry	16	437
Furniture	13	2,362
Textiles	12	2,125
Fabricated metal products	12	1,263
Paper	11	660
Lumber and wood products	8	1,020
Ordnance and accessories	5	100
Miscellaneous manufacturing industries	5	367
Leather	2	760
All others	2	620
	$300	27,999

It is notable that, during the decade of the Sixties, forest industries in the Tennessee Valley watershed counties grew into a billion-dollar business — doubling their product value from the 1960 level of $500 million, and that the value of farm products sold during the decade increased by more than $300 million. Also, in 1970, the cumulative investment since 1933 in private waterfront plants and terminals along the Tennessee River topped $2 billion.

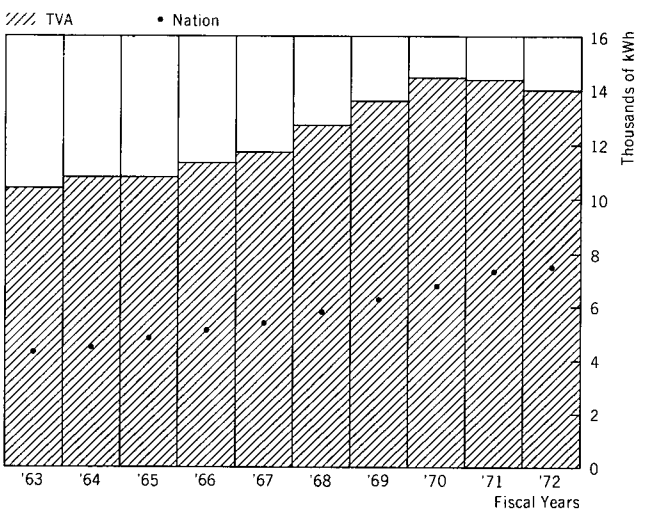
This kind of overall economic expansion and improved living standards in the previous decade required large increases in power supply. And to accompany continuing growth in the region, during this decade, much more power must be provided.

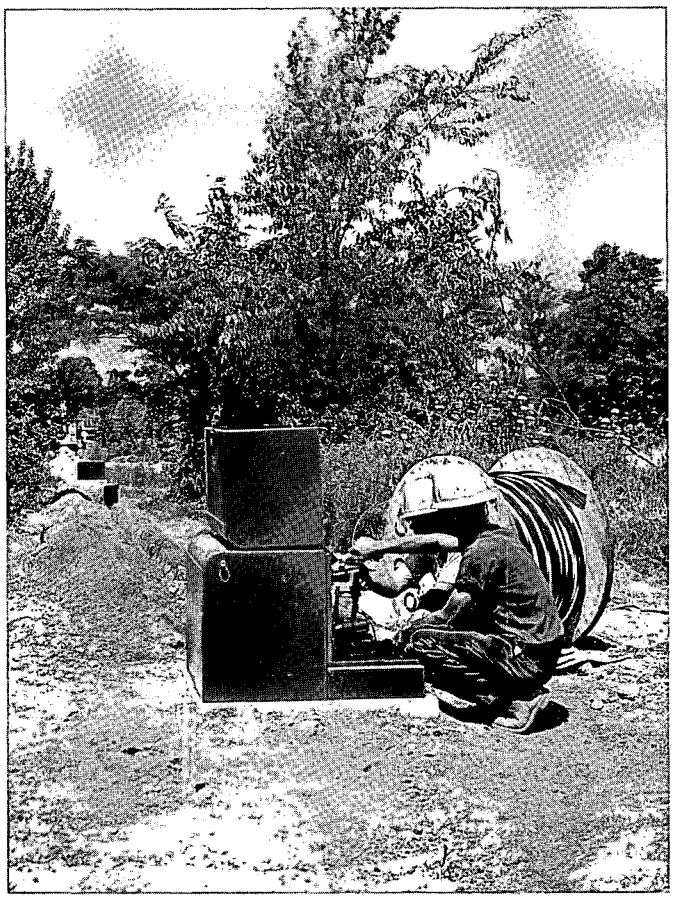
Average residential use leveled by moderate weather

Average home use of electricity declined 360 kilowatt-hours to 14,040 kilowatt-hours, mainly because heating degree days decreased nearly 700, or 18 percent, from 1971 to 1972. (A degree-day is calculated as the difference between actual temperature and a standard temperature at which no heating or cooling is considered to be required.) It was the largest decline in heating degree days in the last 20 years. In addition, cooling degree days were 170, or 32 percent, below the normal degree days of fiscal year 1971.

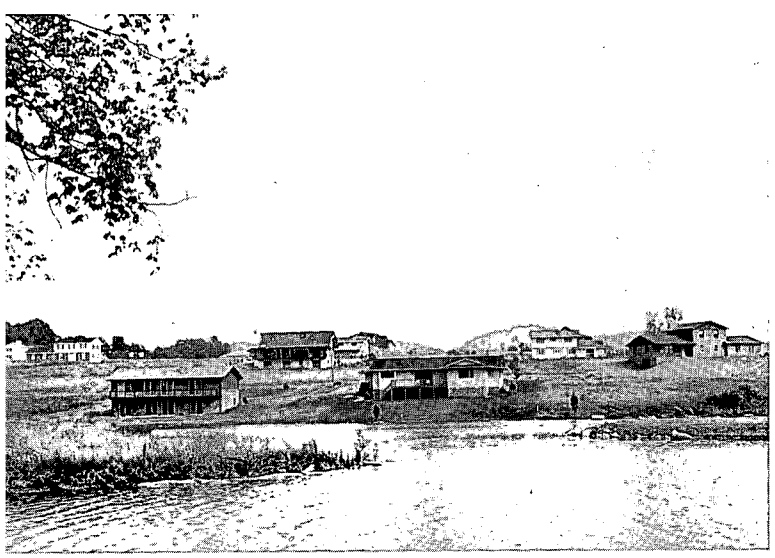
The winter, 9 percent warmer than normal, was the warmest in the region since 1956-57. With about one-third of all homes electrically heated and more than half of all homes partially or completely air conditioned, the effect of the warmer winter and cooler summer weather was considerable. Other factors also, such as conservation of home use, recent rate increases, and the hesitant economy, may have contributed to the decline.

Average Residential Use





Placing residential distribution lines underground (above) is receiving major emphasis by the distributors of TVA power. Popular with homeowners and builders throughout the region, it is estimated that some 30,000 homes are now being served underground. The residential area (below), with underground service, was the site of a 1972 Parade of Homes.



The region's average use is about double the national average. The average cost per kilowatt-hour for residential use in 1972 was 1.28 cents, up from 1.22 cents the year before but still about half the national average.

Since the average residential use is already at such high levels, percentage increases are not expected to be as great in the future as in the past. However, average residential use continues to grow rapidly in low-income areas.

More than 68,000 residential customers were added to distributors' lines in 1972 — the largest number in many years. Customers are being added at a rate that is a full percentage point ahead of the national rate. This upsurge in customer growth reflects a halt to the outmigration which had been taking place as workers left to seek job opportunities elsewhere, and the large increase in the region's population aged 18 to 25 years.

About two-thirds of the new customers added moved into all-electric homes, bringing the total number in the region to 680,000, or 34 percent of all homes.

Demonstration of the ways to use electricity wisely and efficiently receives major emphasis in the TVA-distributor power supply program. Consumers are given information about the proper use and care of home appliances. Lighting, cooking, and laundry workshops are held at various times throughout the region. The value of adequate insulation and adequate wiring is discussed with home owners and builders. These activities and others, and the distributors' advertising messages, attempt to show the residential consumer that the efficient use of electricity will save him money and avoid waste.

Direct-industrial use declined, federal use grew; both point upward

Most of the commercial and industrial customers in the region are served by the distributors of TVA power. But nearly 50 industrial customers are served directly by TVA because of their large or unusual power requirements.

Sales to the industries served by TVA declined by 1.7 billion kilowatt-hours. Depressed markets for products manufactured by some of these industries, primarily the aluminum and phosphorous industries, were main factors in the drop in power sales to those customers. At one point in the year, the industries

were taking power that amounted to only about 70 percent of their contract demand. But as the year ended, production headed upward and industrial power loads picked up to about 80 percent of contract demand. A number of heavy industries — aluminum, chemicals, alloys — are returning to normal production levels.

The use of TVA electricity by Federal agencies increased during the year and sales to them will be growing greatly over the next several years because of additional power requirements of the Atomic Energy Commission. AEC has contracted to increase its purchases in steps, to reach a total of 3,165,000 kilowatts by 1976. Its contract total in 1972 was 1,340,000 kilowatts. The additional power will be needed by AEC for enriching the uranium used to fuel nuclear power plants. Some of the step increases are contingent upon TVA having the capacity available.

Generation, transmission, interconnections: system records set

TVA system generating plants met all power requirements during the year; the peak winter load was less than the alltime high, but new summer peak loads for generation, for the total system, and for the region were established in June. These peaks were surpassed in July 1972 when a hot, humid, stagnant air mass covered the region and much of the south for several days.

Winter peak power loads — FY 1972

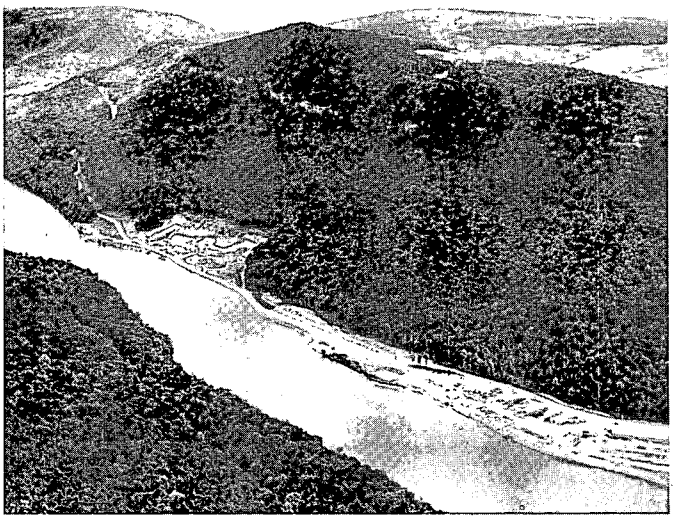
Total generation . . .
14,632,000 kilowatts, 9 am, February 4, 1972
Tennessee Valley region . . .
16,664,000 kilowatts, 8 am, February 4, 1972

Summer peak power loads — FY 1972

Total generation . . .
15,989,000 kilowatts, 5 pm, June 27, 1972
Tennessee Valley region . . .
14,113,000 kilowatts, 4 pm, June 6, 1972

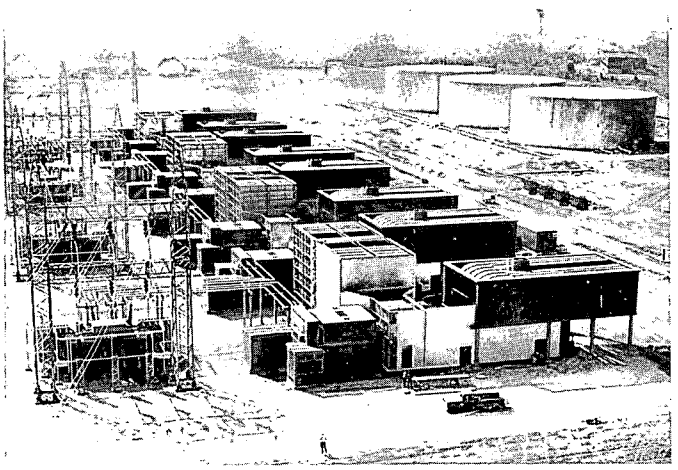
These peak loads illustrate the significance of seasonal exchanges and emergency assistance among neighboring power systems.

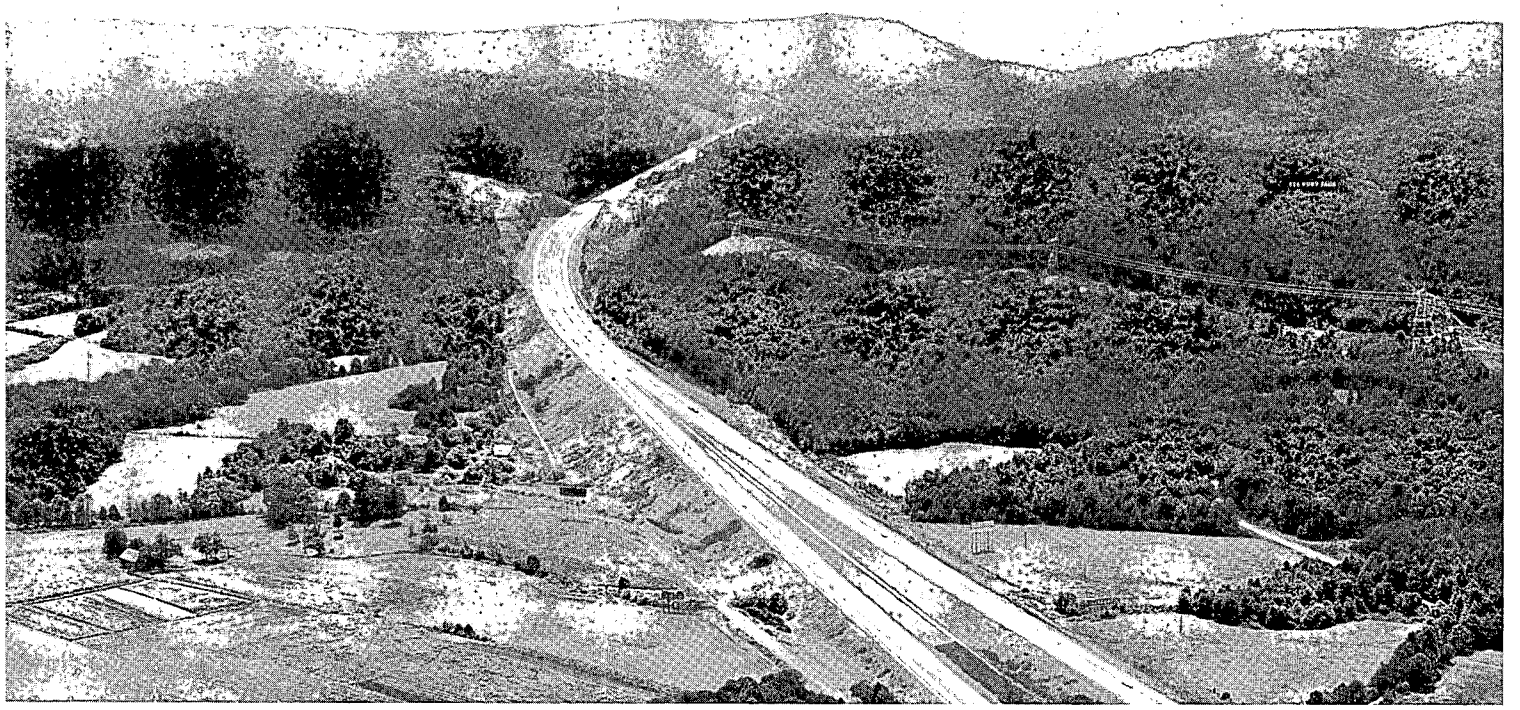
Because of the vast amount of electric home heating in the region, TVA's peak power demand occurs in winter. But with heavy air conditioning demands made on power systems to the south and west of the region, their peak loads occur in summer. Thus, TVA and the other systems, through transmission line interconnections, are able to exchange



A few miles west of Chattanooga at Raccoon Mountain, TVA is installing a large pumped-storage hydroelectric project whose turbines will be used to generate electricity as needed to help meet peak power loads on the system. Raccoon Mountain will have 1,530,000 kilowatts of capacity in four units. The first unit is scheduled for operation in late fall 1974, and succeeding units in 1975. During off-peak periods, water will be pumped up into the mountaintop reservoir and held ready for release as generation for peaking purposes is needed.

More than a million kilowatts of gas turbine capacity is being installed to help meet system power loads. Sixteen units are in operation at the Allen Steam Plant, and four more are undergoing test operation. The eight units shown here are located at the Colbert Steam Plant, and they also are undergoing test operation.





An aerial view of White Oak Mountain, between Chattanooga and Cleveland, Tennessee, shows an interstate highway and one of TVA's 500-kv transmission lines. The line was purposely placed below the crest of the ridges and across the highway at a right angle in order to reduce its prominence on the landscape. This new line from the Sequoyah Nuclear Plant site interconnects at the state boundary with a line from the Georgia Power Company.

power seasonally to help meet these peaks. As a result, the capacity on the TVA system and the other systems is more fully utilized year-round, bringing greater efficiency and economy. In effect, the amount of power exchanged takes the place of additional capacity that otherwise would have to be installed.

In 1972, hydro plants in the TVA system generated a record amount of electricity. Hydroelectric production was 21.3 billion kilowatt-hours, some 4 billion more than in 1971 and some 500 million more than the previous record set in 1968. In a normal year, about 18 billion kilowatt-hours is expected.

This record production had a favorable effect on system operations and financial margins, since this lower cost generation provided power that otherwise would have come from higher cost steam generation.

Steam plant generation of 73.4 billion kilowatt-hours was nearly 900 million less than last year because of the excellent hydro production and the fairly moderate power requirements.

In October 1971, the Johnsonville Steam Plant marked its 20th year of commercial power production. Johnsonville was the first in a series of large steam plants that made coal the principal source of electric power supply in the region. Also in October, Paradise Steam Plant unit 3 received an Architectural Award of Excellence from the American Institute of Steel Construction.

During the year, TVA placed in service 668 miles of transmission lines, including a 23-mile-long 500-kV line from the Sequoyah Nuclear Plant site to the Georgia border for an additional interconnection with the Georgia Power Company. Also, construction of a short span of 345-kV line from the Shawnee Steam Plant for an interconnection with three Illinois and Missouri power companies is proceeding on a schedule that should have it in service in the fall of 1972.

Seven new substations were placed in service during the year and power capability was increased in 28 others already in service.

With these additions, the TVA transmission system has grown to 16,000 miles of lines and over 600 substations. The system interconnects at numerous points with neighboring power systems for power exchanges that promote economy and increased reliability.

On a seasonal basis, TVA exchanges 1,500,000 kilowatts with an interconnected group of systems to the south and west and 300,000 kilowatts with Southern Services Incorporated. An additional

exchange of 260,000 kilowatts begins in November 1972 with a group of three Illinois and Missouri power companies.

Interconnections also are important for emergency assistance, allowing a system to supply power to another that is experiencing major equipment outages, and for economy exchanges — allowing a system to secure lower cost power than it could generate from another system that has surplus available.

Fuels: costs rising, availabilities uncertain

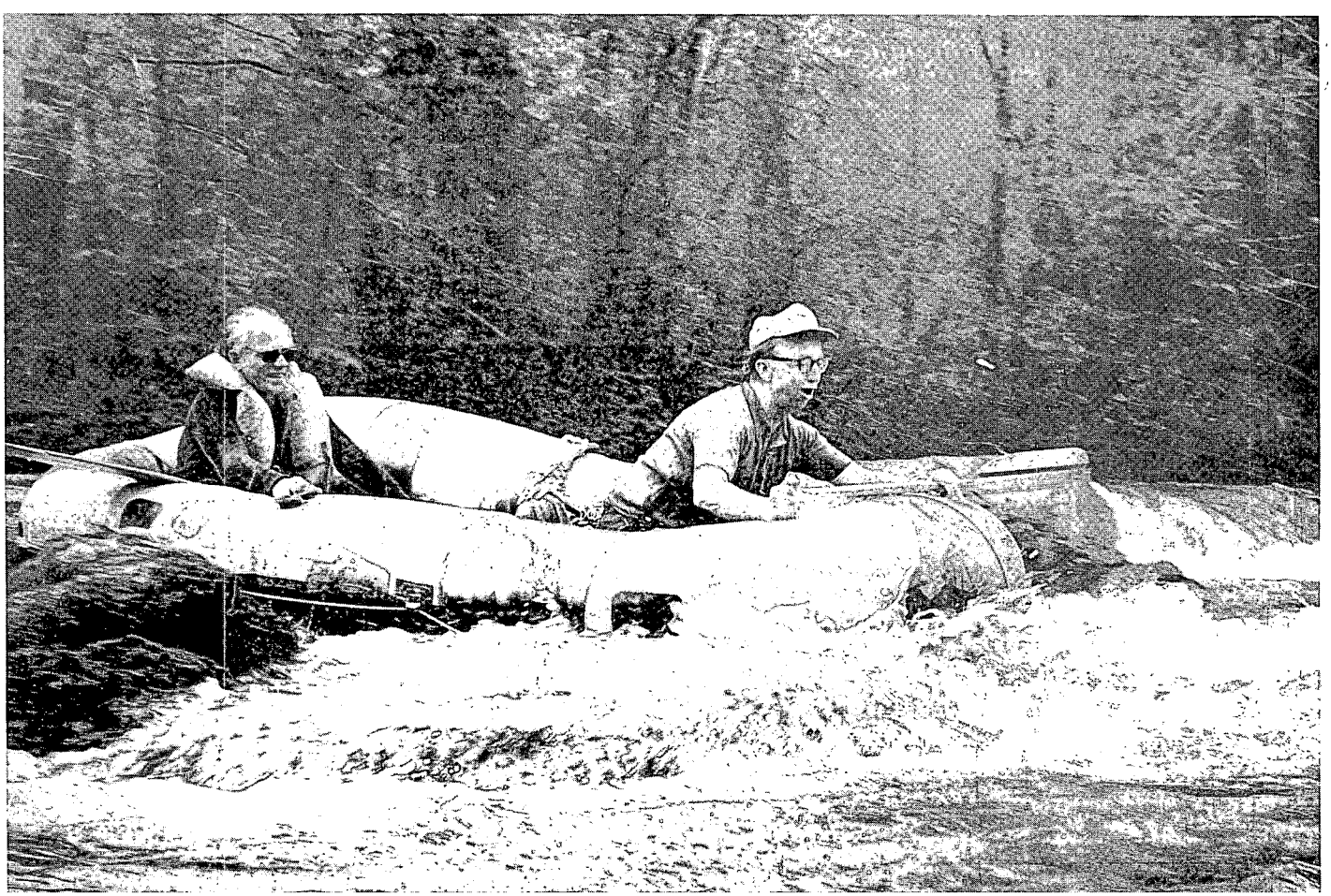
About 80 percent of TVA's generating capacity is in coal-burning plants. Even with large increments of nuclear capacity coming into service during this decade, these coal-burning plants still will be needed to meet the region's power needs. Projections up to 1980 indicate that plants will burn about 37-42 million tons of coal each year in generating electricity.

The plants burned 31.9 million tons of coal in 1972, down about a half-million tons from the previous year. However, the cost per ton of coal burned increased to $6.51, up 62 cents from 1971 and up $1.74 from the cost in 1970. Much of the coal burned during the year was delivered under long-term contracts made in prior years that carried relatively lower costs.

New coal contract prices continue high. A June contract award for coal for the John Sevier Plant involves a delivered cost of 40-41 cents per million Btu (heat content). As recently as 1968, coal was purchased for this plant at a delivered cost of about 23 cents per million Btu. Based on the plant's historical overall coal requirements, the difference in price is equal to a total cost increase of about $6-7 million a year.

The contract with the coal supplier for the Bull Run Steam Plant was amended in May to incorporate TVA's expanded strip mining and reclamation controls and a guarantee that sulfur content will not exceed nine-tenths of one percent in remaining deliveries. The contract amendments include a price increase averaging 58 cents a ton to cover costs of the more restrictive reclamation and sulfur content provisions, plus increased costs under Federal mine safety regulations and the 1971 mine workers' wage agreement. This represents an increased total cost

In addition to being an excellent trout stream, the Hiwassee River has been described by a New York Times *travel columnist as "perhaps the finest and roughest rafting river in the East." Between Memorial Day and Labor Day weekend, TVA schedules releases of water through at least one of the generating units located in the Apalachia Dam upstream to ensure a steady flow of water. As it flows through a scenic gorge in the Unicoi Mountains below the powerhouse, the fast moving Hiwassee drops about 17 feet per mile over a rock bottom, ridged like a file. Plans for protecting the river's scenic quality, while providing for appropriate recreation uses, are being developed by the Tennessee Department of Conservation, Tennessee Game and Fish Commission, U. S. Forest Service, and TVA.*



to TVA of $19 million on the nearly 33 million tons of coal remaining to be delivered, and the recently enacted Kentucky severance tax will add about $10 million more to coal costs under this contract.

Even with higher prices being paid, there is a growing concern over the future availability of fuels for power generation. Coal reserves are plentiful, but producers appear hesitant to increase production and open new mines because of the uncertainty over proposed sulfur dioxide emission standards which might leave them with a product that has no market.

Most of the coal with low sulfur content is in the western states. Even if those fields could expand production to meet national needs, it would take time to do so and transportation charges to the east and south would be extremely high. It is unclear whether existing rail transportation capacity is adequate to move large amounts of western coal to other regions. And for such long distances, reliability of supply would be a concern.

Toward the end of the fiscal year, TVA issued bid invitations for low sulfur coal as one of the means for meeting state air quality standards that will limit future SO_2 emissions from power plants. These bids may give an indication of the availability and costs of low sulfur coal for power generation.

During the next few months, TVA is planning to test western subbituminous coal at the Johnsonville, Allen, and Colbert Steam Plants to learn more about problems involved when this low sulfur coal is burned in boilers not designed to use it. This coal also introduces special problems in the control of fly ash emissions.

Natural gas is already in short supply and its use is being restricted in some parts of the Nation. Oil supply also is limited and growing demands are being placed on this fuel; much of it is imported, prices are rising rapidly in response to the demand, and there is concern that this supply might, at some time, be interrupted.

TVA awarded a contract during the year for a one-year supply of fuel oil for the eight gas-turbine units at Colbert. The cost is estimated to be about 83 cents per million Btu, or two to three times as much as comparable costs for coal.

The Nation's known uranium reserves that are economically recoverable will last only a few decades if used in today's light water reactors. But if the breeder reactor is developed successfully, uranium reserves will be extended for centuries.

As part of the long-range fuel procurement program for its nuclear power plants, TVA has purchased an interest in mineral rights of properties which are to be explored for uranium. Under the agreement, TVA has gained a 20 percent interest in portions of American Nuclear Corporation's uranium mineral rights in Wyoming, with options to purchase up to 50 percent.

For the nuclear plants under construction or on order, fuel supplies already are on order for the first several years of their operation, through fuel contracts awarded when the units were ordered.

Fuel cost is by far the most significant factor in the cost of electric power, once a plant is built. Nuclear fuel costs are lower than fossil fuel costs now, and a look to the future suggests that nuclear fuel costs will tend to be relatively stable while the availability and costs of fossil fuels are uncertain.

Facilities construction: schedules revised, future units planned

TVA gears the installation of new capacity to the time when forecasts indicate it will be needed to meet the region's growing power requirements. Lead time, the interval between ordering new capacity and having it ready for service, has lengthened considerably, particularly for nuclear units. TVA already has invited bids for new nuclear capacity scheduled for service in 1980-82, a lead time of 8 to 10 years.

Between now and the early 1980's, TVA plans to install about 20 million kilowatts of additional capacity to meet the region's power growth.

Power Plant Projects

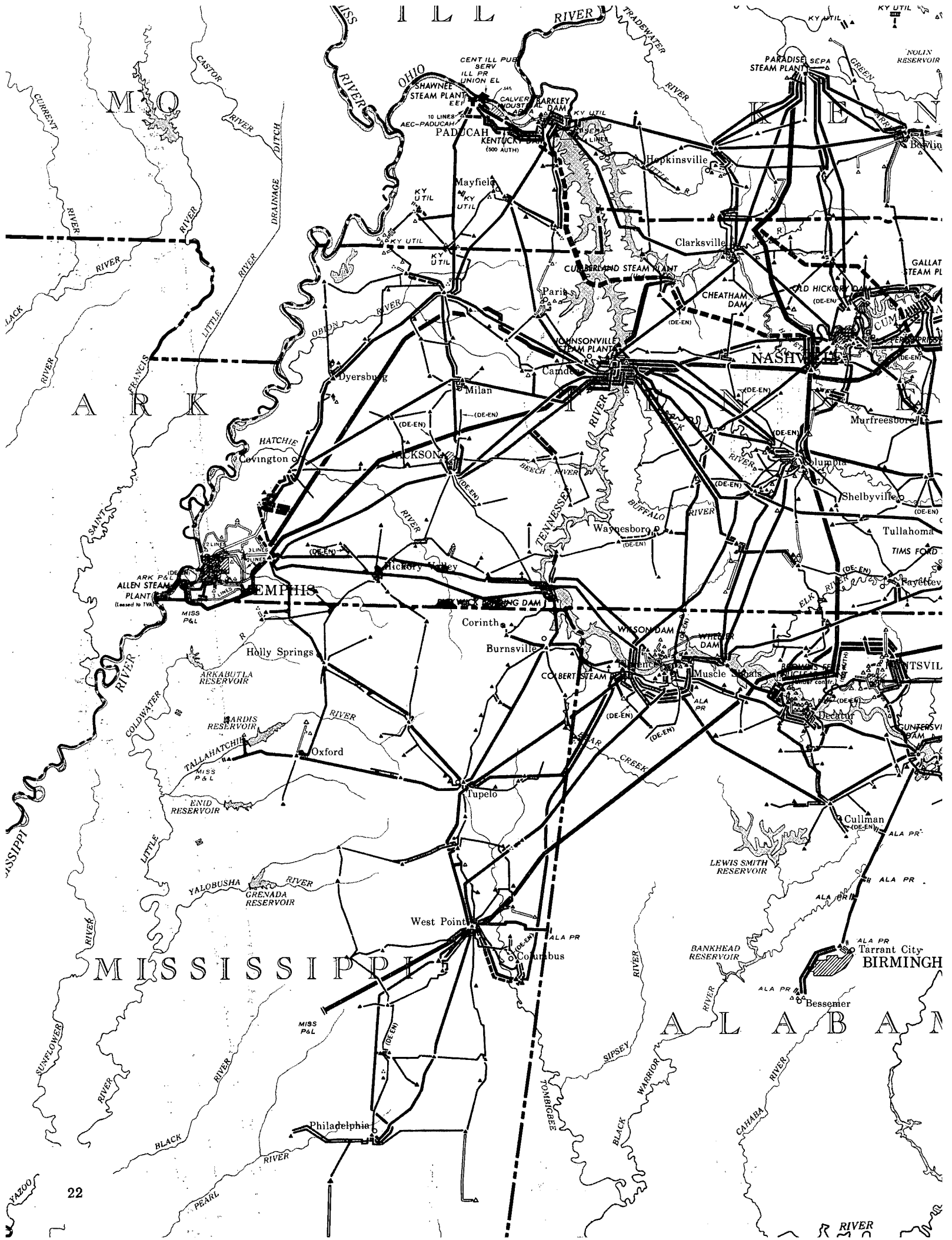
	Total capacity (megawatts)	Scheduled operation (calendar years)
Gas Turbine Capacity	714	1972
Cumberland Steam Plant	2,600	1972-1973
Browns Ferry Nuclear Plant	3,456	1973-1974
Sequoyah Nuclear Plant	2,441	1974-1975
Raccoon Mountain Pumped-Storage Project	1,530	1974-1975
Watts Bar Nuclear Plant	2,540	1977-1978
Additional Nuclear Plant	2,664	1979-1980
Additional Capacity	4,800	1980-1982

Test operation is underway on gas turbine units 17-20 at Allen and units 1-8 at Colbert, and on coal-fired unit 1 at the Cumberland Steam Plant. These units have been producing power for the system and are expected to be placed into commercial operation after testing and equipment modification have been completed.

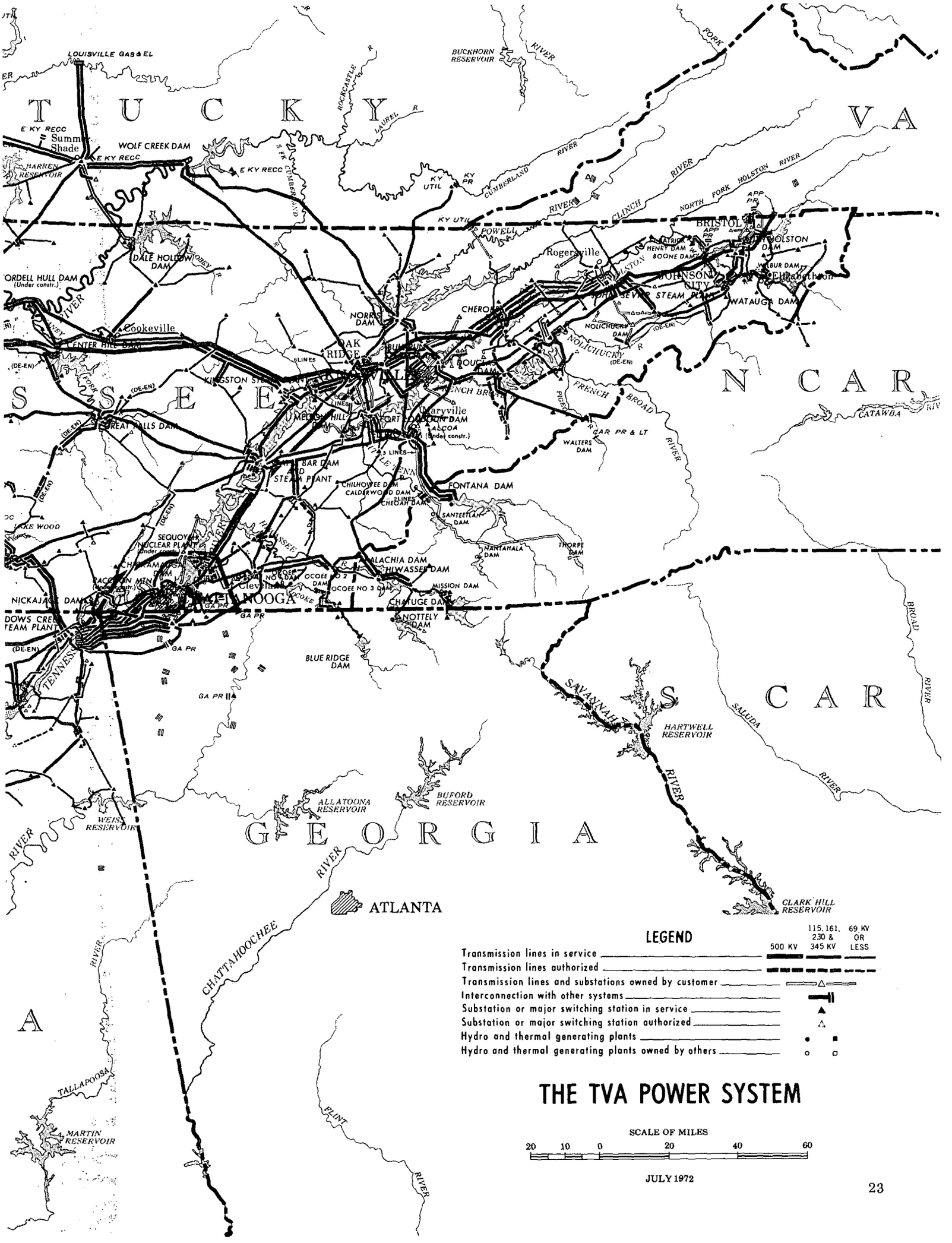
GENERATING PLANTS / *Units in Service on June 30, 1972*

TVA HYDRO PLANTS	NO. UNITS	INSTALLED CAPACITY — KW	FISCAL 1972 NET GENERATION — KWH (MILLIONS)
Apalachia	2	75,000	528.6
Blue Ridge	1	20,000	57.2
Boone	3	75,000	201.8
Chatuge	1	10,000	31.6
Cherokee	4	120,000	367.8
Chickamauga	4	108,000	854.2
Douglas	4	115,000	453.8
Fontana	3	225,000	1,009.3
Fort Loudoun	4	131,190	683.1
Fort Patrick Henry	2	36,000	121.0
Great Falls	2	31,860	153.2
Guntersville	4	97,200	823.1
Hiwassee	2	117,100	299.9
Kentucky	5	175,000	1,216.9
Melton Hill	2	72,000	217.7
Nickajack	4	97,200	751.1
Nolichucky	4	10,640	19.5
Norris	2	100,800	614.6
Nottely	1	15,000	39.9
Ocoee #1	5	18,000	90.0
Ocoee #2	2	21,000	143.3
Ocoee #3	1	27,000	204.1
Pickwick	6	220,040	1,362.7
South Holston	1	35,000	175.3
Tims Ford	1	45,000	20.0
Watauga	2	50,000	131.9
Watts Bar	5	150,000	1,083.7
Wheeler	11	356,400	1,438.7
Wilbur	4	10,700	22.9
Wilson	21	629,840	2,798.3
Total TVA Hydro	113	3,194,970	15,915.2
TVA GAS TURBINE PLANTS			
Allen #1-16	16	382,400	38.2
#17-20*	—	—	19.5
Colbert #1-8*	—	—	13.4
	16	382,400	71.1
TVA STEAM PLANTS			
Allen	3	990,000	4,654.6
Bull Run	1	950,000	5,082.0
Colbert	5	1,396,500	5,467.9
Cumberland*	—	—	234.9
Gallatin	4	1,255,200	5,781.9
John Sevier	4	823,250	3,796.8
Johnsonville	10	1,485,200	6,005.6
Kingston	9	1,700,000	9,355.5
Paradise	3	2,558,200	14,343.6
Shawnee	10	1,750,000	9,798.2
Watts Bar	4	240,000	320.2
Widows Creek	8	1,977,985	8,598.6
Total TVA Steam	61	15,126,335	73,439.8
Alcoa Dams (12)		423,715	2,119.7
Corps of Engineers Dams (7)		753,000	3,257.7
Total System		**19,880,420**	**94,803.5**
Total Hydro		4,371,685	21,292.6
Total Steam		15,126,335	73,439.8
Total Gas Turbine		382,400	71.1

*Produced power during test operation, but units were not in commercial operation at June 30.



ILL
MO
KEN
ARK
TENN
MISSISSIPPI
ALABAM
OHIO RIVER
TRADEWATER RIVER
CASTOR RIVER
CURRENT RIVER
DRAINAGE DITCH
LITTLE RIVER
FRANCIS RIVER
SAINT FRANCIS RIVER
HATCHIE RIVER
OBION RIVER
BEECH RIVER
BUFFALO RIVER
ELK RIVER
TENNESSEE RIVER
COLDWATER RIVER
TALLAHATCHIE RIVER
YALOBUSHA RIVER
BLACK RIVER
PEARL RIVER
YAZOO RIVER
SUNFLOWER RIVER
TOMBIGBEE RIVER
SIPSEY RIVER
BLACK WARRIOR RIVER
CAHABA RIVER
NOLIN RESERVOIR
GREEN RIVER
PARADISE STEAM PLANT
SEPA
CENT ILL PUB SERV
ILL PR
UNION EL
SHAWNEE STEAM PLANT
EEI
CALVERT INDUSTRIAL AREA
BARKLEY DAM
KY UTIL
10 LINES
AEC-PADUCAH
PADUCAH
KENTUCKY DAM
(500 AUTH)
Hopkinsville
Mayfield
Clarksville
CUMBERLAND STEAM PLANT
Paris
CHEATHAM DAM
OLD HICKORY DAM
GALLAT STEAM PL
JOHNSONVILLE STEAM PLANT
Camden
NASHVILLE
Dyersburg
Milan
Murfreesboro
Covington
JACKSON
Columbia
Shelbyville
Waynesboro
Tullahoma
TIMS FORD
Fayetteville
ARK P&L
ALLEN STEAM PLANT
(Leased to TVA)
MEMPHIS
MISS P&L
Hickory Valley
Corinth
Burnsville
WILSON DAM
WHEELER DAM
Florence
Muscle Shoals
COLBERT STEAM
Decatur
GUNTERSVILLE DAM
Holly Springs
ARKABUTLA RESERVOIR
HARDIS RESERVOIR
Oxford
Tupelo
ENID RESERVOIR
Cullman
LEWIS SMITH RESERVOIR
GRENADA RESERVOIR
West Point
Columbus
BANKHEAD RESERVOIR
Tarrant City
BIRMINGH
Bessemer
Philadelphia
(DE-EN)
ALA PR
2 LINES
3 LINES


LOUISVILLE GAS & EL
BUCKHORN RESERVOIR
ROCKCASTLE R
LAUREL R
FORK
T U C K Y
V A
E KY RECC
Summer Shade
WOLF CREEK DAM
E KY RECC
BARREN RESERVOIR
E KY RECC
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KY UTIL
KY PR
CUMBERLAND RIVER
CLINCH RIVER
NORTH FORK HOLSTON RIVER
APP PR
KY UTIL
POWELL
BRISTOL
PATRICK HENRY DAM
BOONE DAM
HOLSTON DAM
Rogersville
DALE HOLLOW DAM
ORDELL HULL DAM (Under constr.)
JOHNSON CITY
WILBUR DAM
Elizabethton
JOHNSONVILLE STEAM PLANT
WATAUGA DAM
CHEROKEE
NORRIS DAM
NOLICHUCKY DAM
(DE-EN)
Cookeville
CENTER HILL DAM
OAK RIDGE
KINGSTON STEAM PLANT
DOUGLAS DAM
FRENCH BROAD RIVER
S E E
N C A R
(DE-EN)
GREAT FALLS DAM
Maryville
ALCOA
ALCOA DAM (Under constr.)
CAR PR & LT
WALTERS DAM
CATAWBA
BAR DAM AND STEAM PLANT
CHILHOWEE DAM
CALDERWOOD DAM
CHEOAH DAM
FONTANA DAM
SANTEETLAH DAM
LAKE WOOD
SEQUOYAH NUCLEAR PLANT (Under constr.)
TENNESSEE RIVER
CHICKAMAUGA DAM
APALACHIA DAM
HIWASSEE DAM
NANTAHALA DAM
THORPE DAM
OCOEE NO 1 DAM
OCOEE NO 2 DAM
OCOEE NO 3 DAM
MISSION DAM
NICKAJACK DAM
CHATUGE DAM
NOTTELY DAM
GA PR
BLUE RIDGE DAM
SAVANNAH RIVER
S C A R
HARTWELL RESERVOIR
SALUDA RIVER
BROAD RIVER
ALLATOONA RESERVOIR
BUFORD RESERVOIR
WEISS RESERVOIR
G E O R G I A
ATLANTA
CHATTAHOOCHEE RIVER
CLARK HILL RESERVOIR
TALLAPOOSA
MARTIN RESERVOIR
FLINT RIVER
A
LEGEND
115, 161, 230 & 345 KV
69 KV OR LESS
500 KV
Transmission lines in service
Transmission lines authorized
Transmission lines and substations owned by customer
Interconnection with other systems
Substation or major switching station in service
Substation or major switching station authorized
Hydro and thermal generating plants
Hydro and thermal generating plants owned by others
THE TVA POWER SYSTEM
SCALE OF MILES
20 10 0 20 40 60
JULY 1972

FINANCIAL STATEMENTS

TENNESSEE VALLEY AUTHORITY: A corporation wholly owned by the United States of America

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LYBRAND, ROSS BROS. & MONTGOMERY

CERTIFIED PUBLIC ACCOUNTANTS

COOPERS & LYBRAND

IN PRINCIPAL AREAS OF THE WORLD

To the Board of Directors of
Tennessee Valley Authority:

We have examined the financial statements of TENNESSEE VALLEY AUTHORITY at June 30, 1972 and 1971 and for the years then ended which appear on pages 25 to 32 herein. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the aforementioned financial statements present fairly:

(1) the financial position of the Authority at June 30, 1972 and 1971, and the results of operations and changes in financial position of its several programs for the years then ended; and

(2) the assets and liabilities of the Authority at June 30, 1972 and 1971, relating to the power program, and the results of operations and changes in financial position of that program for the years then ended,

all in conformity with generally accepted accounting principles applied on a consistent basis.

LYBRAND, ROSS BROS. & MONTGOMERY

New York, August 25, 1972.

NET INCOME AND RETAINED EARNINGS – POWER PROGRAM

For the Years Ended June 30, 1972 and 1971

	1972		1971	
	kWh	Amount	kWh	Amount
		(Thousands)		
Operating Revenues				
Sales of electric energy				
Municipalities and cooperatives	57,820,337	$415,349	55,534,621	$379,189
Federal agencies	12,501,761	73,255	11,773,513	61,840
Industries	19,591,953	124,308	21,278,275	125,014
Electric utilities	539,724	6,250	1,407,313	10,109
Total outside sales	90,453,775	619,162	89,993,722	576,152
Interdivisional	636,631	3,429	653,925	3,170
Total sales of electric energy	91,090,406	622,591	90,647,647	579,322
Rents		19,272		18,713
Total operating revenues		641,863		598,035
Operating Expenses				
Production		325,567		306,111
Transmission		17,779		16,905
Customer accounts		442		426
Demonstration of power use		1,158		1,178
Administrative and general		24,031		22,006
Payments in lieu of taxes		25,726		19,961
Social security taxes		3,210		2,930
Provision for depreciation		83,399		80,002
Total operating expenses		481,312		449,519
Operating income		160,551		148,516
Other Income and Deductions				
Interest income		54		29
Allowance for funds used (construction and nuclear fuel); note 2		52,023		48,131
Other		164*		7*
Total other income and deductions		51,913		48,153
Income before interest charges		212,464		196,669
Interest Charges				
Interest on long-term debt		69,028		48,603
Other interest expense; note 2		31,140		29,003
Amortization of long-term debt discount, expense, and premium, net; note 2		172		59
Total interest charges		100,340		77,665
NET INCOME		**112,124**		**119,004**
Payment of return on appropriation investment; note 5		**55,810**		**65,147**
Increase in retained earnings		56,314		53,857
Retained earnings at beginning of period		**714,736**		**660,879**
Retained earnings at end of period		**$771,050**		**$714,736**

*Deduct.

The notes on pages 31 and 32 are an integral part of the financial statements.

BALANCE SHEETS

June 30, 1972 and 1971

ASSETS

	Power program		All programs	
	1972	1971	1972	1971
	(Thousands)			
Property, Plant, and Equipment, substantially all at original cost				
Completed plant				
Multipurpose dams; note 1	$ 488,644	$ 478,298	$1,010,967	$ 962,191
Single-purpose dams	66,876	63,688	66,876	63,688
Steam production plants	1,713,992	1,697,729	1,713,992	1,697,729
Other electric plant	1,134,849	1,078,137	1,134,849	1,078,137
Other plant	—	—	150,457	152,891
	3,404,361	3,317,852	4,077,141	3,954,636
Less accumulated depreciation and depletion; note 2	1,075,425	997,916	1,201,213	1,117,576
	2,328,936	2,319,936	2,875,928	2,837,060
Construction and investigations in progress; note 3	1,294,367	822,362	1,359,775	909,981
Nuclear fuel in process of fabrication	63,860	41,500	63,860	41,500
Total property, plant, and equipment	3,687,163	3,183,798	4,299,563	3,788,541
Current Assets				
Cash	50,763	20,769	86,835	43,982
Accounts receivable	61,170	54,536	70,453	62,643
Inventories, principally at average cost	109,323	83,132	114,565	88,469
Total current assets	221,256	158,437	271,853	195,094
Deferred Charges				
Unamortized debt discount and expense; note 2	11,034	9,428	11,034	9,428
Other	647	762	647	762
Total deferred charges	11,681	10,190	11,681	10,190
Total assets	**$3,920,100**	**$3,352,425**	**$4,583,097**	**$3,993,825**

The notes on pages 31 and 32 are an integral part of the financial statements.

LIABILITIES

	Power program		All programs	
	1972	1971	1972	1971
	(Thousands)			
Proprietary Capital				
Appropriation investment; note 4				
Total congressional appropriations	$1,383,558	$1,380,199	$2,573,274	$2,506,124
Transfers of property from other Federal agencies	21,305	21,077	53,358	52,944
	1,404,863	1,401,276	2,626,632	2,559,068
Less repayments to General Fund of the U. S. Treasury; note 5	350,059	330,059	391,645	371,611
Appropriation investment	1,054,804	1,071,217	2,234,987	2,187,457
Retained earnings of power program; page 25	771,050	714,736	771,050	714,736
Accumulated net expense of nonpower programs; page 29	—	—	538,136*	494,128*
Total proprietary capital	1,825,854	1,785,953	2,467,901	2,408,065
Long-Term Debt; note 6	1,225,000	675,000	1,225,000	675,000
Short-Term Notes; note 6	730,000	780,300	730,000	780,300
Other Current Liabilities				
Accounts payable	102,047	88,730	110,719	97,747
Employees' accrued leave	11,300	9,714	20,977	18,680
Payrolls accrued	12,278	3,840	14,879	5,145
Interest accrued	12,558	7,873	12,558	7,873
Total other current liabilities	138,183	110,157	159,133	129,445
Deferred Credits				
Unamortized debt premium; note 2	165	234	165	234
Contributions in Aid of Construction	898	781	898	781
Commitments; note 3				
Total liabilities	**$3,920,100**	**$3,352,425**	**$4,583,097**	**$3,993,825**

*Deduct.

NET EXPENSE AND ACCUMULATED NET EXPENSE – NONPOWER PROGRAMS

For the Years Ended June 30, 1972 and 1971

	1972	1971
	(Thousands)	
Water Resources Development		
Navigation operations		
Studies and investigations	$ 823	$ 907
Operation and maintenance of facilities	4,926	5,001
Total expense of navigation operations	5,749	5,908
Flood control operations		
Studies and investigations	899	749
Operation and maintenance of facilities	3,914	3,743
Local flood control improvements	68	482
Total expense of flood control operations	4,881	4,974
Recreation projects		
Recreation resources development	736	688
Operation and maintenance of facilities	1,498	10
Total expense of recreation projects	2,234	698
Regional water quality management	1,545	1,496
Fishes and waterfowl resources development	338	433
Preliminary surveys and engineering	547	1,159
Total expense of water resources development	15,294	14,668
Fertilizer and Munitions Development		
Developmental production		
Cost of products distributed	23,090	22,872
General expenses		
Loss on retirements of manufacturing plant and equipment	3,533	1,250
Loss on disposal of Florida phosphate reserves	9	870
Other general expenses	1,536	1,247
Total general expenses	5,078	3,367
Total production expense	28,168	26,239
Less transfers and sales of products		
Transfers to TVA programs, at market prices		
Fertilizer industry demonstrations	14,974	15,410
Farm test demonstrations	280	334
Agricultural projects	178	299
Other	37	58
	15,469	16,101
Direct sales	146	654
Total transfers and sales	15,615	16,755
Net expense of developmental production	12,553	9,484
Fertilizer introduction		
Fertilizer industry demonstrations		
Fertilizers used	14,974	15,410
Educational distribution expense	1,298	1,217
	16,272	16,627
Less industry payments for fertilizer	14,393	14,801
	1,879	1,826

	1972	1971
	(Thousands)	
Fertilizer and Munitions Development (Continued)		
Fertilizer introduction (Continued)		
Farm test demonstrations outside the Valley		
Fertilizers used	$ 280	$ 334
Planning and supervision	503	492
	783	826
Less farmer payments for fertilizer	190	225
	593	601
Net expense of fertilizer introduction	2,472	2,427
Research and development	5,059	4,972
Net expense of fertilizer and munitions development	20,084	16,883
General Resources Development		
Agricultural projects		
Agricultural development		
Fertilizers used	178	299
Planning and supervision	952	912
	1,130	1,211
Less farmer payments for fertilizer	114	180
	1,016	1,031
Devleopment investigations and general expenses	438	414
Net expense of agricultural projects	1,454	1,445
Forest and wild land resources development	1,235	1,096
Tributary area development	1,668	1,514
Regional development planning	376	522
Townlift community improvement	480	373
Demonstrations in education and manpower development	139	1,027
Minerals projects	213	224
Environmental quality projects	332	164
Net expense of general resources development	5,897	6,365
Land Between the Lakes Operations	1,972	1,699
Environmental Research and Development	182	156
Valley Mapping	499	308
Other Expense, Net	80	23
NET EXPENSE	**44,008**	**40,102**
Accumulated net expense at beginning of period	494,128	454,026
Accumulated net expense at end of period	**$538,136**	**$494,128**

The notes on pages 31 and 32 are an integral part of the financial statements.

CHANGES IN FINANCIAL POSITION

For the Years Ended June 30, 1972 and 1971

	Power program		All programs	
	1972	1971	1972	1971
	(Thousands)			
Source of Funds				
Net power income; page 25	$ 112,124	$ 119,004	$ 112,124	$ 119,004
Add items not requiring funds; note a	31,931	31,969	31,931	31,969
Funds from power operations	144,055	150,973	144,055	150,973
Sale of power facilities	480	610	480	610
Funds from power program; note b	144,535	151,583	144,535	151,583
Net expense of nonpower programs; page 29			44,008*	40,102*
Add items not requiring funds; note a			10,270	8,633
Funds used in nonpower operations			33,738*	31,469*
Sale of nonpower facilities			564	2,140
Funds used in nonpower programs			33,174*	29,329*
Sale of long-term bonds	547,034	—	547,034	—
Issues of short-term notes	2,020,000	1,740,000	2,020,000	1,740,000
Congressional appropriations	3,359	2,654	67,150	56,180
Property transfers	228	248	414	506
Contributions in aid of construction	117	22	117	22
Total source of funds	**$2,715,273**	**$1,894,507**	**$2,746,076**	**$1,918,962**
Disposition of Funds				
Expended for plant and equipment, excluding allowance for funds used	$ 538,165	$ 433,344	$ 559,033	$ 458,012
Less salvage from plant transfers, and depreciation charged to construction and clearing accounts	2,676	2,175	5,053	4,457
	535,489	431,169	553,980	453,555
Payments to U. S. Treasury; note 5				
Return on appropriation investment	55,810	65,147	55,810	65,147
Repayment of appropriation investment	20,000	20,000	20,034	20,010
	75,810	85,147	75,844	85,157
Redemption of short-term notes	2,070,300	1,380,700	2,070,300	1,380,700
Deferred charges, net	1,119*	3,253	1,119*	3,253
Changes in working capital				
Cash (Increase or decrease*)	29,994	37,597*	42,853	36,210*
Accounts receivable (Increase or decrease*)	6,634	8,683	7,810	12,081
Inventories (Increase or decrease*)	26,191	45,625	26,096	45,425
Other current liabilities (Increase* or decrease)	28,026*	22,473*	29,688*	24,999*
Total (Increase or decrease*)	34,793	5,762*	47,071	3,703*
Total disposition of funds	**$2,715,273**	**$1,894,507**	**$2,746,076**	**$1,918,962**

The notes on pages 31 and 32 are an integral part of the financial statements.

*Deduct.

NOTES:

a. Items not requiring funds:

	Power		Nonpower	
	1972	1971	1972	1971
	(Thousands)			
Provisions for depreciation	$ 83,399	$ 80,002	$ 6,714	$ 6,497
Provisions for depletion	104	19	14	16
Loss on retirements and disposals of property, plant, and equipment	164	7	3,542	2,120
Amortization of deferred charges and credits, net	287	72	—	—
Allowance for funds used (construction and nuclear fuel)	52,023*	48,131*	—	—
	$ 31,931	$ 31,969	$ 10,270	$ 8,633

*Deduct

b. Net power proceeds (see note 6) may be derived as follows:

	Year ended June 30	
	1972	1971
	(Thousands)	
Funds from power program	$144,535	$151,583
Add back interest charges	100,168	77,606
Net power proceeds	$244,703	$229,189

NOTES TO FINANCIAL STATEMENTS

1. **Allocation of cost of multipurpose projects** — Section 14 of the TVA Act requires TVA's Board of Directors to allocate the cost of completed multipurpose projects, subject to the approval of the President of the United States. The cost of facilities installed exclusively for a single purpose is assigned directly to that purpose; the cost of multiple-use facilities is allocated among the various purposes served. The allocation for the Tims Ford multipurpose dam, placed in service in 1972, is to be submitted for the President's approval.

The total investment of $1,010,967,000 in completed multipurpose dams at June 30, 1972, is classified as follows:

	Investment		
	Direct	Multiple-use	Total
		(Thousands)	
Power	$311,489	$177,155	$ 488,644
Navigation	150,809	136,785	287,594
Flood control	59,668	134,668	194,336
Recreation	103	23,236	23,339
Tributary area development	20	17,034	17,054
Total	$522,089	$488,878	$1,010,967

2. **Accounting policies** — Straight-line depreciation is provided for substantially on a composite basis. Rates of depreciation are derived from engineering studies of useful life and are reviewed each year. Depletion of coal land and land rights and phosphate land and mineral rights is provided on a unit of production basis.

The practice of capitalizing an allowance for funds used during construction and during the fabrication of nuclear fuels is followed in the power program. The rate is established at the beginning of each 6-month period on the basis of the cost of borrowings during the preceding 12 months. Rates used were 5.4 percent and 5.5 percent during 1972 and 8.4 percent and 7.7 percent during 1971.

Discounts, expenses, and premiums on power borrowings are amortized on a straight-line basis over the term of the related securities. Amortization of discount on short-term notes is charged to other interest expense.

3. **Estimates of cost to complete major construction projects, and commitments** — The cost to complete the major power projects (including nuclear fuel) under construction or authorized for construction at June 30, 1972, is estimated to be $3,673,700,000, including commitments of $1,127,800,000 for materials and services contracted for and not delivered. The corresponding estimate for multipurpose and nonpower projects is $173,200,000, including commitments of $1,600,000. Additional contractual commitments of $600,000 for multipurpose and nonpower projects had been entered into at June 30, 1972, on which TVA's obligation is limited by the availability of funds from congressional appropriations for succeeding fiscal periods.

TVA and the City of Memphis, Tennessee, have entered into agreements under which (1) TVA sells to the City all the power and energy requirements of its electric distribution system, and (2) the City leases to TVA the Thomas H. Allen steam-electric generating plant with an installed capacity of 990,000 kilowatts; each agreement is for a term of 20 years, beginning January 1, 1965. The lease agreement provides for annual rental payments of $6,900,000 and grants TVA an option to buy the plant for $2,000,000 at the end of the lease term.

On June 22, 1972, the TVA Board of Directors approved a Utility Contribution Agreement with Breeder Reactor Corporation (BRC), a District of Columbia nonprofit corporation, obligating TVA to pay to Breeder Reactor Corporation the sum of $21.7 million over a 10-year period beginning December 31, 1972, and ending December 31, 1981, on behalf of TVA and its distributors in support of the Nation's first commercial scale liquid metal fast breeder reactor demonstration plant project.

NOTES TO FINANCIAL STATEMENTS, continued

4. **Appropriation investment** — Changes in appropriation investment during the years ended June 30, 1972 and 1971, were as follows:

	Power program		All programs	
	1972	1971	1972	1971
	(Thousands)			
Congressional appropriations	$ 3,359	$ 2,654	$ 67,150	$ 56,180
Transfers of property from other Federal agencies	228	248	414	506
	3,587	2,902	67,564	56,686
Less repayments to General Fund of the U. S. Treasury	20,000	20,000	20,034	20,010
Increase or decrease* for the period	16,413*	17,098*	47,530	36,676
Balance, beginning of period	1,071,217	1,088,315	2,187,457	2,150,781
Balance, end of period	$1,054,804	$1,071,217	$2,234,987	$2,187,457

An additional appropriation of $64,550,000 was made as of July 1, 1972, by Public Law 92-405, approved August 25, 1972.

5. **Payments to the U. S. Treasury** — Section 15d of the TVA Act requires the payment from net power proceeds of a return on the net appropriation investment in power facilities plus repayments of such investment, beginning with fiscal year 1961. The amount of return payable during each year is based on the appropriation investment as of the beginning of that year and the computed average interest rate payable by the U. S. Treasury on its total marketable public obligations as of the same date. The repayment schedule calls for payment of not less than $10 million for each of the first five years (1961-1965), $15 million for each of the next five years (1966-1970), and $20 million for each year thereafter until a total of $1 billion shall have been repaid. The payments required by Section 15d may be deferred under certain circumstances for not more than two years.

Required payments have been made as follows:

	Return	Repayment	Total
		(Thousands)	
Total to June 30, 1971	$513,393	$145,000	$658,393
Year ended June 30, 1972	55,810	20,000	75,810
	$569,203	$165,000	$734,203

For 1973 the required payments will be $53,784,000 as a return on the appropriation investment at the computed average interest rate of 5.099 percent and $20,000,000 as a repayment, a total of $73,784,000.

In addition to the payments from net power proceeds, $34,000 of nonpower proceeds was paid to the U. S. Treasury in 1972 under the provisions of Section 26 of the TVA Act. This brought the total payments from nonpower proceeds to $41,586,000.

Prior to 1961, under then existing legislation, TVA paid to the Treasury $185,059,000 of power proceeds. In addition, $65,072,000 of bonds sold to the Treasury and Reconstruction Finance Corporation in fiscal years 1939-1941 have been fully repaid from power proceeds. Section 26 of the TVA Act provides for annual payments to the Treasury of any power or nonpower proceeds not needed for the operation of dams and reservoirs, the conduct of the power program, and the manufacture and distribution of fertilizers.

6. **Borrowing authority** — Section 15d of the TVA Act authorizes TVA to issue bonds, notes, and other evidences of indebtedness up to a total of $5 billion outstanding at any one time to assist in financing its power program. Debt service on these obligations, which is payable solely from TVA's net power proceeds, has precedence over the payments to the U. S. Treasury described in note 5. Issues outstanding on June 30, 1972, consist of the following:

Long-term debt	(Thousands)
4.40% 1960 Series A, due November 15, 1985	$ 50,000
4⅝% 1961 Series A, due July 1, 1986	50,000
4½% 1962 Series A, due February 1, 1987	45,000
5.70% 1967 Series A, due May 15, 1992	70,000
6⅜% 1967 Series B, due November 1, 1992	60,000
8% 1969 Series A, due June 1, 1974	100,000
8¼% 1969 Series B, due October 15, 1994	100,000
9% 1970 Series A, due March 15, 1995	100,000
9¼% 1970 Series B, due June 15, 1995	50,000
8¾% 1970 Series C, due June 15, 1975	50,000
7¼% 1971 Series A, due July 1, 1976	100,000
7.30% 1971 Series B, due October 1, 1996	150,000
7% 1972 Series A, due January 1, 1997	150,000
7.35% 1972 Series B, due May 1, 1997	150,000
Total long-term debt	1,225,000
Short-term notes	
Payable to U. S. Treasury	100,000
Payable to public	630,000
Total short-term notes	730,000
	$1,955,000

An additional bond issue, 7.35% 1972 Series C, due July 1, 1997, in the amount of $150,000,000 was sold in July 1972.

7. **Retirement plan** — TVA has a contributory retirement plan which covers substantially all of its salaried employees. The cost of currently accruing benefits is funded currently, and the unfunded prior service cost is being amortized and funded over a period of 34 years from July 1, 1971. The cost of the plan to TVA for the years ended June 30, 1972 and 1971, was $16,813,000 and $15,256,000, respectively.

8. **Litigation** — In December 1971 a suit was filed in Federal Court seeking to enjoin the construction of the Tellico Dam multipurpose project on various grounds, including alleged failure to comply with the National Environmental Policy Act. The United States District Court for the Eastern District of Tennessee issued a preliminary injunction, pending trial, enjoining certain phases of work on the project, but allowing other activities to go forward. Counsel for TVA believe that the suit is without merit. The issuance of the preliminary injunction has been appealed.

On July 5, 1972, the Environmental Defense Fund and six other plaintiffs filed a complaint for injunction, declaratory judgment, and other relief to restrain TVA from construction of the Duck River project, consisting of the Normandy and Columbia dams. The action was filed in the United States District Court for the Eastern District of Tennessee, Northern Division, but was transferred to the Winchester Division of that court. TVA has filed a motion to dismiss the action or in the alternative for summary judgment. No motion has been made at this time for a preliminary injunction or a temporary restraining order. Counsel for TVA believe that the action is without merit.

On May 26, 1972, TVA filed an action in the United States District Court for the Northern District of Alabama, Northeastern Division, to acquire 1,174 acres of land in Jackson County, Alabama, known as the Bellefonte site, "for and as a part of an inventory of sites for electric generating plants." Defendants filed an answer in which they raised 34 objections and defenses to the taking. In substance they are that TVA lacks statutory and constitutional authority to acquire the property, that it is not being acquired for a public use, and that the taking is unnecessary, an abuse of discretion, and in violation of the National Environmental Policy Act of 1969. TVA filed a motion to strike such defenses and objections on the ground that they are insufficient as a matter of law. Counsel for TVA believe that the defenses are without merit.

OPERATING STATISTICS

TENNESSEE VALLEY AUTHORITY: A corporation wholly owned by the United States of America

POWER EARNINGS

(Millions)

	1972	1971	1970	1969	1968
OPERATING REVENUES					
Sales of electric energy					
Municipalities and cooperatives	$415.3	$379.2	$285.5	$222.2	$197.2
Federal agencies	73.3	61.9	59.4	63.6	78.9
Industries	124.3	125.0	106.0	92.2	84.2
Electric utilities	6.3	10.1	7.6	7.3	8.6
Interdivisional	3.4	3.1	3.0	2.8	2.7
Total sales of electric energy	622.6	579.3	461.5	388.1	371.6
Rents	19.2	18.7	18.1	15.2	12.1
Total operating revenues	641.8	598.0	479.6	403.3	383.7
OPERATING EXPENSES					
Production	325.6	306.1	246.1	210.3	191.1
Transmission	17.8	16.9	15.1	14.3	13.9
Customer accounts	.4	.4	.3	.3	.2
Demonstration of power use	1.2	1.2	1.1	1.0	1.0
Administrative and general	24.0	22.0	18.0	15.6	14.4
Payments in lieu of taxes	25.7	20.0	16.1	14.5	13.1
Social security taxes	3.2	2.9	2.4	2.2	1.8
Depreciation	83.4	80.0	75.1	71.6	70.7
Other	—	—	—	—	—
Total operating expenses	481.3	449.5	374.2	329.8	306.2
Operating income	160.5	148.5	105.4	73.5	77.5
Other Income and Deductions	51.9	48.2	31.6	16.0	8.1
Income before interest charges and extraordinary item	212.4	196.7	137.0	89.5	85.6
Interest Charges	100.3	77.7	62.4	38.8	26.5
Income before extraordinary item	112.1	119.0	74.6	50.7	59.1
Extraordinary Item	—	—	—	—	10.3*
Net Income	**$112.1**	**$119.0**	**$ 74.6**	**$ 50.7**	**$ 48.8**
NET POWER PROCEEDS FROM OPERATIONS					
Income before interest charges and extraordinary item	$212.4	$196.7	$137.0	$ 89.5	$ 85.6
Add back noncash items	31.8	31.9	43.5	55.6	62.6
Total	**$244.2**	**$228.6**	**$180.5**	**$145.1**	**$148.2**

*Deduct.

FISCAL YEARS

1967	1966	1965	1964	1963	1962	1961	1960	1959	1958
$172.0	$158.2	$136.8	$118.2	$110.6	$ 98.3	$ 91.0	$ 85.4	$ 76.6	$ 80.7
83.9	84.0	82.4	100.7	100.2	101.7	109.9	110.0	108.2	113.1
79.6	71.5	67.1	59.7	52.4	47.9	43.5	43.3	40.9	35.1
10.1	7.9	4.8	3.1	1.2	.3	.2	.3*	8.5	1.3
3.1	3.0	3.0	2.8	2.6	2.3	2.2	2.3	2.0	2.0
348.7	324.6	294.1	284.5	267.0	250.5	246.8	240.7	236.2	232.2
2.4	2.2	1.9	1.9	1.8	1.6	1.5	1.7	1.3	1.3
351.1	326.8	296.0	286.4	268.8	252.1	248.3	242.4	237.5	233.5
187.8	170.4	139.9	134.3	129.6	116.3	119.8	116.6	116.0	110.9
12.9	12.4	12.2	12.0	11.8	11.0	10.7	9.2	8.9	8.6
.2	.2	.2	.3	.3	.2	.2	.2	.2	.2
.9	.8	.8	.8	.8	.8	.7	.6	.6	.5
13.3	12.1	11.5	10.9	10.2	9.4	9.2	10.3	9.7	8.7
11.9	10.5	9.1	8.2	7.3	6.7	6.5	6.3	5.9	5.3
1.7	1.2	1.0	1.0	.9	.8	.8	.8	.6	.5
65.7	62.6	59.1	56.8	52.8	52.1	50.6	48.7	44.7	43.8
—	—	—	—	—	.1	.3	.1	.1	—
294.4	270.2	233.8	224.3	213.7	197.4	198.8	192.8	186.7	178.5
56.7	56.6	62.2	62.1	55.1	54.7	49.5	49.6	50.8	55.0
3.7	5.2	3.9	4.7	6.8	6.8	3.4	1.5	—	—
60.4	61.8	66.1	66.8	61.9	61.5	52.9	51.1	50.8	55.0
19.7	13.9	11.1	8.6	6.8	5.3	1.3	—	—	—
40.7	47.9	55.0	58.2	55.1	56.2	51.6	51.1	50.8	55.0
—	—	—	—	—	—	—	—	—	—
$ 40.7	**$ 47.9**	**$ 55.0**	**$ 58.2**	**$ 55.1**	**$ 56.2**	**$ 51.6**	**$ 51.1**	**$ 50.8**	**$ 55.0**
$ 60.4	$ 61.8	$ 66.1	$ 66.8	$ 61.9	$ 61.5	$ 52.9	$ 51.1	$ 50.8	$ 55.0
62.0	57.4	55.2	52.1	46.3	47.3	49.7	48.7	44.7	43.8
$122.4	**$119.2**	**$121.3**	**$118.9**	**$108.2**	**$108.8**	**$102.6**	**$ 99.8**	**$ 95.5**	**$ 98.8**

NET POWER ASSETS

(Millions)

NET ASSETS	1972	1971	1970	1969	1968
Completed plant	$3,404.4	$3,317.9	$3,202.9	$2,977.3	$2,900.7
Less accumulated depreciation	1,075.4	998.0	924.5	856.0	789.3
Net completed plant	2,329.0	2,319.9	2,278.4	2,121.3	2,111.4
Construction in progress	1,294.3	822.4	481.9	386.4	216.3
Nuclear fuel	63.9	41.5	24.8	13.2	—
Inventories	109.3	83.1	37.5	44.2	51.5
Other current assets less other current liabilities	26.3*	34.9*	16.6	2.2	3.6
Deferred charges, net	11.5	10.0	6.8	6.9	5.1
Total	**$3,781.7**	**$3,242.0**	**$2,846.0**	**$2,574.2**	**$2,387.9**

DERIVED FROM					
U. S. Treasury funds, gross	$1,470.0	$1,466.4	$1,463.5	$1,462.0	$1,461.0
Less Treasury funds repaid	415.2	395.2	375.2	360.1	345.1
Net U. S. Treasury funds	1,054.8	1,071.2	1,088.3	1,101.9	1,115.9
Long-term debt	1,225.0	675.0	675.0	375.0	275.0
Short-term notes payable to U. S. Treasury	100.0	100.0	100.0	100.0	100.0
Short-term notes payable to public	630.0	680.3	321.0	352.7	250.0
Advances and contributions	.9	.8	.8	.7	.7
Retained earnings	771.0	714.7	660.9	643.9	646.3
Total	**$3,781.7**	**$3,242.0**	**$2,846.0**	**$2,574.2**	**$2,387.9**

Note: In all years, the amounts for "U. S. Treasury funds, gross" include the full $65.1 million of bonds issued by TVA to the Treasury and to the RFC, and the amounts for "Less Treasury funds repaid" include the amounts redeemed. All of these bonds were redeemed by June 30, 1956.

*Deduct.

At June 30

1967	1966	1965	1964	1963	1962	1961	1960	1959	1958
$2,792.5	$2,602.6	$2,466.8	$2,335.2	$2,236.3	$2,084.1	$2,042.5	$1,940.3	$1,873.4	$1,755.0
727.2	671.9	614.3	563.8	514.1	463.9	417.8	370.7	326.9	284.8
2,065.3	1,930.7	1,852.5	1,771.4	1,722.2	1,620.2	1,624.7	1,569.6	1,546.5	1,470.2
150.0	203.5	220.6	259.0	247.7	288.0	161.7	116.0	89.6	114.5
—	—	—	—	—	—	—	—	—	—
44.9	32.4	39.1	33.3	32.8	35.7	31.8	34.9	33.9	42.9
23.8	7.3	8.4	.5*	17.8*	15.8*	5.5	51.7	48.6	36.8
3.3	2.5	1.4	1.1	1.0	1.0	.4	—	—	—
$2,287.3	**$2,176.4**	**$2,122.0**	**$2,064.3**	**$1,985.9**	**$1,929.1**	**$1,824.1**	**$1,772.2**	**$1,718.6**	**$1,664.4**

$1,455.2	$1,455.1	$1,454.7	$1,454.4	$1,454.0	$1,453.5	$1,453.1	$1,451.4	$1,449.1	$1,445.7
330.1	315.1	300.1	290.1	280.1	270.1	260.1	250.1	250.1	250.1
1,125.1	1,140.0	1,154.6	1,164.3	1,173.9	1,183.4	1,193.0	1,201.3	1,199.0	1,195.6
215.0	145.0	145.0	145.0	145.0	145.0	50.0	—	—	—
100.0	100.0	95.0	85.0	50.0	—	—	—	—	—
202.2	140.0	80.0	35.0	—	—	—	—	—	—
.7	.7	.7	.6	.6	.6	.6	.6	.4	.4
644.3	650.7	646.7	634.4	616.4	600.1	580.5	570.3	519.2	468.4
$2,287.3	**$2,176.4**	**$2,122.0**	**$2,064.3**	**$1,985.9**	**$1,929.1**	**$1,824.1**	**$1,772.2**	**$1,718.6**	**$1,664.4**

SYSTEM INPUT, SYSTEM OUTPUT

(Millions of kilowatt-hours)

SYSTEM INPUT	1972	1971	1970	1969	1968
System generation					
Hydro					
TVA plants	15,915.2	12,733.6	12,313.2	11,595.4	15,187.8
ALCOA plants	2,119.7	1,811.7	1,779.3	1,813.3	2,283.8
Cumberland plants	3,257.7	2,737.1	2,447.2	1,579.2	3,361.6
Total hydro	21,292.6	17,282.4	16,539.7	14,987.9	20,833.2
TVA steam plants	73,439.8	74,332.1	76,144.6	75,600.9	69,619.4
Gas turbine plants	71.1	18.3	—	—	—
Total net generation	94,803.5	91,632.8	92,684.3	90,588.8	90,452.6
Purchased	266.1	593.2	459.2	4.3	—
Interchange received	7,075.4	8,889.6	8,141.8	7,354.8	5,156.2
Total input	**102,145.0**	**101,115.6**	**101,285.3**	**97,947.9**	**95,608.8**
SYSTEM OUTPUT					
Sales					
Municipalities and cooperatives	57,820.3	55,534.6	53,692.9	49,008.2	44,575.0
Federal agencies	12,501.8	11,773.5	13,069.6	14,826.9	18,801.8
Industries	19,592.0	21,278.3	22,012.6	20,568.1	19,213.4
Electric utilities	539.7	1,407.3	1,273.7	1,300.5	1,462.1
Total outside sales	90,453.8	89,993.7	90,048.8	85,703.7	84,052.3
Interdivisional	636.6	653.9	673.5	670.2	667.8
Total sales	91,090.4	90,647.6	90,722.3	86,373.9	84,720.1
Returned to ALCOA*	1,857.6	1,846.7	1,847.5	1,756.2	1,863.5
Interchange delivered	5,998.1	5,049.4	5,379.7	6,808.5	6,204.9
Losses	3,198.9	3,571.9	3,335.8	3,009.3	2,820.3
Total output	**102,145.0**	**101,115.6**	**101,285.3**	**97,947.9**	**95,608.8**
Generating capacity, June 30 — kilowatts	19,880,420	19,828,380	19,422,480	18,239,280	18,202,090
Area peak load — kilowatts	16,664,000	16,745,000	16,797,000	15,017,000	15,266,000
Monthly billing demands, 12 months — megawatts**	178,179	176,610	174,030	163,861	160,932

*In return for energy delivered to the TVA system from the ALCOA plants.

**The sum of the monthly billing demands of power sold by TVA.

1967	1966	1965	1964	1963	1962	1961	1960	1959	1958
13,317.9	11,024.4	14,615.5	13,255.3	12,844.7	15,651.3	12,860.8	13,496.7	12,020.4	14,922.6
1,868.9	1,777.1	2,163.0	2,044.4	1,783.1	2,432.5	1,804.0	1,971.3	1,637.5	2,155.9
2,555.3	1,338.0	2,023.6	1,532.6	1,699.0	2,370.8	2,225.4	1,990.8	1,340.3	2,240.7
17,742.1	14,139.5	18,802.1	16,832.3	16,326.8	20,454.6	16,890.2	17,458.8	14,998.2	19,319.2
68,114.0	67,941.9	55,651.7	56,535.5	52,221.6	44,575.9	47,627.0	45,953.9	45,971.4	41,474.1
—	—	—	—	—	—	—	—	—	—
85,856.1	82,081.4	74,453.8	73,367.8	68,548.4	65,030.5	64,517.2	63,412.7	60,969.6	60,793.3
79.7	23.7	—	—	—	—	—	—	3.7	—
5,141.0	2,676.9	2,765.4	3,041.2	2,643.8	2,225.5	2,155.2	2,077.9	1,611.8	1,419.4
91,076.8	**84,782.0**	**77,219.2**	**76,409.0**	**71,192.2**	**67,256.0**	**66,672.4**	**65,490.6**	**62,585.1**	**62,212.7**
40,705.9	37,783.5	32,161.3	27,848.1	25,530.4	22,815.2	21,174.1	20,044.5	17,716.2	18,697.2
20,226.3	20,638.2	20,391.9	25,361.8	25,211.4	25,891.3	28,209.1	28,284.0	28,012.3	28,896.9
18,589.8	16,765.1	15,773.7	14,077.4	12,228.4	10,950.7	10,077.4	10,364.3	9,518.0	8,361.6
1,768.1	1,150.1	769.8	441.8	181.5	65.2	49.1	48.0	1,389.7	248.1
81,290.1	76,336.9	69,096.7	67,729.1	63,151.7	59,722.4	59,509.7	58,740.8	56,636.2	56,203.8
796.6	768.4	764.1	720.7	666.2	598.8	591.5	601.8	527.3	513.9
82,086.7	77,105.3	69,860.8	68,449.8	63,817.9	60,321.2	60,101.2	59,342.6	57,163.5	56,717.7
1,688.1	1,694.7	1,638.5	1,865.7	2,049.4	1,962.7	1,913.4	1,890.1	1,965.8	2,041.7
4,614.3	3,430.6	3,490.4	3,839.0	3,441.2	3,278.2	2,915.2	2,494.7	1,642.0	1,644.8
2,687.7	2,551.4	2,229.5	2,254.5	1,883.7	1,693.9	1,742.6	1,763.2	1,813.8	1,808.5
91,076.8	**84,782.0**	**77,219.2**	**76,409.0**	**71,192.2**	**67,256.0**	**66,672.4**	**65,490.6**	**62,585.1**	**62,212.7**
18,111,860	17,149,500	14,675,615	13,353,615	12,711,215	11,998,660	11,884,660	11,373,460	10,997,210	10,222,210
14,634,000	14,263,000	12,801,000	12,218,000	12,124,000	10,889,000	10,322,000	9,641,000	9,375,000	9,418,000
157,203	145,557	133,691	126,046	119,112	110,882	108,416	105,363		

CUSTOMER STATISTICS

In the following tables, the sales and related statistics for TVA and for the local distributors have been combined to portray total sales to ultimate customers.

Ultimate Customers

JUNE	TOTAL	RESIDENTIAL	COMMERCIAL AND INDUSTRIAL	FEDERAL AGENCIES	OUTDOOR LIGHTING
1972	2,236,153	1,987,724	245,965	11	2,453
1971	2,158,423	1,919,208	236,687	11	2,517
1970	2,096,544	1,863,578	230,654	11	2,301
1969	2,047,338	1,817,982	227,179	11	2,166
1968	1,994,065	1,769,141	222,870	11	2,043
1967	1,946,594	1,726,382	218,257	11	1,944
1966	1,895,082	1,679,342	213,927	11	1,802
1965	1,840,791	1,630,547	208,533	10	1,701
1964	1,589,238	1,408,899	178,821	9	1,509
1963	1,547,451	1,371,450	174,675	9	1,317
1962	1,489,367	1,320,950	167,141	9	1,267
1961	1,453,163	1,288,521	163,422	9	1,211
1960	1,413,136	1,252,920	159,087	9	1,120
1959	1,380,505	1,224,348	155,036	9	1,112
1958	1,509,283	1,334,756	173,190	10	1,327

Electricity Sales — Millions of kilowatt-hours

FISCAL YEAR	TOTAL	RESIDENTIAL	COMMERCIAL AND INDUSTRIAL	FEDERAL AGENCIES	OUTDOOR LIGHTING
1972	87,333	27,474	46,005	13,138	716
1971	85,930	27,291	45,553	12,427	659
1970	86,380	26,835	45,200	13,743	602
1969	82,111	24,449	41,610	15,497	555
1968	80,600	22,174	38,448	19,470	508
1967	77,708	19,945	36,276	21,023	464
1966	73,649	18,736	33,087	21,407	419
1965	67,050	16,501	29,043	21,156	350
1964	66,149	15,069	24,722	26,082	276
1963	61,861	14,026	21,729	25,878	228
1962	58,669	12,492	19,499	26,490	188
1961	58,559	11,631	17,964	28,801	163
1960	58,041	10,936	18,072	28,886	147
1959	54,670	9,501	16,494	28,540	135
1958	55,473	9,502	16,412	29,411	148

Revenue from Electricity Sales — Thousands of dollars

FISCAL YEAR	TOTAL	RESIDENTIAL	COMMERCIAL AND INDUSTRIAL	FEDERAL AGENCIES	OUTDOOR LIGHTING
1972	860,669	352,116	412,374	76,685	19,494
1971	796,426	332,544	381,299	65,010	17,573
1970	667,418	277,153	312,574	62,459	15,232
1969	576,589	231,391	265,294	66,323	13,581
1968	539,668	206,112	239,740	81,669	12,147
1967	492,374	177,055	217,543	87,026	10,750
1966	464,555	168,902	199,281	86,981	9,391
1965	418,705	151,007	174,808	85,344	7,546
1964	397,474	138,555	149,638	103,503	5,778
1963	374,020	131,323	135,315	102,722	4,660
1962	351,808	120,226	123,974	103,991	3,617
1961	343,232	113,748	114,340	112,085	3,059
1960	334,844	108,588	111,227	112,282	2,747
1959	314,170	98,065	103,346	110,203	2,556
1958	328,490	101,792	108,788	115,064	2,846

Residential Statistics

FISCAL YEAR	AVERAGE ANNUAL USE	AVERAGE ANNUAL BILL	AVERAGE RATE
1972	14,040 kWh	$179.92	1.28¢
1971	14,400	175.53	1.22
1970	14,560	150.39	1.03
1969	13,600	128.71	.95
1968	12,668	117.74	.93
1967	11,680	103.68	.89
1966	11,294	101.81	.90
1965	10,831	99.12	.92
1964	10,818	99.47	.92
1963	10,406	97.43	.94
1962	9,553	91.94	.96
1961	9,135	89.34	.98
1960	8,806	87.44	.99
1959	7,863	81.16	1.03
1958	7,189	77.02	1.07

Notes: 1. The City of Memphis ceased to be a regular distributor of TVA power in 1958 and its customer statistics are excluded beginning in fiscal year 1959. The City again became a regular distributor January 1, 1965, and its customers statistics are included thereafter.

2. Federal agencies include only TVA's direct service and interdivisional sales.

3. To avoid overstating the number of customers in the region, the number of Outdoor Lighting customers excludes the customers who supplement regular service with the special outdoor lighting fixture. Only public street lighting and athletic field lighting customers are counted. However, the energy sales and revenue figures under Outdoor Lighting do include data for the special fixtures.

FUEL STATISTICS

	FISCAL YEARS				
Fuel Burned	**1972**	**1971**	**1970**	**1969**	**1968**
Steam plants					
Coal — tons	31,893,192	32,458,437	32,231,605	30,889,528	27,696,533
Gas — MCF	18,712,421	17,279,633	16,148,405	19,317,397	22,034,253
Total fuel expense	$213,031,932	$195,598,895	$157,478,759	$143,425,848	$125,506,883
Coal expense per ton	$6.509	$5.886	$4.771	$4.509	$4.361
Gas expense per MCF	$0.291	$0.263	$0.230	$0.215	$0.215
Gas turbine plant					
Oil — gallons	3,452,990	1,015,670	—	—	—
Gas — MCF	515,784	137,256	—	—	—
Total fuel expense	$581,553	$180,432	—	—	—
Oil expense per gallon	$0.110	$0.127	—	—	—
Gas expense per MCF	$0.392	$0.373	—	—	—
Fuel Ratios					
Steam plants					
Fuel expense per kWh generation — mills	2.910	2.631	2.068	1.897	1.803
Btu per kWh net generation	9,710	9,690	9,650	9,560	9,490
Cents per million Btu burned	29.96	27.14	21.44	19.84	18.99
Btu per pound of coal fired	10,820	10,796	11,106	11,356	11,498
Gas turbine plant					
Fuel expense per kWh net generation — mills	8.171	9.850	—	—	—
Btu per kWh net generation	14,297	15,600	—	—	—
Cents per million Btu burned	57.15	63.14	—	—	—
Coal Received					
Tons	34,021,932	38,121,872	30,955,067	28,864,249	29,049,696
Cost FOB plant	$220,429,421	$224,281,101	$139,832,705	$126,079,012	$121,754,637
Cents per million Btu FOB plant	29.86	27.23	20.35	19.22	18.20